SYLLABI

Department of Materials Science & Engineering

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Module Code	MT1022	Title	Properties of Materials			
Credits	2.0	Hours/Week	Lectures	2.0	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	3/4		

Lecturer(s) – Mr. V. Sivahar

Learning Objectives:

- To provide basic knowledge on structures, properties and applications of engineering materials

Learning Outcomes

Students should be able to;

- Recognize the structure of metals, polymers and ceramics
- Identify the relationships between the structure of materials and their properties
- Asses the properties of engineering materials

Syllabus Outline:

- Structure of atoms, atomic theories, atomic bonding in materials
- Crystal structures and defects
- Structure-property relationships
- Mechanical properties of materials
- Electrical properties of materials
- Chemical properties of materials
- Radioactivity and nuclear properties

Module Code	MT 1962	Title	Engineering Skill Development			
Credits	1.5	Hours/Week	Lectures	1	Pre-requisites	Semester 1 subjects
GPA/NGPA	NGPA		Lab/Tutorials	6		

Learning Objectives:

- To impart knowledge in engineering drafting and handling basic engineering tools and equipment.

Learning Outcomes

- Students are expected to master the basics of engineering drafting and workshop practice.

Syllabus Outline:

- **Auto CAD**
  (Complete 2-D Drafting Course)

- **Work Shop Practice**
  Sheet metal work.
  Welding.
  Forging.
  Machine shop (Milling Machine, Hand tools and Drills)
  Lathe Work
  Familiarization with CNC machine.
  Wood Work.

Module Code	MT 1952	Title	Engineering Design			
Credits	1.5	Hours/Week	Lectures	2	Pre-requisites	Semester1 subjects
GPA/NGPA	NGPA		Lab/Tutorials	3		

Learning Objectives:

- To introduce design principles.
- To provide knowledge on various aspects of design using several selected design case studies.
- To give opportunity to carry out a group based product design assignment addressing issues such as manufacturability, marketability, creativity, team work, meeting deadlines.

Learning Outcomes

- Students are expected to acquire knowledge on the practical applications of design principles, product development and marketing and team work

Syllabus Outline:

- **Module1: Deign principles**
  Introduction to engineering design
  Life cycles of engineering products and process
  Design process and design tools
  Concurrent engineering
  Creativity and reasoning
  Analysis, synthesis, simulation, evaluation and decision marking
- **Module 2: Case studies**
  Several simple but compressive design case studies selected from different disciplines of engineering addressing following topics:
  Design for manufacturing
  Mechanical and material aspects in design
  Electrical, electronic and IT aspects in design
- **Module 3: Design assignments**
  Group based design assignments
  Assignments for Materials Engineering
  Students will be asked to design artifacts such as
  I. Coaxial AC – power
  II. Portable tension testing machine
  III. A low – cost, un-breakable container to retain hotness/coldness of liquids
- **Conceptual design techniques such as:**
  a) Objectives trees
  b) Function means trees
  c) Morphological charts
  d) Comparison of alternatives

Module Code	MT 1032	Module Title	Principles of Materials Science and Engineering - I			
Credits	2.0	Hours/ Week	Lectures	1.5	Pre-requisites	MT 1022
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide knowledge on basics of principles of Materials Science and Engineering

Syllabus Outline:

- Introduction to Alloys and alloy formation, Solidification of metals, Formation of grain structure, Thermodynamics of alloy formation, Phase diagrams and construction of phase diagrams, Binary alloy phase diagrams and evolution of microstructure. Iron-Carbon equilibrium phase diagram, Introduction to ternary phase diagrams.
- Introduction to heat treatment of steels.
- Introduction to Failure and Fracture mechanisms of Materials, ductile & brittle, fatigue and creep failure
- Introduction to polymers, Classification of polymers, Viscoelastic behaviour of polymers, Properties and application of selected engineering polymers.
- Introduction to engineering ceramics, Classification of ceramics materials, Ceramic processing, Properties and application of ceramic materials, Introduction to advanced ceramics.
- Introduction to composite materials.
- Introduction to Nano-materials.
- Degradation of metals, polymers, ceramics and composite materials.

Module Code	MT 1062	Title	Polymer Science			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
			Lab/Tutorials	1.5		
GPA/NGPA	GPA					

Learning Objectives:

- To introduce the fundamentals of polymer science

Learning Outcomes

Student should be able to;

- Understand chemistry of polymer synthesis
- Distinguish industrial polymerization methods
- Understand specificity of molecular structure and properties of polymers
- Predict structure property – relationship.

Syllabus Outline:

- **Nature and structure of polymer**
  Basic concept and polymer nomencluture, classification of polymers, specific features of polymer structure.
- **Chain Structure and configuration**
  Configuration and conformation, stereochemistry, isomerism, co-polymers
- **Polymerization Techniques**
  Free-radical polymerization, cationic polymerization, anionic polymerization, coordination polymerization, step polymerization and polycondensation, comparison of polymerization methods, Reaction kinetics
- **Industrial Polymerization methods**
  Chain reaction polymerization techniques, bulk, suspension, solution and emulsion polymerization, comparison of polymerization methods.
- **Properties of polymers**
  Thermal properties, mechanical properties, chemical properties, solution properties, electrical and optical properties, structure property relationships.

Module Code	MT 1162	Title	Metals and Alloys 1			
Credits	2.0	Hours/ Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Outcomes:

Student should be able to assess,

- the basic principals underlining production of Steels and Cast irons
- relationship between microstructure and properties of Steels and cast irons
- properties and uses of non-ferrous metals and alloys

Syllabus Outline:

- **General introduction**

- **Basic principles and selected processes of steel making**
  - Bessemer process
  - Open-hearth process
  - Electric arc process
  - Oxygen processes
- **Classification, microstructure, properties and uses of plain carbon steels.**
  - Low carbon steels
  - Medium carbon steels
  - High carbon steels
  - Ultra-high carbon steels
- **Classification, microstructure, properties, uses and production of cast iron.**
  - White cast iron
  - Grey cast iron
  - Malleable cast iron
  - Ductile cast iron

- **General introduction and classification of non-ferrous metals and alloys**
  - Copper & its alloys
  - Aluminium & its alloys
  - Magnesium & its alloys

- **Intermetallics**

- **Glassy metals**

Module Code	MT 2122	Title	Principles of Materials Science and Engineering II			
Credits	2.0	Hours/ Week	Lectures	1.5	Pre-requisites	MT 1032
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide knowledge on basics of principles of Materials Science and Engineering

Syllabus Outline:

