NED University of Engineering and Technology

Department of Materials Engineering
Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-102: Introduction to Engineering Materials	☐ SPRING ■ FALL	TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 12-01-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Introduction to engineering materials, their scope and role in industrial development, raw materials for engineering materials: their availability and demand, fundamentals of engineering materials: atomic bonding, crystal structures of metals, introduction to polymers, ceramic, composite and semiconductor materials. Processing, properties and applications of metallic, polymeric, ceramic, composite and semiconductor materials. An introduction to new breeds of engineering materials e.g., shapes memory materials, smart materials, electrical, magnetic and optical materials. Materials of aerospace and transportation industries. Laboratory activities

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Identify** basic properties based on knowledge of atomic composition and chemical bonding and structure of various materials	C1	Engineering Knowledge
CLO-2	**Solve** for atomic packing factor, unit cell and lattice parameter of different materials	C3	Problem Analysis
CLO-3	Work as an individual/team member to **express** the knowledge of engineering materials	A3	Individual and Teamwork
CLO-4	**Explain** the procedure for evaluating different materials properties	C2	Engineering Knowledge

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
ME-101 Engineering Mechanics	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 12-01-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Statics of Particles: Forces in a plane; Newton's First Law, Free body diagram; Forces in space (rectangular components); Equilibrium of a particle in space. Kinematics of Particles: Rectilinear and curvilinear motion of particles; Components of velocity and acceleration; Motion relative to a frame in translation. Kinetics of Particles: Newton's Second Law; Dynamic equilibrium; Rectilinear and curvilinear motion; Work and energy; Kinetic energy of particle; Principle of Work and Energy; Conservation of energy; Impulse and momentum; Impulsive forces and conservation of momentum; Impact, direct and oblique; Conservation of angular momentum. Rigid Bodies: Equivalent systems of forces; Principle of transmissibility; Moment of a force; Couple; Varignons Theorem. Centre of gravity of a three-dimensional body and centroid of a volume. Moments of inertia, radius of gyration, parallel axis theorem. Equilibrium of Rigid Bodies: Free-body diagram; Equilibrium in two and three dimensions; Reaction of supports and connections; Equilibrium of two-force and three-force bodies. Kinematics of Rigid Bodies: General Plane motions; Absolute and relative velocity and acceleration. Plane Motion of Rigid Bodies: Forces and acceleration; Energy & momentum; Conservation of linear and angular momentum. Friction: Laws of dry friction; Angles of friction; Wedges; Square-threaded screws; Journal & thrust bearings; Belt friction. Analysis of Structures: Internal forces & Newton's Third Law; Simple & space trusses; Joints & sections; Frames & machines. Forces in cables.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Define** different theoretical concepts related to static and dynamic equilibrium for particles and rigid bodies	C1	Engineering Knowledge
CLO-2	**Solve** problems related to force moments and equilibrium in particles and/or rigid bodies	C3	Problem Analysis
CLO-3	**Solve** problems related to kinematics and kinetics of particles and/or rigid bodies	C3	Problem Analysis
CL0-4	**Observe** the material properties, stress and strain conditions for various materials	P1	Engineering Knowledge

REMARKS (if any):

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NED University of Engineering and Technology

Department of Materials Engineering
Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
ME-104: WORKSHOP PRACTICE	☐ SPRING ■ FALL	TH ☐3 ☐2 ☐1 ■0 PR ☐3 ■2 ☐1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 12-01-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Use of carpenter's tools, Exercise in preparing simple joints, Bench fitting practice, Exercise in marking and fittings; Use of measuring instruments. Smith's forge; Exercise in bending, upsetting and swaging. Familiarizing the students with the following processes: Soldering and brazing, Welding, Heat treatment, Moulding and casting. Simple machine shop processes, such as turning, shaping, milling and sheet metal work.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	**Practice** metal working using equipment and tools as per the provided guideline	P3	Investigation
CLO-2	**Practice** wood working using equipment and tools as per the provided guideline	P3	Investigation
CLO-3	**Adopt** safety protocols as per the health safety and environment (HSE) guidelines	A4	Engineer and Society

REMARKS (if any):

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NED University of Engineering and Technology

Department of Materials Engineering
Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE PH-122: APPLIED PHYSICS	**SEMESTER** ☐ SPRING ■ FALL	**CREDIT HOURS** TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 12-01-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Introduction: Scientific notation and significant figures. Types of errors in experimental measurements. Units in different systems. Graphical Techniques (Log, semi-log & other non-linear graphs) Vectors: Review of vectors, Vector derivatives. Line & surface Integrals. Gradient of a scalar. Mechanics: The limits of Mechanics. Coordinate systems. Motion under constant acceleration, Newton laws and their applications. Galilean invariance. Uniform circular motion. Frictional forces. Work and Energy. Potential Energy. Energy conservation. Energy and our Environment. Angular momentum. Electrostatics and Magnetism: Coulombs Law. Electrostatic potential energy of discrete charges. Continuous charge distribution. Gauss's Law. Electric field around conductors. Dielectrics. Dual trace oscilloscope with demonstration. Magnetic fields. Magnetic force on current. Hall effect. Biot-Savart Law. Ampere's Law. Fields of rings and coils. Magnetic dipole. Diamagnetism, Paramagnetism and Ferromagnetism. Semiconductor Physics: Energy levels in a semiconductor. Hole concept. Intrinsic and Extrinsic regions. Law of Mass Action. P-N junction. Transistor. Simple circuits. Waves and Oscillations: Free oscillation of systems with one and more degrees of freedom Solution for Modes. Classical wave equation. Transverse modes for continuous string. Standing waves. Dispersion relation for waves. LC network and coupled pendulums. Plasma oscillations. Optics and Lasers: Harmonic traveling waves in one dimension .Near and far fields. Two-slit interference. Huygens Principle. Single-slit diffraction. Resolving power of optical instruments. Diffraction Grating. Lasers. Population inversion. Resonant cavities. Quantum efficiency. He-Ne, Ruby and CO2 lasers. Doppler effect and sonic boom. Modern Physics: Inadequacy of classical physics, Planck's explanations of black body radiation Photoelectric effect, Compton effect. Bohr theory of Hydrogen atom, Atomic spectra, Reduce mass, De- Broglie hypothesis Braggs Law, Electron microscope, Uncertainty relations Modern atomic model, .Zeeman effect, Atomic nucleus, Mass-energy relation, Binding energy, Nuclear forces and fundamental forces, Exponential decay and half-life. Radioactive equilibrium in a chain, Secular equilibrium, Nuclear stability, Radiation detection instruments, Alpha decay, Beta decay, Gamma decay attenuation Nuclear radiation hazards and safety, Medical uses of Nuclear Radiation. Fission, Energy release. Nuclear Reactors. Breeder Reactor. Nuclear Fusion.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	**DISCUSS** principle of physics; and explain the concept of classical and modern physics to solve related problems	C2	Engineering Knowledge
CLO-2	**USE** the concept of classical physics for engineering problems	C3	Problem Analysis
CLO-3	**APPLY** the concept of Modern physics to solve physical problems	C3	Problem Analysis
CLO-4	**PRACTICE** of operating equipment/tools to understand principles of physics under supervision.	P3	Engineering Knowledge

REMARKS (if any):

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NED University of Engineering and Technology

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Course Profile

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COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
HS-104: FUNCTIONAL ENGLISH	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 12-01-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Listening: Types of Listening, Problems in listening and coping strategies, Listening skills, Sub skills, Practice in Listening. Note taking: Techniques for taking notes, Note taking in different forms paragraphs (points, figures, processes, tables, graphs etc.). Vocabulary development: Enhancing current vocabulary to reflect a better usage of words in spoken and written language, Tips / strategies in vocabulary enhancement, Practice in vocabulary development. Reading: Reading skills, Sub skills, reading comprehension levels, reading
strategies, Reading practice through variety of reading texts and comprehension exercises, Beyond reading [outline, précis, speech and presentation]. Writing: Process of Writing, Informal Writing strategies. Writing Correctly: Sentence structure and punctuation, Error correction. Paragraphs: Structure, Types, Topic and the topic sentence, Unity, Adequate development and coherence in paragraphs. Essays: Types, Five paragraphs, long essays, Structure (thesis statement and the paragraphs). Short Reports: Structure, Format and types (informational and analytical). Letters: Elements, Styles, Formatting (digital letter writing), Organization and structure of the letter, Types (Routine requests and intimation, invitation, thank you and condolence letters etc.)

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	**Demonstrate** effective presentation skills in academic settings.	A3	Communication
CLO-2	**Comprehend** explicit and implicit information through reading and listening strategies.	C2	Communication
CLO-3	**Compose** drafts of various academic genres using writing processes and strategies.	C6	Communication

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Course Profile

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COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
EE-118: BASIC ELECTRICITY & ELECTRONICS	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Analysis: Series and Parallel electric circuit: kirshhoffs voltage low (ICVL) and kirshhoffs current low (KCL), voltage divider and current divider rules; series parallel circuit; Y-Delta conversion; methods of circuits analysis: mesh analysis and nodal analysis; network theorem; superposition. Theremean's Norton and Magzimum power transfer; magnetic circuits; magnetic fields, flux density, permeability, reluctance, magnetizing force, hysteresis, and ampere's circuital low; capacitor and inductors; electric field and dielectric strength; charging and discharging face of! Capacitor; capacitor types; Faraday's low of electromagnetic induction; Lent's low; charging and discharging face of an inductor. AC Analysis Poly Phase Systems: General format sinusoidal voltage and current, phase relation: average power and power factor, frequency response of basic elenients (R. L,C) rectangular and polar form conversions: series- parallel circuits with phase or diagram; mesh analysis and nodal analysis; network theorems; passive filters: law pass, high pass, pass band, stop band filters, resonance: series resonant and parallel resonate circuits, poly phase systems. Electrical Machines: Introduction to electrical machines; Transformer: basic construction, operation and types; DC Motors and Generators: construction of DC motors and generators, working principles, equivalent circuits, losses and efficiency calculations; AC motors and generators: construction of AC motors and generators, working principles, equivalent circuits, losses and efficiency calculations, power and torque curves in generators. Basic Electronics: Introduction to electronics engineering; P-N Junction: Semiconductor theory, doping and energy bands, diode models, diode data sheet understanding, diode applications (half wave, full wave and bridge rectifier, clipper and clamper); BJT and FET construction, operation and characteristic curves, introduction to Digital electronics; Comparison with Analogue electronics.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	Have understanding of basic circuit analysis law and **APPLY** them to solve various electric circuits	C3	Engineering Knowledge
CLO-2	To enable students to **USE** various techniques to **SOLVE** and analyze electric circuits and problems effectively	C3	Problem Analysis
CLO-3	Have ability to manipulate various electrical circuits **UNDER GUIDANCE** and are able to verify different network theorem experimentally	P3	Problem Analysis

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
AU-102: ENGINEERING DRAWING AND COMPUTER GRAPHICS	■ SPRING ☐ FALL	TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Engineering Drawing: Drawing equipment and the use of instruments; basic drafting techniques and standards; freehand sketching of machine and engine components; geometrical curves including plane curves: cycloid, hypocycloid, and the involutes. Intersections and development of surfaces of geometrical bodies such as prism, pyramids, cylinders and cones. Concept of working drawing of component parts of machines and engines: size, description, dimensions, and specification; limit dimensioning and geometric tolerances; limits; fits and tolerances; conventional symbols. Computer Aided Graphics: Introduction, application of computers in drafting and designing, methods for creating drawing entities, common editing features, dimensioning with variable setting, printing and plotting. The Software configuration of a graphics system; functions of a graphics package; constructing the geometry; Introduction to wire framing and solid modelling.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Draw** geometric curves, simple machine parts, sections and assembly drawings.	P3	Engineering Knowledge
CLO-2	**Interpret** working drawings	C4	Communication
CLO-3	**Use** software for simple 2D and 3D drawings.	C3	Modern Tool Usage