- Brief review on types of bonding, Crystal Geometry and Structure.
- Structure of Solids, Crystalline & amorphous solids.
- Crystal Imperfections, Point defects; Line defects (Dislocations); Edge dislocations, Screw dislocations, Surface imperfections; Surface free energy, Grain boundaries (Interfaces), Stacking faults, Twin Boundaries.
- Fundamentals of Diffusion in Solids
- Phase Transformations in Materials
- Nucleation and Growth, Practical applications, Solidifications and crystallization of materials, glass transition.
- Elastic, Anelastic and Viscoelastic Behavior of Materials
- Plastic Deformation, Work Hardening and Annealing of Metals

Module Code	MT 2042	Title	Ceramic Science			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To introduce the basic concepts of Ceramic Science

Learning Outcomes

Students should be able to demonstrate a sound knowledge on

- Importance of powder properties, Characterization and Consolidation in ceramic fabrication
- How to identify & analyse proper drying & Sintering conditions
- Causes of defects in ceramic products
- Fabrication of Clay-Based traditional ceramics

Syllabus Outline:

- **Introduction to ceramics**
  Structure, properties and applications of traditional ceramics, advanced ceramics, glass and cement.

- **Ceramic powder preparation**
  Mechanical methods – communition, mechano-chemical synthesis
  Chemical methods – solid state reactions, liquid solutions, vapour phase reactions.

- **Powder characterization**
  Particle size, particle size distribution, particle shape, surface area

- **Powder consolidation and forming of ceramics**
  Powder mixing, types of mixtures, powder consolidation methods, powder pressing techniques,.

- **Drying and sintering**
  Shrinkage and swelling, sintering fundamentals, evaluation of sintered ceramics, finishing operations.

- **Fabrication of clay based traditional ceramics**
  Plastic and non-plastic raw materials, preparation of body mixtures, forming methods, casting, extrusion, ceramic kilns, firing.

- **Body mixtures and fabrication of selected ceramic products**
  Bricks and tiles, wall tiles, floor tiles, porcelain ware, sanitary ware, bone china, refractories, cement.

Module Code	MT 2052	Title	Communication Skills			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To improve basic communication skills, critical reading, verbal communications and writing.

Learning Outcomes

students should be able to

- Perform quality research and communicate the research outcomes in an effective manner
- Be future engineers / managers with effective communication ability with subordinator, peers and supervisors
- Handle crisis situations, build teams for a healthy working atmosphere

Syllabus Outline:

- **Introduction to communication skills**
  Transmitting information, Importance of effective communication, Transmitting and Receiving information, Feed back
- **Reading skills**
  Types of reading materials available, Methods for effective reading, Critical review of literature
- **Listening and Observation skills**
  Effective listening and Observation, Methods to receive information, Storing data.
- **Writing as a presentation skill**
  Personal records, Writing memos and letters, Aspects in science and engineering Writing technical reports, research papers and Thesis
  - Structure of a report, Grammar & vocabulary
  - Effective writing, Figures, Tables, Graphs and photographs
  - Literature survey and references
- **Oral presentation skills**
  Effective public speaking, Preparing a talk(Delivery of talk , Atmosphere, Body language, Personality) , Identification of the audience, methods of presentation, timing, using equipment
- **Inter personal interaction**
  Inter-personal communication ,Team building, Crisis management

Module Code	MT 2142	Title	Electrical And Magnetic Properties Of Materials			
Credits	3.0	Hours/Week	Lectures	2.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide basic knowledge on relationship between structure and electrical properties of materials.

Learning Outcomes

Student should be able to demonstrate a sound knowledge on;

- Electron's behavior in materials, which describes their physical properties
- Properties of materials used in electronic industry
- Basics of manufacture of electronic devices

Syllabus Outline:

- **Basic principles**
  Wave equation; Explanation of wave particle duality concept using interference, diffraction, photoelectric effect, compton effect, black body radiation.
  Heisenberg uncertainty principle, Schrondinger's wave equation and its solutions
  free electron model: density of state, Fermi energy and Fermi-Dirac distribution
  band theory: Kronig – penny model, energy band diagram.
- **Conductivity of metals and semi conductors**
  Relationship between charge carrier density & conductivity ,Factors affecting conductivity of metals. Conductivity of intrinsic and extrinsic semi conductors and energy band diagrams.
- **Semiconductor devices and their fabrication**
  p-n junction: depletion layer & potential barrier, rectification action. Break down of p-n junction, Tunnel diode, backward diode, Zener diode, metal semiconductor Junction. n-p-n, JUGFET & MOSFET transistors.
  Fabrication: Raw materials, growth of single crystals, fabrication by crystal pulling, Alloy junctions and point contact method, epitaxial growth techniques, Fabrication of integrated circuits.
- **Dielectric materials**
  Polarization and its mechanisms, frequency and temperature dependence of permittivity, Complex permittivity, dielectric loss, dielectric strength, break down process, Classification of dielectrics, Insulators, high permittivity dielectric, piezoelectric, ferroelectrics,
- **Magnetic materials**
  Magnetic moment, orbital and spin magnetic moments, Quantum mechanical model of electrons magnetic moment,
  Classification of magnetic behavior of solids: and their uses, Diamagnetism, paramagnetism,
  ferromagnetism, antiferromagnetism, ferrimagnetism,
  Domain theory, Magnetization curve and hysterisis loop, Applications, Hard and soft magnetic materials, Production of permanent magnets.

Module Code	MT 2072	Title	Metal Forming And Machining			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide knowledge on mechanical and metallurgical aspects of metal forming and machining processes.

Learning Outcomes

Students should be able to;

- Understand the basics of metal forming and machining as essential manufacturing processes
- Understand most important metal forming and machining processes and their application in manufacturing of engineering products
- Select proper tools and machinery for cost effective manufacturing with above-mentioned processes

Syllabus Outline:

- **Introduction**

  Introduction and classification of metal forming and machining processes

  Comparison of metal forming and machining processes with other manufacturing processes like casting.

- **Mechanical aspects of metal forming**

  Mechanical forces and stresses on metallic materials, Mohr's circle, yield criteria

- **Metallurgical aspects of metal forming**

  Metallurgical behavior of metals and cold and hot forming processes
  Work hardening and strain hardening effects, dynamic recrystalization
  Strain rate sensitivity factor, super plasticity.

- **Bulk forming processes for metals**

  Hot and cold rolling, forging, wire drawing, tube turning, extrusion, deep drawing

- **Sheet forming processes for metals**

  Bending, shearing, stretch forming, flanging, blanking, etc.

- **Metal forming equipments**

  Hammers, presses and their dynamic characterizations, Tools and dies

Machines and tools
Formability of metals
Fundamentals for machining
Tool work piece interaction, Metal cutting processes, Machinability of materials, tool constructions, Special machining processes**,** Selection of materials for cutting tools

Module Code	MT 2032	Title	Degradation Of Materials			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide knowledge on degradation mechanisms, forms of corrosion and corrosion prevention methods

Learning Outcomes

Students should have a sound understanding of;

- Degradation mechanisms of metals, ceramics and polymers
- Forms of corrosion and protection techniques against them

Syllabus Outline:

- Introduction to Degradation
  Degradation principles, electrochemical aspects, Polarization, environmental effects, metallurgical aspects.
- Corrosion
  Definition of corrosion, Cost of corrosion, Corrosion damage, Corrosion rate expressions
- Forms of corrosion.
  General corrosion, galvanic corrosion, crevice corrosion, pitting corrosion, intergranular corrosion, selective leaching, erosion corrosion, stress corrosion, hydrogen damage.
- Corrosion testing and evaluation
  Introduction, classification, purpose, Huey test, Streicher test.
- Designing to minimize corrosion
  Material selection, mechanical factors, compatibility of different materials, Site location, fabrication.
- Degradation of ceramics
  Acid brick, stoneware and porcelain, Structural clay, glass, concrete.
- Degradation of polymers
  Natural and synthetic rubbers,
  Plastics (thermo plastics and Thermo sets)
- Protection methods
  Material selection, alteration of environment, design, Cathodic and anodic protection, coatings.

Module Code	MT 2152	Title	Polymer Technology			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide basic understanding of manufacturing technologies related to polymer products and compound developments**.**

Learning Outcomes

Student should have knowledge on,

- Important polymer processing techniques and polymer processing fundamentals
- Various types of additives used in rubber compounding
- How to manufacture advance composite articles (such as tyres, horse etc.)

Syllabus Outline:

- **Properties and application of rubber and plastics**
  General purpose rubbers, Special purpose rubbers, Block copolymers, Thermoplastic resins and Thermosetting resins.

- **Rubber Technology**
  Compounding ingredients, Rubber compounds, Mixing, Extrusion, Calendering, Injection Moulding, Compression Moulding, Transfer Moulding, Vulcanization, Rubber-textile composites.

- **Plastic Technology**
  Extrusion, Injection Moulding Compression Moulding, Transfer Moulding, Blow Moulding, Thermoforming, Rotational Moulding, Casting, Calendering, Powder coating, Compounding, Joining and assembling of plastics.

Module Code	MT 3052	Title	Characterization Of Materials			
Credits	2.5	Hours/Week	Lectures	2.0	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide knowledge on different techniques and instruments used to analyze materials for identification, structure determination, property measurements, etc.

Learning Outcomes

The students should demonstrate ability to

- Select suitable instruments to measure required property
- Do chemical analysis
- Determine the structure of material
- Use instruments for qualitative & quantitative analysis

Syllabus Outline:

- **Crystallography**
  Fundamental of crystallography, Symmetry elements, crystal systems, 32 crystal classes
- **X – ray diffraction**
  X-ray spectrums and filters
  Continuous and characteristic spectrums, absorption, X-ray filters
  Diffraction methods, Bragg law, diffraction methods, non-ideal diffraction of X-ray
- **Intensity of powder patterns and indexing**
  Atomic scattering factor, structure factor, indexing of powder patterns.
- **Chemical Analysis**
  Lattice parameter
  phase diagram determination
- **Thermal analysis**
  Thermogravimetry, DTA and DSC analysis
- **Nuclear magnetic resonance**
  Basic principles, chemical shift, spin-spin splitting, Qualitative and quantitative analysis.
- **Spectroscopic techniques**
  Introduction to spectroscopic techniques, UV- visible, spectroscopy, IR- spectroscopy
- **Viscometry**
  Introduction, fundamentals of capillary viscometry, capillary viscometers, rotational viscometers, lactometers

Module Code	MT 3212	Title	Metal Casting And Powder Metallurgy			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide theoretical and practical knowledge on metal casting and Powder metallurgy.

Learning Outcomes

Students should be able to;

- Understand and explain the casting process, various casting processes and casting defects
- Understand the solidification theory of metals and heat treatment of castings
- Understand and explain powder metallurgy process
- Understand metal powder production techniques and powder compaction techniques

Syllabus Outline:

- **Introduction**
  Introduction to foundry technology, Developments in casting methods, Modern techniques in metal casting

- **Casting processes**
  Ingot casting, Continuous casting, Sand casting, Investment casting, Centrifugal casting, Die casting (Pressure and Gravity)
  Modern techniques
- **Sand Moulding Techniques**
  Ingredients of moulding sand, properties of moulding sand, manual moulding processes, machine moulding processes
- **Solidification theory**
  Solidification of pure metals and alloys, grain formation, dendritic growth etc. Heat transfer during solidification
- **Melting, type of furnace, heat conduction**
- **Casting design and material selection.**
  Design of component for casting, Design of runners, risers, and gates., Avoidance of aspiration
- **Casting defects and heat treatment of casting**
- **Introduction to powder metallurgy**.
  Application of P/M techniques and its advantages, properties.
- **Production and properties of metal powders**.
  Atomization, reduction of metal oxides, electrolysis, pulverization, powder properties.
- **Compaction, sintering, mechanical properties.**
  Hot and cold methods, metal injection molding,etc., Theory and principal of sintering, Mechanical properties of powder metallurgical products, Applications

Module Code	MT 3252	Title	Ceramic Technology			
Credits	3.0	Hours/Week	Lectures	2.5	Pre-requisites	MT 2042
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To develop an understanding of science and technology related to ceramic fabrication.

Learning Outcomes

Students should be able to demonstrate a sound knowledge on

- Fabrication & selection of glazes and colour pigments for ceramic products
- Colloidal science used in wet forming techniques
- Special fabrication and densification techniques used in advanced ceramics
- Fabrication & application of glass

Syllabus Outline:

- **Ceramic glazes**
  Introduction to glazes, types of glazes, properties of glazes, glaze application methods, glaze calculation.
- **Ceramic colour pigments**
  Types of pigments, In-glaze, on-glaze, under-glaze colour applications
- **Rheology and colloids**
  General introduction to colloids and rheology.
  Broken bond theory, isomorphous substitution, double layer theory.
- **Special ceramic fabrication techniques**
  Isostatic pressing, injection moulding, fusion casting, tape casting, thick and thin film fabrication.
- **Sintering and densification techniques of ceramics**
  solid state sintering, viscous sintering, grain growth and microstructural evolution, pressure sintering (hot pressing), microwave sintering, reaction sintering.
- **Sol-gel processing**
  Types of gels, metal alkoxides, sol-gel preparation techniques, applications of sol-gel processing.
- **Glass**
  Raw materials, glass production techniques, treatment for glass, types of glasses, Applications.