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COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
CY-109: APPLIED CHEMISTRY	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Gases: Gas Laws, Kinetic Gas Equation, Van der Waal's Equation, critical phenomenon, liquification of gases, specific heat (molar heat capacity). Properties of Solution & Liquids: Surface Tension, Viscosity, Osmosis, Osmotic Pressure, pH-Buffer Solution, Spectrophotometer, Basic concepts of Colloidal Chemistry, classification purification (dialysis). Thermochemistry: Chemical Thermodynamics, Hess' Law, Heat of reaction, Relation between H and U measurement of heat reaction, Bomb Calorimeter. Electrochemistry: Laws of Electrolysis, E.M.F. series, corrosion (Theories, inhibition & protection). Water and Sewage: Sources of water, impurities, hardness, water softening, purification of water for potable and industrial purposes, electrodialysis. Introduction to environmental pollution; main sources and effects. Sewage treatment. Fuels: Types of fuels, classification of fossil fuels. Metals & Alloys: Properties and general composition of metals and alloys such as Iron, Copper, Aluminum, Chromium, Zinc used in engineering field. Engineering Materials: Inorganic Engineering materials: Cement, Glass. Organic Engineering Materials: Polymers, Rubbers, Plastics, and Paints. Semiconductors and Dielectric materials.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**EXPLAIN** the concepts of physical and analytical chemistry for engineering applications.	C2	Engineering Knowledge
CLO-2	**SOLVE** problems of fluids and fuels, thermo & electrochemistry.	C3	Problem Analysis
CLO-3	**APPLY** the concepts of applied chemistry to industrial processes.	C3	Problem Analysis
CLO-4	**OPERATE** the equipment with guidance to measure physical & chemical parameters	P3	Engineering Knowledge

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Course Profile

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COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
MT-114: CALCULUS	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Set and Functions: Define rational, irrational and real numbers; rounding off a numerical value to specified number of decimal places or significant figures; solving quadratic, and rational in equalities in involving modulus with graphical representation; defination of set: set operations, venn diagrams, De-Morgan's laws, Cartesian product, relation, function and their types (Absolute value, greatest integer and combining functions). Graph of some well-known functions. Limit of Function and continuous and discontinuous functions with graphical representation. Propositional Logic: Definition of proposition, statement and argument, logical operators, simple and compound proposition various types of connectives, truth table, tautology, contradiction, contingency & logical equivalence. Boolean Algebra: Definition, Boolean function, quality, some basic theorems & proofs, to evaluate Boolean algebra, truth functions, Canonical sum of product form, Digital logic Gates & Switching circuit designs. Complex Number: Argand diagram, De Moivre formula, root of polynomial equations, curve & regions in the complex plan, slandered functions & their inverses exponential, circular & hyperbolic function.) Differential Calculus: Differentiation & Successes differentiation & its application; Leibnitz theorem. Taylor & Maclaurin theorem with remainders in Cauchy & Lagrange form, power series, Taylor & Maclaurin series, L. Hospital rule, extreme values of a function of one variable using first & second derivative test, asymptotes of a function, curvature & radius of curvature of a curve, partial differentiation, exact differential & its applications in computing errors, extreme values of a function of two variables with an without constant. Solution of non-linear equation, using Newton Raphson Methods. Integral Calculus: Indefinite integral & their computational techniques, reduction formulae, define integral & their convergence. Beta a* Gamma functions & their indefinites, applications of integration. Centre of pressure and depth of center of pressure. Solid Geometry: Coordinate Systems in three dimensions. Direction cosines & ratios, vector equation of a straight line, plane & sphere, curve tracing of a function of two & three variables.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Identify** functions and define real and complex numbers	C1	Engineering Knowledge
CLO-2	**Apply** differential and integral calculus to engineering problems.	C3	Problem Analysis
CLO-3	**Discuss** the behavior of sequence and series.	C2	Problem Analysis

REMARKS (if any):

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Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
HS-105: PAKISTAN STUDIES	■ SPRING ☐ FALL	TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

An Outline of Emergence of Pakistan: A brief historical survey of Muslim community in the sub-continent. War of Independent 1857 and After match. Sir Syed Ahmed Khan, Development of Two Nation Theory. Formation of Muslim League. Lucknow Pact. Khilafat & Non-Cooperation Movement. Political Events from 1924 to 1937. Pakistan Resolution - Struggle for Pakistan from 1940 to 1947. Emergence of Pakistan. Land of Pakistan: Geophysical conditions, Territorial situation and its importance, Natural Resources-Mineral and Water Constitutional Process: Early effects to make constitution - Problems and issues. Constitution of 1956 and its abrogation. The constitution of 1962 and its annulment. Constitutional and Political Crisis of 1971; The constitution of 1973. Recent constitutional developments. Post-Independence Development: Education in Pakistan; Planning & Development in the Field of Education. Development of Science and Technology with special reference to Engineering and Architecture. Brief survey of Pakistan Economy: Industrial and Agricultural Development. Internal and external trade. Economic planning and prospects. Cultural Development in Pakistan: Definition, Contents & Contributing factors in culture, Development of Art, Philosophy and literature. Foreign Policy: Relations with neighbors, Super powers & the Muslim World.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Understand** the historical and ideological perspectives of Pakistan and their implications for individuals and professionals in societal contexts	C2	Engineer and Society
CLO-2	**Explain** the strategic implications of international conventions and treaties applicable to Pakistan at the national and international level	C2	Lifelong Learning

REMARKS (if any):