Module Code	MT 3232	Title	Polymer Engineering			
Credits	3.0	Hours/Week	Lectures	2.5	Pre-requisites	MT 2152
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To impart knowledge on fundamentals of polymer engineering and understand the practical implication of theoretical facts.

Learning Outcomes

Students should be able to ;

- Understand unique and extraordinary properties of polymers
- Analyze industrial problems through polymer engineering fundamentals
- Predict factors influencing long and short term durability

Syllabus Outline:

- **Rubber elasticity**
  Chain conformations in polymers, the statistical theory of rubber elasticity, entropy, internal energy, effect of temperature, theory of Mooney and Ruilin, Selected examples: Design of rubber springs, Static seals, Dynamic seals

- **Viscoelasticity**
  Visco-elastic models, Stress-strain-time relationship, Superposition, retardation and relaxation time spectrums, WLF equation, Dynamic behaviours of polymers, Frequency-temperature equivalence problems.

- **Rheology of polymers**
  Newtonian and non-Newtonian fluids, Time dependent fluids, Time independent fluids, Flow curves, Isothermal channels flow, Boundary effect, Equipments used to obtain flow data

- **Morphology of polymer**
  Polymer crystallography, Lamella, Sperulites effect of crystallinity, Orientation induced crystallization, Chain orientation, Properties of oriented polymers, Frozen stress, Stress concentration.

- **Yield and fracture**
  Short term tensile strength, Brittle failure, Ductile failure, Basic concept of fracture mechanism

Module Code	MT 3242	Title	Joining Of Materials			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide knowledge on application of material science and engineering concepts to joining of materials as well as on joining processes used in manufacturing of engineering products.

Learning Outcomes

Students should be able to

- Understand the mechanical and materials science concepts in joining of materials
- Understand all essential joining processes and their application in manufacturing of engineering products
- Select a suitable joining process for a particular job with the consideration of manufacturing cost

Syllabus Outline:

- **Introduction to joining of materials**
  Mechanical ,Materials science and design aspects of joining
- **Solid state welding processes.**
  Fundamentals of solid state welding , Cold welding, Forge welding, Diffusion welding,
  Ultrasonic welding, Friction welding, Electric resistance welding,
  Spot-welding, Projection welding.
- **Fusion welding processes.**
  Heat affected zone in fusion welding, Gas welding and cutting, Manual electric arc welding, MIG/MAG welding, TIG welding, Plasma welding and cutting, Submerge arc welding, Electron and Laser beam welding, Brazing and Soldering, Fundamentals of soldering and brazing,
  Low temperature and High temperature brazing processes,Fluxes and their properties, Heating techniques
- **Welding defects , weld inspection and testing**
- **Joining of polymers**
  Fundamentals of joining of polymers, joining methods, adhesives, their properties and selection, defects and remedial methods
- **Joining of dissimilar materials**
  Joining of high / advanced ceramics like Al_2O_3, SiC, Si_3N_4 to each other and to high temperature steels

Module Code	MT 3712	Title	Extraction Of Metals			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide knowledge on primary production of ferrous and non ferrous metals.

Learning Outcomes

- Student should have adequate knowledge to devise procedures for production of primary metals, both ferrous and non-ferrous of desired purity

Syllabus Outline:

- **Ore preparation:**
  Comminution; classification; froth floatation; magnetic and electrostatic separation; agglomeration

- **Pyrometallurgy:**
  Drying; calcination; roasting; oxide reduction; smelting; matte converting; fire refining; distillation

- **Hydrometallurgy:**
  Leaching; precipitation techniques; ion exchange; solvent extraction; reverse osmosis

- **Electrometallurgy:**
  Basics electrolytic cell; electrolysis of aqueous and molten electrolytes; electrowinning and electrorefining; cell voltage and power requirements for both processes.

- **Extraction procedures for ferrous and non-ferrous metals:**
  Blast furnace and alternative iron making processes; extraction and refining of Ti, Cu, Al, Zn, Pb and precious metals.

Module Code	MT 3722	Title	Latex Science and Technology			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	MT 2152
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To study the fundamentals of colloidal science and to provide knowledge on technologies involved in latex based products manufacture in detail.

Learning Outcomes

After competing this unit the students should be able to,

- Handle problems related to quality of latex and latex compounding ingredients
- Identify & analyze failures in product manufacturing plants
- Use fundamentals to run plants effectively and efficiently
- Develop techniques to improve the quality of products
- Attend to routine trouble shooting effectively

Syllabus Outline:

- Introduction to natural rubber latex
- Theories for colloidal stabilization
- Latex compounding ingredients
- Preparation of dispersions and emulsions
- Manufacture of latex based products
- Testing of latex based products
- Synthetic latices

Module Code	MT 3902	Title	Industrial Visits I			
Credits	1.0	Hours/Week	Lectures		Pre-requisites	None
GPA/NGPA	NGPA		Lab/Tutorials	6.0		

Learning Objectives:

- To familiarize the students with materials Engineering related industries and to give basic understanding about the methods used to apply materials engineering principles in manufacturing.

Learning Outcomes

The students should have a thorough knowledge on

- Management structures of the industries visited
- History of the industry
- Raw materials used
- Processing and fabrication techniques
- Future developments

Syllabus Outline:

- **Proposed field visits are:**

  Dankotuwa Porcelain (pvt) Ltd
  Ceylon Glass Company
  Nawaloka Polysac(Pvt) Ltd.
  Hiat Steels (Pvt) Limited.

At least two visits will be covered.
Individual Field Visit Reports Should be submitted before next Field Visit.

Module Code	MT 3992	Title	Industrial Training			
Credits	6.0	Hours/Week	Lectures		Pre-requisites	None
GPA/NGPA	NGPA		Lab/Tutorials			

Learning Objectives:

- To provide exposure to application of technology and management

Learning Outcomes

- Students should have knowledge on what is taking place in industrial organizations in terms of applications of technology, quality control, management, safety measures etc.

Syllabus Outline:

Industrial Training Modules for the students of the Department are defined as follows and these modules will be circulated prior to the commencement of each training session. (Available training placements are categorized into the following major streams)

- Material processing companies (24 weeks)
- Metal, Polymer and Ceramics Manufacturing Industries (24 weeks)
- Research Industries (24 weeks)
- Industries in Materials Engineering Allied Fields (24 weeks)

Details of the above training programs has been submitted to the Industrial Training Unit of UOM.