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COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
MM-201: PHYSICAL METALLURGY	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Basic principles of chemistry & physics applied to structure of materials, especially metals & alloys. Crystal structure of materials, Space lattice, Crystal system, Unit cell, Packing density, Coordination number, Allotropy, Rotational & Reflection Symmetries, Crystal planes & direction, Crystalline defects, Twining, Phase transformations in metals, glasses and organic materials. Elementary physical chemistry of phases, phase diagrams & phase rule application, Binary system, Ternary system, Solid Solution, Interstitial solid solution & Substitutional solid solution, Factor affecting the limit of solubility, Ordered and Disordered solutions, diffusion in solids, structure of interfaces, nucleation and growth, Crystallization, solidification, Grain boundaries, Grain size, Cast structure, Segregation, Shrinkage defects, Solid state transformations, Iron -Carbon Diagram, Microstructure & properties of steel and Cast Iron, pearlitic, bainitic, massive and order-disorder transformations, precipitation. Elementary treatment of martensitic transformation, iron-carbon system, & heat-treatment of steels. Microstructure of Copper based and Aluminum based alloys and their relationship to the properties, Metallurgical Microscope, Objectives lenses and their short comings, Polarized light microscopy. Microstructure of plastics, polymers, rubbers and composites.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Discuss** fundamental concepts and properties of metals/alloys, crystal structure, phases , solid solution, diffusion, etc.	C2	Engineering Knowledge
CLO-2	**Illustrate** different type of phase diagrams for ferrous and nonferrous materials	C3	Design/Development of Solutions
CLO-3	**Apply** the knowledge of physical metallurgy to solve the related problems using quantitative and qualitative methods	C3	Investigation
CLO-4	**Use under supervision** various techniques of metallography to reveal macro and microstructures of metals	P3	Investigation

REMARKS (if any):

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Course Profile

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COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-204: ENGINEERING CERAMICS AND REFRACTORY MATERIALS	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Types and classification of engineering ceramics. Traditional ceramics, brick and tile, refractory and insulating materials, china, porcelain, enamels, abrasives, cements, coordination number, interstitial sites, solid solutions, types of transformations, silica and silicate structures, mullite and spinels, glass and glass processing, glass ceramics, Advanced structural ceramics, oxide ceramics, nitride ceramics, fracture toughness, micro crack formation, high temperature application of ceramics, processing of ceramics, shaping and binding, molding, firing, sintering. Refractories: Raw materials for refectories such as fire clay, china clay, silica materials, alumina, magnesite, dolomite, chromite, graphite, carbon materials, Zirconia, classification of refractories. Manufacturing, testing, and use of basic, neutral, acid, and specialty refractories. Relationship between physical properties of various refractories. Selection and use of refractories in materials and metallurgical industry. Application and selection methods, manufacturing of refractories for ferrous and nonferrous industrial furnaces.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	**Discuss** the raw materials used in the processing of ceramics & refractories keeping in view their environmental impact and utilization of local resources	C2	Environment and Sustainability
CLO-2	**Compare** different ceramic materials for specific application.	C4	Design/Development of Solutions
CLO-3	**Analyze** the structure- property relationship of ceramics, glasses and refractories	C4	Investigation

REMARKS (if any):

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COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-205: MECHANICS OF MATERIALS	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) ME-101: Engineering Mechanics	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Review mechanics of materials. Deformation; strain; elastic stress-strain behavior of materials; Introduction to stress-strain diagram, working stresses, unit design, Introduction to elastic and nonlinear continua. Poisson's ratio; Determination of forces in frames; Simple bending theory; general case of bending; Shear force and bending moment diagrams; Relationship between loading, shear force and bending moment. Stress; Skew (antisymmetric) bending Direct, shear, hydrostatic and complementary shear stresses; Bar and strut or column; Theory of buckling instability, Thin ring, Elementary thermal stress and strain; General stress-method. Theory of elasticity, Analytical solution of elasticity problems brittle fracture. strain energy in tension and compression. Analysis of bi-axial stresses, principal planes, principal stress-strain, stresses in thin walled pressure vessels. Mohr's circles of bi-axial stress. Torsion of circular shafts, coiled helical spring, strain energy in shear and torsion of thin walled tubes, torsion of non- circular sections. Shear centre and shear flow for open sections, General case of plane stresses, principal stress in shear stresses due to combined bending and torsion plane strain. Composite materials, Volume dilatation, Theories of Yielding, Thin Plates and Shells Stress Concentration

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	**Calculate** internal loads based on different support reaction	C3	Engineering Knowledge
CLO-2	**Correlate** the internal stresses with different external loading conditions	C4	Design/Development of Solutions
CLO-3	**Construct** the Mohr circle to find stresses in materials at different angles	C3	Modern Tool Usage
CLO-4	**Operate under supervision** different equipments and techniques to determine mechanical properties	P3	Individual and Teamwork

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology
Department of Materials Engineering
Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MT-215: DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Infinite Series: Applications of simple convergence tests such as comparison, root, ratio, Raabe's and Gauss' tests on the behaviour of series. Ordinary Differential Equations: Definitions, formation & solution. Boundary conditions. Homogeneous and Non-homogeneous linear differential equations with constant coefficients, linear equations will variable coefficients. Cauchy's & Legendre's equations. Equations of second order. System of simultaneous linear equations with constant coefficients. Numerical approximation to solutions. Solution in Series. Simple applications in Engineering. Orthogonal trajectories. Partial Differential Equations: Formation of partial differential equations. Solution of first order linear and special types of second and higher order differential equations used in Engineering problems. Various standard forms. Laplace Transformations: Elementary transformations. Shifting Theorems.

Heaviside's expansion formula. Simple applications. Complex Variables: Limit, continuity, zeros & poles, Cauchy - Reimann Equations, conformal transformations, contour integration.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	**Describe** formation of differential equations to explain physical situations	C2	Engineering Knowledge
CLO-2	**APPLY** appropriate methods to solve differential equations and complex integrals of relevant engineering problems.	C2	Problem Analysis

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology
Department of Materials Engineering
Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MY-211: METALLURGICAL THERMODYNAMICS AND KINETICS	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 11-12-2020	**APPLIED FROM BATCH** 2021

COURSE CONTENTS

Fundamentals of Thermodynamics: State functions, First law of thermodynamics, Enthalpy, Heat capacities, Second law of thermodynamics, Entropy, Gibbs and Helmholtz energies, Equilibrium conditions, Chemical potential, Maxwells relationships, Third law of thermodynamics, Enthalpy & entropy calculations, activity, Gibbs-Hemholt equation, Gibbs- Duhem equation, Measurement of heat reactions, Phase equilibria in single & multi- component systems. Behaviour of solutions, non-ideal solutions, thermodynamics of phase diagrams. Experimental Methods: Evaluating thermodynamic functions, estimation & calculation of the values of thermodynamic functions, free energy of formation, free energy diagrams. Kinetics: The Arrhenius equation, the activated complex theory, collision theory, calculation of reaction rates. Heterogeneous reactions, gas-solid reactions, liquid-solid reactions, liquid-liquid reactions at slag-metal interface, gas-liquid reactions. Kinetics of phase transformations under non-equilibrium conditions. Application: Application of the laws of thermodynamics to metallurgical processes, electrochemistry, interfacial phenomena, extraction and refining of metals, corrosion, and electrodeposition. Computational thermodynamics.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	To **explain** the thermodynamics & kinetics of phase transformations.	C2	Engineering Knowledge
CLO-2	To **apply** thermodynamic principles for extraction and refining of various metals from their ores.	C3	Problem Analysis
CLO-3	To **solve** thermodynamic problems for different materials and processes.	C3	Design/Development of Solutions

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology
Department of Materials Engineering
Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
HS-205: ISLAMIC STUDIES	■ SPRING ☐ FALL	TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2020

COURSE CONTENTS

Thematic Study of Holy Quran. 1.Basic Islamic Beleives Topics i) Tauheed: Al-Ambiya-22, Al-Baqarah-163-164 ii) Prophethood: Al-Imran-79, Al- Huda-7 Al-Maidah-3 iii) Here-After: Al-Hajj-5, Al-Baqarah-48 *Two Hadith 2. Basic Islamic Practices: Al-Mu'minun-l-ll 3. Amre-Bil-Ma'Roof Wa-Nahi Anil Munkar The Concept of Good & Evil. i) Importance & necessity of Da'Wat-e-Deen Al-Imran-llO. ii) Method of Da'Wat-e-Deen. An-Nehl-125, Al-Imran-l04 *Two Hadith 4. Unity of the Ummah: Al-Imran-l03, Al-Hujurat-l0, Al-Imran-64, AI-An'am-l08 *Two Hadith 5. Kasb-e-Halal. Taha-8l, Al-A'raf-32-33, Al-Baqarah-188 *Two Hadith. 6. Huquq-ul-Ibad: i) Protcetion of Life: AI-Maidah-32 ii) Right to Property: An-Nisa-29 iii) Right of Respect & Dignity: AI-Hujurat-11-12 iv) Freedom of Expression: AI-Baqarah-256 v) Right of Equality: AI-Hujurat-13 vi) Economic Security: AI-Ma'arij-24-25 vii) Exployment Opportunity on Merit: An-Nisa-58 viii) Excession Right to Justics: An-Nisa-135 7 .Women Rights: An-Nehl-97, AI-Ahzab-35, An-Nisa-O7 8. Relations With Non-Muslims: AI-Mumtahanah-8-9, AI-Anfal-61. Last sermon of Hajj at Arafat Translation & the important points of the sermon. 9. Serat Life of the Holv Prophet: Birth, Life at Makkah. Declaration of Prophethood, preaching & its difficulties migration to Madina. Brotherhood (Mawakhat) & Madina charter. The Holy War of the prophet (Ghazwat-e-Nabawi) Hujjat-ul- Wida. 10. Islamic Civilization: Impacts of Islamic civilization on the sub-continent. The civilization of sub- continent before Islam.The Political, Social & Moral impacts of Islamic Civilization on sub-continent. Academic, Intellectual, Social & Cultural Impacts of Islam on the World.

*N. B: As prescribed by UGC. The original Text & complete course plan may be obtained from the Department of Humanities.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Explain** the given Quranic verses and Hadiths to their tangible meaning and message.	C2	Ethics
CLO-2	**Describe** the basic concepts of Shariah, the features of Seerat-un-Nabi (SAW), and the impact of Islam on our society.	C2	Ethics

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology
Department of Materials Engineering
Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
IM-207: COMPUTER PROGRAMMING AND DRAFTING	■ SPRING ☐ FALL	TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2020

COURSE CONTENTS

Introduction: Introduction to programming concepts & languages, Compilation & Interpretation, Overview of modular programming, ASCII character set. Building Blocks: Identifiers & keywords, Data-types, Variables & Constants, Statements & Operators, Input & Output Functions. Branching Statements: Conditional branching & Looping (Counter & condition-controlled loops). Subroutine: As brief overview, Defining a subroutine, Accessing a subroutine, Passing arguments, Returning values and Recursion. Arrays & Strings: Defining an array, Referring to individual elements of an array, Processing an array, Multidimensional arrays, String handling and Manipulation, Overview of pointers. Computer Aided Drafting: Introduction, Application of computers in drafting and designing, Methods for creating drawing entities, Common editing features, Dimensioning with variable setting, Printing and Plotting.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	To **describe** basic computational concepts of programming languages (e.g. C++) and computer aided drafting for the solution of engineering problems and behaviour of fragments of programming language code	C2	Engineering Knowledge
CLO-2	**To apply** the knowledge of computer programming to write, compile and execute simple programs, showing how input data is processed, output data is produced and how the values of variables change	C3	Design/Development of Solutions
CLO-3	To **practice** simple programs/mechanical parts using Computer Programming & drafting software's.	P3	Modern Tool Usage

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology
Department of Materials Engineering
Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-202: PRODUCTION AND REFINING OF MATERIALS	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2020

COURSE CONTENTS

Ferrous Materials: Principles related to iron & steel making from ores, New trends in iron & steel making, Blast furnace chemistry, operations & productivity, Wrought Iron & sponge Iron. Direct reduction processes of iron making, Description of steel making processes, chemistry of steel making, Bessemer & electric steel making operations & productivity, Secondary steel making process, e.g., AOD, VOD, ESR, VAR. Non-conventional techniques of iron & steel making. Non-Ferrous Materials: Overview of the production and refining processes of non-ferrous materials. Extraction of of Cu, Ni, Al, Zn, Mg, Pb and Sn from ores. Pyro- and hydro- metallurgical process of refining. Special methods used for Rare earth materials. Introduction to synthesis and production processes for rubbers, plastics and composites materials.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Discuss** different parameters and raw materials used in the processing of Ferrous and non-ferrous Materials keeping in view their environmental impact and utilization of local resources.	C2	Environment and Sustainability
CLO-2	**Describe** basic chemistry and operations for production and refining of materials	C2	Design/Development of Solutions
CLO-3	**Conceptualize** the knowledge of Production and Refining through effective communication	A4	Communication
CLO-4	**Compare** appropriate and economical production and refining techniques for materials	C4	Engineer and Society