Module Code	MT 4022	Title	Total Quality Management			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To familiarize the students with the principles and methods associated with total quality management.

Learning Outcomes

Students should be able to

- Understand the importance of TQM, audits, systems, and standards.
- Design and implement quality programmes in the industry for the maximum buyer satisfactions.

Syllabus Outline:

- **Introduction to quality**
  Definition of quality importance of quality aspects in engineering, understanding the relationship between quality and productivity.

- **Quality in production and service systems**
  Statistical process control, control charts, measuring systems, quality circles, Quality control in materials engineering.

- **Quality management systems**
  Total quality management, planning for quality assurance, Organizing and controlling for quality, economics of quality.

- **Quality improvement and problem solving**

- **Human resource management for quality improvement**

Module Code	MT 4032	Title	Optical and Electron Microscopy			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide knowledge on fundamentals of optical and electron microscope with emphasis on how to set up microscopes for critical microscopic observations and microanalysis.

Learning Outcomes

Students should have ability to demonstrate

- Optical property determination and characterization of materials
- Selection of suitable mode of operation to observe required features in microscopy
- Sample preparation for microscopic observation
- Use of electron microscope for chemical analysis

Syllabus Outline:

Optical microscopy

- **Resolution and contrast in microscopy**
  Resolution, illumination techniques and contrast, image defects

- **Polarizing microscopy**
  Interference of polarized light, double refraction, specimen preparation, Determination of refractive index, conoscopic observation, use of hot stage

Electron microscopy

- **Interaction of electron beam with matter**
  Electron physics and optics, electron interaction with solid matter

- **Optical system of an electron microscope**
  Electron gun, lenses, image defects and detector

- **SEM and TEM**
  SEM: emissive and reflection modes, sample preparation
  TEM: image formation, bright field and dark field illumination, sample Preparation,Reciprocal lattice concept, electron diffraction

- **Analytical modes:**
  EDAX and WDAX

Module Code	MT 4052	Title	Mechanical Behaviors of Materials			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To introduce engineering students to the stress, strain, and deformation behavior of engineering materials and structures. To introduce the students to the mechanics of materials method of problem formulation and solution procedures for solving solids mechanics problems. Basics of engineering design concepts are brought into the course by way of selected problems.

Learning Outcomes

- The students should acquire basic knowledge on fracture mechanics and material failures.

Syllabus Outline:

- **Fracture Mechanics**

Theoretical tensile and shear strengths of ideal materials, slip in ductile materials, ductile-brittle transition ,temperature.

***Brittle fracture**:* Sources of micro and macro cracks, stress concentration approach, Griffith's energy balance approach, stress intensity factor approach and fracture toughness, statistical approach to brittle fracture - Weibull analysis, mean strength, effect of volume and loading systems, compliance method, selection of working stresses.

***Ductile fracture**:* Overall yielding, cup and cone type failure.

Fatigue: Mechanism, factors influencing fatigue failures, Goodman-Gerber diagram, estimation of fatigue life, Minor's law of Cumilative fatigue, design against fatigue.

***Creep**:* Mechanism, factors influencing creep failures, micro structural fractures, creep rupture, design against creep, creep resisting alloys.

- **Strength and Fracture of FRC's**

Fibre reinforced materials, continuous and discontinuous fibres, orientation of the fibres, mechanics of load transfer from matrix to fibre, Modulus, tensile strength and toughness of composites, modes of fracture.

- **Specific fracture mechanisms for polymers**

Module Code	MT 4352	Title	Metals and Alloys 11			
Credits	3.0	Hours/Week	Lectures	2.5	Pre-requisites	MT 1162
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Outcomes:

Student should be able to assess,

- Relationship between microstructure, properties and applications of metals and alloys.

Syllabus Outline:

- **Introduction**

- **Alloy Steels**
  - Definition and effects of Alloying on steel

- **Classification, microstructure, properties and uses of alloy steels**
  - High-strength low alloy steels
  - SAE-AISI alloy steels
  - Alloy tool steels
  - Stainless steels
  - Heat-resisting steels
  - Electrical steels (silicon steels)

- **Alloy Cast Irons**
  - Definition and effects of various alloying elements on cast iron

- **Classification, microstructure, properties and uses of different alloy cast irons**
  - Chromium white cast irons
  - Martensitic white cast irons
  - Austenitic grey cast irons

- **Relationship between microstructure and properties of different non ferrous metals and alloys**
  - Copper & its alloys
  - Aluminium & its alloys
  - Magnesium & its alloys
  - Zinc & its alloys
  - Titanium & its alloys
  - Lead, Tin & their alloys
  - Beryllium & its alloys
  - Nickel & its alloys

Module Code	MT 4242	Title	Advanced Ceramics			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	MT 2042
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide knowledge on synthesis, fabrication and applications of advanced ceramic materials.

Learning Outcomes

Students should be able to demonstrate a sound knowledge on;

- Fundamental properties of electro ceramics, their fabrications and applications
- Optical & structural properties of advanced ceramics and their production and applications
- Synthesis, properties, current & future applications of Bio ceramics
- Recent trends in advanced ceramics applications.

Syllabus Outline:

- **Electro ceramics**

Piezoelectric Ceramics, Ferroelectric Ceramics, Positive and negative Temperature Coefficient Resistors, Magnetic ceramics, Fuel Cells and High Energy Batteries, Electronic ceramic devices.

- **Glass ceramics**

Fabrication, properties and applications of glass ceramics, photo sensitive and photo chemical glasses, Photo sensitively machined glass ceramics, High strength glass ceramics, Transparent glass ceramics, machinable glass ceramics.

- **Oxide ceramics**

Silica, Magnesia, Alumina, Zirconia,

- **Carbide ceramics**

SiC and other carbide ceramics, Powder synthesis, fabrication, properties and applications.

- **Nitride ceramics**

Silicon Nitride and other Nitride ceramics

- **Bio ceramics**

Polycrystalline ceramics, Porous ceramics, Bio active glass, Bio active glass ceramics
Bio active composite, Dental Ceramics.

Module Code	MT 4252	Title	Design And Fabrication Of Polymer Products			
Credits	3.0	Hours/Week	Lectures	2.5	Pre-requisites	MT 1062
GPA/NGPA	GPA		Lab/Tutorials	1.5		MT 2152

Learning Objectives:

- To understand the design principles of complex polymer products based on performance and manufacturing requirements.