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology
Department of Materials Engineering
Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-208: FUNDAMENTALS OF MODERN MANUFACTURING AND FOUNDRY	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2020

COURSE CONTENTS

Scope and importance of manufacturing processes; Introduction to melting and casting Practice, pattern making, Tooling, equipment, machines and types of furnaces used in melting of materials, Re-melting furnaces. Selection and control of melting processes control of chemical compositions and charge calculations. Casting and fettling operations, Casting Defects, inspection and quality assurance. Classification of mechanical working processes, basic concept plastic deformation, Hot working processes: forging and its types, Extrusion and its methods, Hot spinning; Pipe welding, & piercing. Cold working processes; Squeezing, Bending, Shearing, & Drawing processes, Riveting, Coining, Peening, Angle bending, Blanking, Bar & tube drawing, Wire drawing, Embossing & Stretch forming, sheet metal forming process, rolling principles. Introduction to Non-conventional manufacturing processes. Introduction to CAD (Computer-aided design)/ CAM (Computer-aided manufacturing) technology. Secondary manufacturing process. Prototypes and experimentation. Applications of computers in manufacturing processes. Manufacturing defects causes and remedies, Cost/Volume/Profit analysis.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Comprehend** the principles of melting and casting.	C2	Engineering Knowledge
CLO-2	**Illustrate** various melting furnaces and casting techniques	C3	Investigation
CLO-3	**Contrast** different techniques required to produce component of required shape	C4	Lifelong Learning
CLO-4	Practice different manufacturing and foundry techniques under supervision	P3	Individual and Teamwork

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology
Department of Materials Engineering
Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-307: JOINING OF MATERIALS	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2020

COURSE CONTENTS

Survey of joining processes for materials. Basis of selections and use of joining processes. Introduction to welding and joining, weld defects, selection of appropriate welding process, effect of heat on metals, pre heating, stress, strain, weldability, type of joints, types of welds, filler metals, welding problems, producing good weld. Gas welding and equipments, fluxes, torch gases hoses and hose conection, torches, mixers, welding tips, regulaters clamps outfits. Arc welding, power sources, DC and AC power sources, cables, electrodes, current and circuit polarity, electrode selection, weld deposit. TIG & MIG welding; Introduction, principles, non- consumable tungsten electrodes, gas supply and equipment, and TIG joint preparation, spot welding, electrode wire, gas supply, spray metal transfer method, CO2 – MIG welding, MIG spot welding. Submerged arc and other shielded methods, equipment, current, flux, electrodes, atomic hydrogen welding, plasma arc welding electro slag welding under water shielded metals, arc welding, vapor shielded metal arc welding- CIG welding. Resistance welding, resistance spot welding, multiple spot welding, PIGME welding process, flash and upset welding, percussion welding. Thermit welding, equipment techniques, process, ignition powder removing the mold inspection. Other welding processes; laser welding, electron beam welding, pressure welding, ultrasonic welding. solders principles, Equipment, fluxes, automatic soldering systems, soldering aluminum and aluminum alloys, magnesium and magnesium alloys, brazing, equipment, copper and copper alloys, aluminum brazing, dissimilar metals joining. Methods for joining of non-metallic materials, plastic welding, adhesive bonding, bonding materials, inspection and testing of weldment Cold welding, adhesive bonding, diffusion bonding, soldering, brazing, flames, arcs, high- energy density heat sources, solidification, cracking resistance, shielding methods, and electric contacts.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	**Compare** and **contrast** modern joining techniques in relation with accessories/equipment/principles, etc.	C4	Modern Tool Usage
CLO-2	**Analyze** the physical and chemical changes occurring during joining of materials and its consequences	C4	Engineer and Society
CLO-3	Work on mini-project to **evaluate** the effect of joining processes on material properties	C5	Project Management
CLO-4	**Work under supervision** to produce different joints using various joining techniques	P3	Design/Development of Solutions

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology
Department of Materials Engineering
Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-309: CONSTRUCTION MATERIALS	■ SPRING ☐ FALL	TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 12-09-2019	**APPLIED FROM BATCH** 2020

COURSE CONTENTS

Introduction to materials in construction environment, Fundamentals of soil. Cement: Introduction, Types of Cement, Manufacturing Process, Admixtures, Hydration Process, Pozzolans, High Alumina & Slag Cement, Testing of Cement, Fine & Coarse Aggregate, Properties of Aggregate. Concrete: Introduction, Types of Concrete, Properties of fresh and harden concrete, Concrete Mix Design, Micro cracking, Stress-strain relation, Deformation of concrete, Strength and failure of concrete, Cohesion & Segregation, Effect of Temperature on Concrete, Durability of concrete. Masonry: Introduction, materials for masonry, Structural behaviour. Construction Steel: Introduction, Steel Reinforcing Bars, steel for other structural sections, weathering steel. Wood: Introduction, Sustainability of wood, Lumber, wood products. Advanced Construction materials: Fiber Reinforced Concrete, High Performing Concrete, Self-Healing Concrete. Laboratory activities.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	**Understanding** the basic concepts of all construction materials; their properties, production and processing.	C2	Engineering Knowledge
CLO-2	**Describe** the raw materials used in construction industry keeping in view their environmental impact and utilization of local resources	C2	Environment and Sustainability
CLO-3	**Compare and Contrast** various construction material keeping in view the health, safety, legal and cultural issues	C4	Engineer and Society

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-301: CORROSION: PROTECTION AND PREVENTION	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2020

COURSE CONTENTS

General concepts of corrosion applied to materials, corrosive environments, atmosphere, water, chemicals, gases, general corrosion, galvanic corrosion, oxygen concentration cell, atmospheric corrosion, chemical corrosion, corrosion in gas, types of scale, mechanism of scale protection, oxide, defect structure, oxidation rates, high temperature gas reactions, localized corrosion, pit and crevice corrosion. Mechanically assisted corrosion, stress corrosion cracking, corrosion fatigue, hydrogen damage, corrosion in ceramics and plastics, atmosphere water, chemical corrosion, corrosion prevention and protection. Chemical inhibiters, environmental control, anodic and cathodic protection, mechanical protection, coatings, anodizing, painting, corrosion resistant materials, corrosion of carbon steels, stainless steel, aluminum alloys, case studies. Corrosion of metals: simple electrochemical theory, polarisation curves, activation and concentration polarisation; Evans diagrams, Passivity, pitting, localised corrosion, Common problems: galvanic corrosion, differential aeration, crevice corrosion, Corrosion Prevention: Cathodic protection, anodic protection, inhibitors, Paint; modes of protection, inhibitive and metallic pigments, Metal coatings; action, methods of application, Anodising of aluminium. Design and materials selection.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Demonstrate** fundamental principles and knowledge of corrosion and its preventive measure keeping in view the health and safety issues	C3	Engineer and Society
CLO-2	**Solve** various numerical problems related to basic phenomenon, corrosion rate, thermodynamics and cathodic protection	C3	Problem Analysis
CLO-3	**Analyze** corrosion problem from daily life/industrial environment and propose corrective measure	C4	Environment and Sustainability
CLO-4	**Operate Under Supervision** different electrochemical and other techniques to study the corrosion behaviour of metal and cathodic protection system	P3	Modern Tool Usage

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
MM-303: INSPECTION AND TESTING OF MATERIALS	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2020

COURSE CONTENTS

Introduction to inspection and testing of materials, its scope and importance. The Brinell test, the Vicker test, the Rockwell test, the Knoop test, the Scleroscope test, conversion tables for various scales of hardness. Stress and strain, load extension diagrams, modules of elasticity, elastic limit, yield stress, proof stress, work hardening, tensile testing, (equipment and specimens). Compression testing, bend testing, torsion testing. impact testing. Toughness, brittleness and ductility, notched bar impact testing, the Charpy and Izod impact tests, brittle and ductile fractures. The fatigue test, different types of fatigue fractures, Goodman diagram, endurance limit-ultimate tensile strength. The Creep Test. Overview of the main NDT techniques of materials testing, Visual, Ultrasonic, Penetrant, Magnetic particles and x-ray, and eddy current techniques, Example in NDT of materials. Advanced techniques used for testing of plastics, rubbers, polymers and composite materials

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Compare and contrast** various DT / NDT techniques	C4	Lifelong Learning
CLO-2	**Analyze** the result of destructive and nondestructive examinations	C4	Investigation
CLO-3	**Select** an appropriate Destructive / Nondestructive testing technique for specific application	C5	Engineer and Society
CLO-4	**Operate under supervision** different DT/NDT techniques	P3	Modern Tool Usage

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-304: HEAT TREATMENT OF MATERIALS	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) MM-201: Physical Metallurgy	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2020

COURSE CONTENTS

Introduction and scope of the heat treatment processes used for materials. Review of iron carbon phase diagram, Effect of common alloying additions on the equilibrium diagram, annealing and its types, Structures of slowly cooled steels. Specialized heat treatments including full annealing, normalizing, process annealing. Oxidation and decarburization during heat treatment, Batch and continuous annealing. Quenching, tempering and hardening of steel, quenching rates and quenching media, martensitic transformation, time temperature transformation diagrams, effects of austenizing, grain size and alloying element on the transformation diagram, continuous cooling diagrams. Hardenability and its measurement, Jominy test. austempering, martempering, retained austenite, tempering of martensitic steel. secondary hardening, heat treatment of dies and tool steel, Alloy steels, HSLA steels, and stainless steels, surface hardening, carburizing, nitriding, cyaniding, carbonitriding, induction and Flame hardening, heat treatment of cast iron heat treatment of non ferrous metal and alloys, age hardening/precipitation hardening, defects caused during heat treatment and their remedies, subzero treatment.heat. Heat treatment of nonmetallic materials like polymers, plastics, rubbers and composites.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	**Compare and contrast** various heat treatment processes for different materials	C4	Design/Development of Solutions
CLO-2	**Demonstrate** the use and synthesis of information from various transformation diagrams	C3	Investigation
CLO-3	**Select** an appropriate heat treatment process to tailor microstructure for a particular application	C5	Engineer and Society
CLO-4	**Under supervision,** perform various heat treatment processes	P3	Modern Tool Usage

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
HS-304: BUSINESS COMMUNICATION AND ETHICS	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2020

COURSE CONTENTS

Part-1 Communication Skills (Oral): Definitions and Conditions. Modes:- verbal, non-verbal, vocal, non-vocal, sender, receiver, en-loding, decoding, noise, context, emotional maturity, relationships, etc. Language, perception. Non-verbal, body language, physical appearance, cultural differences etc. Personal and interpersonal skills/perceptions. Communication dilemmas and problems. Public Speaking – speaking situation, persuasion. Part-II Written Communication: Formal / Business letters. Memos (brief revision). Notice and minutes of meetings. Contracts and agreements (basic theoretical knowledge and comprehension). Research / scientific reports. Tenders (basic theoretical knowledge and comprehension). Participating in seminars, interviews, writing and presenting conference papers, solving IELTS type papers. (Non- examination). Part-III Engineering / Business Ethics: Course objective. Need for code of ethics. Type of ethics, involvement in daily life. Problems/conflicts/dilemmas in application. Review of Pakistan Engineering Council Code of Conduct.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Demonstrate** effective oral communication and interpersonal skills in simulated professional and business situations.	A3	Communication
CLO-2	**Compose** effective business messages for various purposes and audiences.	C6	Communication
CLO-3	**Apply** principles, theories, and codes of ethics in situations related to professional practice.	C3	Ethics

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
MT-315: MATHEMATICAL METHODS	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2020