Learning Outcomes

Student should be able to ;

- Apply polymer engineering fundamentals to design various engineering items
- Apply knowledge to design advance polymer compounds and items.

Syllabus Outline:

- **Behaviour of plastic rubber**
  Understanding plastics and rubber materials, understanding plastics and rubber test methods physical and mechanical properties of polymers

- **Basic of design**
  Identify the requirements of the products
  Design for maximum stress, strain

- **Design concept and engineering consideration**
  Design concepts for selected articles, part failure
  Time-dependent deformational behaviour
  Manipulation of the creep curves

- **Design of plastics and rubber products**
  Product design examples.
  Static and dynamic seals, design of tyres, conveyor belts, hoses, blow molded product, blowing film design, plastic hollow shapes designs, industrial and structural part design, Troubleshooting; design related, material related and process related

- **Fibre reinforced plastic products**
  Behaviour of unidirectional fibre composites
  Behaviour of random discontinuous fibre composites
  Modeling Processes, Design Guide

- **Mix Design**
  Material properties and selection, Design of compound formulations for various applications

Module Code	MT 4712	Title	Refractories And Kiln Technology			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide knowledge on types and properties of refractories and their industrial applications.

Learning Outcomes

Student should have a thorough knowledge on;

- The raw materials used in refractory industry and the manufacturing process
- Properties and applications of refractories
- Usage of monolithic refractories
- Types of kilns used in industries
- Time-temperature curves and different types of burners used in kilns

Syllabus Outline:

Refractories

- **Types of refractories**
  Silica, Alumina Silicate, Magnasite, Magnasite Chrome, Carbon, Dolamite
- **Properties of refractories**
  Volumetric changes, Conductivity, Refractoriness, Refractoriness under load, Spalling resistance, slag resistance.
- **Industrial application and selection of refractories**
  Refractories used in cement, iron, steel, glass, ceramics industry
- **Ternary phase diagrams**
  Theory of ternary diagrams, cooling and heating paths, Identification and estimation of components

Kiln Technology

- **Firing characteristics of Ceramics**
  Determination of maturing temperatures.
  Reaction occurring on firing.
  Determination of reactions.
  Time Temp distribution curve.
  Optimization of Time Temp distribution curve.
- **Kilns used in ceramics**
  Different types of designs.
  Draft movement.
  Temperature and Pressure distribution.
- **Combustion technology in Ceramic manufacturing**
  Theoretical and practical requirement for efficient combustion. (3 Ts in combustion)
  Preparation of liquid fuel for combustion, high pressure atomization
  Low-pressure atomization, centrifugal atomization.
  Oil burner designs - Gun type, rotary type, and pot type.

Module Code	MT 4762	Title	Nano Materials			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide knowledge and relevant concepts on synthesis, science and technology of nanomaterials.

Learning Outcomes

Students should be able to demonstrate a sound knowledge on;

- Fundamental scientific concepts in assembly, synthesis and applications of different nanoscale materials.
- Measurements and computational tools in nanoscale.
- New properties in nanoscale and emerging applications.

Syllabus Outline:

- Introduction to nanomaterials.
- Materials at reduced dimensions- thin films, nano tubes, nano wires, fullerenes and nanopartricles.
- Synthesis of nanomaterials- physical, mechanical and chemical techniques
- Carbon nanotubes, carbon nano fibres, semiconductive nanomaterials,
- inorganic nanomaterials , Ceramic nanomaterials, metallic nano particles,
- bionanomaterials, composite nanomaterials.
- Measurements and characterization of nanomaterials.
- Computational methods in nanomaterials.
- Applications and Emergent properties at the nanoscale
- Health and environmental issues of nanomaterials.

Module Code	MT 4752	Title	Industrial Polymer Process Engineering			
Credits	3.0	Hours/ Week	Lectures	2.0	Pre-requisites	-
GPA/NGPA	GPA		Lab/Tutorials	3.0		

Learning Objectives:

- To give students an understanding of fundamentals of polymer process engineering

To provide sufficient understanding of the basic calculations required for the design of polymer process equipments

Syllabus Outline:

- Rubber Process Engineering
  - Outlook of rubber processing
  - Primary processes in rubber processing
  - Auxiliary Equipments & secondary operations
- Plastics Process Engineering
  - Fundamentals of extruder design and calculation of technological parameters
  - Blowing process operations
  - Injection moulding process operation and process optimisation
  - Thermoforming process overview and part application issues
  - Analysis of flow through the calendar nip
  - Other processing methods

Module Code	MT 4902	Title	Industrial Visits II			
Credits	2.0	Hours/Week	Lectures		Pre-requisites	None
GPA/NGPA	NGPA		Lab/Tutorials	6.0		

Learning Objectives:

- To familiarize the students with materials Engineering related industries and to give basic understanding about the methods used to apply materials engineering principles in manufacturing.

Learning Outcomes

The students should have a thorough knowledge on

- Management structures of the industries visited
- History of the industry
- Raw materials used
- Processing and fabrication techniques
- Future developments

Syllabus Outline:

- **Proposed field visits are:**

  Lanka Wall Tiles Ltd., Meepe, Padukka.
  Lanka Refractories
  Phoenix Industries (Pvt) Ltd.
  Associated Motor Ways (Pvt) Ltd.
  S-lon (Pvt) Ltd.
  Royal Ceramics Lanka (Pvt) Ltd.
  Ceylon Heavy Industries Company Limited.

At least five visits will be covered.
Individual Field Visit Reports Should be submitted before next Field Visit.

Module Code	MT 4112	Title	Selection Of Materials, Failure Analysis And Non Destructive Testing			
Credits	2.5	Hours/Week	Lectures	2.0	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To build competency in engineering failure analysis. To acquire knowledge on the selection of suitable materials for engineering applications and on the use of non-destructive testing for detection of defects in materials.

Learning Outcomes

Students should be able to

- Understand the causes for engineering failures.
- Perform effective failure analysis on engineering products
- Select suitable materials for engineering components
- Perform non destructive techniques for engineering materials and products

Syllabus Outline:

Failure Analysis

- **Introduction to failure analysis**

  Correct approach to failure investigation, Introductory case studies
- **Types of failure**

  Distortion failures, single load failures, fatigue failures, wear induced failure, effect of materials properties, corrosion induced failure, elevated temp(creep) induced failures, stress conditions and other environmental factors on failure. Case studies of different types of failures
- **Basic fracture mechanics**

  Micro mechanisms of fracture, effect of residual stress, brittle fracture, ductile fracture, case studies of different types of fracture.
- **Failure in polymeric and composite materials**

  Mechanical behavior of polymeric and composite materials. Failure analysis of polymeric and composite materials.
- **Design to avoid Failure**

  Using strength of materials approaches, Using fracture mechanics approaches, Case studies

Selection of Materials

- **Introduction to selection of materials**
- **Criteria for selection of materials**

  Criteria determined by the application, criteria for determination of materials
- **Stress conditions, temperature and other important factors influencing the application**

  Essential mechanical, physical, chemical, electrical and magnetic properties of materials, cost analysis.
- Case studies in engineering applications.

Non-Destructive Testing of Materials (NDT)

Introduction and importance of NDT

NDT vs Destructive Testing

Liquid Penetrant Testing, Eddy current testing, Magnetic Particle Testing, Radiographic Testing, Ultrasonic Testing, Applications of NDT methods

Module Code	MT 4202	Title	Research Project			
Credits	8.0	Hours/Week	Lectures	0	Pre-requisites	
GPA/NGPA	GPA		Lab/Tutorials	24		

Learning Objectives

- To familiarize students to carry out research and application of scientific method

Learning Outcomes

Students should be able to;

- Carry out projects with an engineering background
- Perform analysis of concepts
- Formally present project outcomes

Syllabus Outline:

The students shall conduct a research project on a given or chosen topic, in accordance with the following guideline.

- **Identification of the research need**

This includes the study of the circumstances and situations leading to the research need and the significance and the viability of carrying out the project.

- **Literature Survey**

This is carried out in order to clarify the scope of the research. The students shall learn to make use of the available sources of information and ways of filtering the necessary data.

- **Finalizing the preliminary research and submission of a progress report**

The student shall submit a report on his/her findings on the preliminary investigation and should device a plan to carry out of the further research.

The student then, on the approval of the supervisor, shall proceed with the practical part of the research. It is necessary for the student to hold weekly meetings with the supervisor during the allowed time period. The total duration of this stage shall be 15 weeks.

The student should finalize his/her research findings and submit a draft report to the supervisor on
or before the stipulated date

Student shall present his/ her findings before an evaluation panel consisting of the staff members for the final appraisal of the student's research ability and communication / presentation skills.

Module Code	MT 4362	Title	Heat Treatment and Strengthening Mechanisms of Metals			
Credits	3.0	Hours/Week	Lectures	2.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Outcomes:

- Student should be able to assess different kind of heat treatment processes and appropriate strengthening mechanisms for metals and alloys, considering specific conditions of manufacturing and operation.

Syllabus Outline:

Introduction

(a) Heat Treatment Procedures for Steel and Cast Iron

- **TTT and CCT-diagrams**
- **Heat-treatment of plain carbon steel and alloy steel**
  - Annealing, Normalizing, Hardening, Tempering
- **Surface Treatments of Steels**
  - Carburizing, nitriding, Carbo-nitriding, Cyaniding, Induction Hardening, Flame Hardening
- **Heat treatment of cast iron :**
  - Annealing, Normalizing, Hardening, Tempering

(b) Strengthening Mechanisms of Metals and Alloys

- **General overview of effect of defect on mechanical properties**
  - Introduction to types of strengthening mechanism and their applicability
- **Grain size and grain boundary related effects**
  - Effects of grain size on mechanical properties, Effect of grain boundary angles, Migration of grain Boundaries, Grain growth.
- **Work hardening**
  - Yield point phenomena, Strain ageing and Lachtlier effect.
- **Solid solution strengthening**
  - Types of solid solution strengthening, Factors affecting solid solution strengthening and effect of solid solution
- **Precipitation hardening.**
  - Theory of precipitation hardening, Mechanism of precipitation hardening, Selected samples Cu-Co system, Ni-Al system, Al-Cu system
- **Dispersion hardening**
  - Mechanism, Study of selected systems (Al, Al_2O_3, Pb + PbO),
  - Structure /property relations in Al, Cu, Ti, Ni, Co, Mg and refractory alloy

Module Code	MT 4272	Title	Smart Materials			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	MT 2142
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To introduce fundamentals and applications of smart materials and structures.

Learning Outcomes

Students should have knowledge on;

- Basics of intelligent materials & systems
- Different types of smart materials and their applications
- Current trends & future prospects of smart materials

Syllabus Outline:

- **Introduction**
  Basic structure and properties of advanced materials, general application areas of smart materials and structures.

- **Intelligent materials and systems**
  Their functions and fundamentals of intelligent materials.

- **Smart materials in engineering applications**
  Actuator materials, actuator technologies, sensor materials, sensing technology and micro sensors, Hybrid smart materials, smart skins.

- **Electro and Magneto rheological fluids**

  The electro and magneto-rheological phenomenon, Magneto-rheological fluids, Electrorheological fluids, applications.

- **Piezoelectric materials**
  Piezoelectrics as sensors and actuators, Piezoelectric ceramics, polymers and single crystals, applications and future prospects.

- **Shape memory materials**
  Background, shape memory effect, super elasticity, shape memory alloys, shape memory polymers, applications and future prospects.

- **Fiber optic materials**
  An overview, advantages of fiber optics, light propagation, fiber optic sensors, applications.

Module Code	MT4372	Title	Dies and Moulds for Polymer Processing			
Credits	3.0	Hours/Week	Lectures	2.5	Pre-requisites	MT 2152
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide a knowledge on construction features, design and maintenance of polymer processing equipments and their accessories.

Learning Outcomes

Student will be able to ;

- Understand factors affecting mould performance, productivity and mould life
- Design moulds for products required
- Apply fundamentals of polymer engineering and design guideline to design mould.

Syllabus Outline:

Classification of polymer processing equipment. Design features, Types, batch type equipments, continuous type equipments, cooling and heating system, Plant services.

Design of tyre moulds for pneumatic and solid tyres. Design of tube and air-bag moulds. Design of bladder Factors that influence Thermoset Moulding materials selection in relation to moulding conditions, Design of mould cavity, rubber to metal bonding, Design of moulds for seals.

- **Compression and Transfer mould Design**

Types, Principles. Design of pot and plunger, Feed system, Determination of possible number of cavities, design of mould cavity, Design of loading chamber.

- **Blow mould Design**

Material Selection, Mould Cooling Clamping Force, Mould Venting, Pinch –off, Die design, Parison Diameter Calibration, Wall thickness, Vertical Load Strength, Blow Ratio, Base Push-up, Shapes, Design Considerations – Shrinkage , Neck and Shoulder Design , Threads, Bottom Design

- **Extrusion Die Design**

Characteristics of polymer melt. Die Geometry Die head Pressure, Characteristics of Land length to profile thickness, Extruder Die Swell, Die Making Material. Classification of Dies- Dies for solid rod extrusion, Dies for hollow profiles, Blown film dies, Flat film dies Wire and cable coating dies, Spiral mandrel die, Fish tail die, Adjustable core die.

- **Clarification of injection moulds**

Methodical Mould Design –Number of cavities, Selection of injection moulding machine, Layout of cavities in multi impression moulds feed system –Design of Runners and cavities Ejection systems, Cooling Systems, Venting system, other aspects

Module Code	MT 4292	Title	Polymer Process Control & Instrumentation			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide the basic knowledge on control systems, components and instrumental techniques. To understand the advantages and constraints associated with practical applications of the control techniques for polymer processing.

Learning Outcomes

Student should be able to;

- Understand fundamentals of process control and mechanism of common controllers used in polymer processing techniques
- Install elements of controlling loops correctly

Syllabus Outline:

- **Fundamentals of control**
  Open loop, closed loop, feed back- control systems, on-off control systems, sequence-control systems, continuous control systems, system response, introduction to measuring methods.

- **Operating principles of common transducers**
  Force-measuring transducers, Electrical-resistance, strain gauges, termistors, common transducers, displacement transducers, light sensitive transducers.

Control of the main processes in polymer industries, controls in mixing, controls in calendaring, control of extrusion units, control in injection molding

Module Code	MT 4342	Title	Cleaner Production			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To acquaint the students with the fundamental differences between the theories, concepts and definitions of the new, Cleaner Production. To learn some of the management and leadership skills necessary for helping companies plan and implement policies and programs designed to actualize "Cleaner Production", within their firms. To examine the importance and roles of corporate environmental ethics.

Learning Outcomes

Students should be able to;

- Develop skills to select appropriate environmental friendly techniques to reduce raw material consumption , waste of utilities and disposal cost

Syllabus Outline:

- **Environmental analysis of some typical industrial systems**
  Make use of recent case studies and describe the processes involved
  Modifying each system to achieve a better environmental performance
  Identify the parameters which define the system and the need for measurement and control

- **Measurement and measurement systems**
  Examine an idealized measurement system and use this to define all the important performance characteristics such as accuracy, linearity and drift.
  Basic instruments used for temperature, gas and particle monitoring, chemical analysis and modern data collection methods

- **Case study based on an operational industrial system**

- **Separation techniques**
  Separation techniques and their use in the process and manufacturing industries, definitions of separation efficiency, review of the principal method

Module Code	MT 4722	Title	Construction Materials			
Credits	2.0	Hours/ Week	Lectures	1.5	Pre-requisites	-
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To introduce fundamentals of construction materials

Learning Outcomes: -

Students should have a thorough knowledge on manufacturing process, properties, selection and testing of construction materials.

Syllabus Outline: -

- **Cement**
  - Portland cement and its manufacture
  - Hydration and its development
  - Properties of Portland Cement
  - Types of Cement
- **Concrete**
  - Properties of Concrete
  - Reinforcement and pre-stressed Concrete
- **Analytical methods related to cement and concrete**
- **Timber**
  - Introduction
  - Classification of timber
  - Properties of wood
  - Preservation of timber
  - plywood
  - Engineering application and design (timber, etc).
  - Failure mechanism, Calculation procedure, Defects in timber.
- **Roofing materials**
- **Steel and other metals**
- **Composites**
- **New building materials**
- **Asphalt**
  - Composition of Asphalt
  - Properties and application of Asphalt

Module Code	MT 4732	Title	Bio Materials			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To introduce fundamentals of biomaterials and tissue engineering

Learning Outcomes

- Students should be able to understand the behaviour of different materials in contact with tissue, blood and biological fluids.
- Student should be able to demonstrate the principles of development of biological substitutes for prosthetic, diagnostic, therapeutic and storage applications without affecting the living organisms and their components.

Syllabus Outline:

- **Biomaterials for mechanical replacement of Orthopedic tissues:**
  bone, cartilage, ligament, tendon and whole joint systems.

- **Bio metals, bio ceramics, biopolymers and bio composites.**

- **Tissue mechanics and biocompatibility, mechanical behavior, degradation and host response to biomaterials.**

- **Design and manufacturing considerations for joint and tissue replacements**

Module Code	MT 4742	Title	Composites			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- to introduce the basic concept of composites and timber.

Learning Outcomes

The student will gain adequate knowledge on the

- Manufacture and design of composites
- Timber properties, timber treatment and applications.

Syllabus Outline:

- Mechanics of composite materials
- Types of composites
- Manufacture of fiber reinforced composites
- Properties of and applications of FRCs
- Failure of composites
- Designing with composites and case studies
- Introduction to nano fibres and nano composites

Module Code	MT 4772	Title	Paint Technology			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	MT 2152
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To study the essentials of paint formulations and to provide knowledge on technologies involved in paint manufacture.

Learning Outcomes

After competing this unit the students should be able to,

- Analyse different raw materials that are used in paint manufacture
- Develop and upgrade the qualities of products
- Formulate special paints to meet new requirements
- Improve efficiency in paint processing
- Test and evaluate paint properties

Syllabus Outline:

- Paint components
- Binders
- Pigments & Extenders
- Essential concepts of paint formulation
- Paint properties and their evaluation
- Types of coatings

Module Code	MT 2802	Title	Materials Science			
Credits	2.5	Hours/Week	Lectures	2.0	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide basic knowledge on structure-property relationships and degradation of materials

Outline Syllabus:

- Properties of materials
- Introduction to material failures
- Corrosion –Types, mechanisms and prevention
- Fabrication methods
- Selection of materials – basic concepts
- Selection materials – case studies

Module Code	MT 1812	Title	Engineering Materials			
Credits	2.0	Hours/Week	Lectures	1.5	Pre-requisites	None
GPA/NGPA	GPA		Lab/Tutorials	1.5		

Learning Objectives:

- To provide students of different engineering disciplines an overall general appraisal of material systems in engineering applications

Learning Outcomes:

- Students would be able to understand the basics of materials science and its applications in engineering.

Syllabus Outline:

- Review of crystal and amorphous structures, classification of engineering materials, Introduction to phase diagrams, Binary alloy phase diagrams and evolution of microstructures, iron-carbon equilibrium phase diagram, steels & cast irons, Introduction to non-ferrous metals & alloys

- Introduction to polymers, classification of polymers, thermal/electrical properties of polymers, visco-elastic behavior of polymers, Properties and applications of selected engineering polymers

- Introduction to engineering ceramics, Classification of ceramic materials, Introduction to composite materials, Introduction to nanomaterials