COURSE CONTENTS

Solid Geometry: Rectangular Coordinate Systems in three dimension, direction cosines, plane (straight line) and sphere. Advanced Calculus: Taylor's Theorem for functions of two variables without proof. Maxima and minima of functions of two variables. Lagrange's method of multipliers. Double integration, change of order, conversion to polar form. Applications in finding areas, volumes, centroids, centre of pressure. Movement of inertia and principal axes. Theorems of Pappus and Guldinus. Surface area and volumes of revolution. Vector Calculus: Differentiation of vectors, gradient, divergence and curl. Laplacian and spherical harmonies. Vector integration. Theorems of Gauss, Green and Stokes. Simple applications. Linear Algebra & Matrices: Linearity, dependent and independent vectors, bases and dimension, vector spaces, fields, liner transformations, matrix of a linear transformation. Basic definitions and matrix operations, adjoin and inverse of a 3 x 3 matrix. Rank of a matrix. Cayley-Hamiltion Theorem, eigen values. Applications in solving linear homogeneous and non-homogeneous equations in three unknowns. Cases of existence of solution, no solution, infinite and unique solutions. Elements of Tensors: Cartesian Tensors, understanding of stress tensor and deformation.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Describe** formation of system of linear equations and solid geometry to explain physical situations	C2	Engineering Knowledge
CLO-2	**APPLY** appropriate methods to solve system of linear equations and vector calculus in relevant engineering problems.	C3	Problem Analysis

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
MM-305: POLYMER AND COMPOSITES MATERIALS	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2019

COURSE CONTENTS

Survey and classification of polymeric materials. Review of polymer chemistry, introduction to polymers, classification of polymers, polymerization, co-polymerization, structure and properties of thermoplastic and thermosetting polymers, elastomers and rubber, vulcanization, additives and fillers. Manufacturing, properties and applications of polymers, polystyrene, polybutadiene, polyester, polymethyl methylacrylate (PMMA), nylon 6:6, acrylonitrile-butadiene-styrene (ABS), silicon resin, epoxy resin, phenol- formaldehyde and other advanced polymers, forming processes, testing and identification of polymers, fibers, foams and adhesives, Plastics, conductive polymers and plastics, Introduction to Composite materials, classification characteristics, mechanical behavior potential advantages, properties and applications. Composite material design, specific stiffness and strength, and recent developments such as metal matrix composite, ceramic matrix composites, carbon fiber reinforced composite, production and processing of fibres and other reinforcements, polymeric matrix composites, processing principles and design of ply and laminate structures, filament winding and pultrusion.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Select** appropriate type of polymer/composite material and its manufacturing routes keeping in view the environment and sustainability	C5	Environment and Sustainability
CLO-2	**Compare** polymer and composite materials on the basis of their fundamental characteristics and application	C4	Investigation
CLO-3	**Solve** various numerical problems related to polymers and composite materials	C3	Problem Analysis
CLO-4	**Operate under supervision** different production techniques of polymer and composite materials and their mechanical properties analysis	P3	Modern Tool Usage

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-308: MATERIALS CHARACTERISATION AND ANALYTICAL TECHNIQUES	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S)	**DATE OF COURSE CONTENT APPROVAL**	**APPLIED FROM BATCH**
MM-201: Physical Metallurgy	06-02-2017	2019

COURSE CONTENTS

Introduction to Characterization of Materials. Microstructure investigation: Optical microscopy, interference contrast, SEM (Scanning Electron Microscope) and TEM (Transmission Electron Microscope) principles and configuration, STEM (Scanning Transmission Electron Microscope). Defect analysis, sample preparation, EPMA (Electron Probe Micro Analyzer). Atomic force microscopy. Structural characterization: Introduction to Crystallography and XRD (X-Ray Diffraction) techniques. Overview of crystal structure of materials. Symmetry, lattice directions and planes, preferred orientation and Texture. Production of X-Rays, X-Ray diffraction, Diffraction methods, X-Ray diffractometer, Stereographic projections. Chemical analysis: WDS (Wavelength Dispersive Spectroscopy) and EDS (Energy Dispersive Spectroscopy) microanalysis Surface analysis: X-ray photoelectron spectroscopy (XPS) and ion beam techniques. Thermal analysis: TGA (Thermo Gravimetric Analysis), DTA (Differential Thermal Analysis), DSC (Differential Scanning Calorimetry) and dilatometry

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Compare and contrast** various characterization and analytical techniques	C4	Investigation
CLO-2	**Select** the most promising technique for a particular situation	C5	Lifelong Learning
CLO-3	**Conclude** the results obtained from various characterization techniques in the form of report	C5	Communication
CLO-4	**Operate under supervision** the technique used to characterize various materials	P3	Modern Tool Usage

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
PF-303: APPLIED ECONOMICS FOR ENGINEERS	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2019

COURSE CONTENTS

Introduction: Engineering economy defined; Measures of financial effectiveness; Nonmonetary factors and multiple. Objectives; principles of engineering economy. The Economic Environment: Consumer and producer goods; Measures of economic worth; Price, Supply, & Demand relationship; Production; Factors of production; Laws of return. Cost Concepts Analysis: Sunk & opportunity costs; Fixed, variable, and incremental costs; Recurring & nonrecurring costs; Direct, indirect, and overhead costs; Standard costs; Breakeven analysis; Unit cost of production; Cost-Benefit analysis; Feasibility studies; Value analysis in designing & purchasing. Time Value of Money: Simple interest; Compound Interest; Cash flow diagrams; Interest formulas; Nominal versus effective, interest rates; Continuous compounding. Depreciation and Depletion: Purpose of depreciation; Types of depreciation; Economic life. What can be depreciated? Comparing Alternatives: Present economy; Selection among machines, materials, processes, and designs, Payback period method; Present worth method; Uniform annual cost method; Rate of return method; Alternatives having identical lives. Alternatives having different lives. Production Concepts & Mathematical Models: Manufacturing lead time, Production rate; Capacity; Utilization; Availability; Work in process; WIP and TIP ratios. Linear Programming: Mathematical statement of linear programming problems; Graphic solution; Simplex method; Duality problems. Capital Financing and Budgeting: Types of ownership; types of stock; partnership & joint stock companies; Banking & specialized credit institutions. Industrial Relations: Labour problems; Labour organizations; Prevention & Settlement of disputes.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Discuss** significance of economic analysis in engineering profession	C2	Engineer and Society
CLO-2	**Analyze** alternatives using economic analysis techniques to accomplish given objective.	C4	Problem Analysis

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

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Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
MG-481: ENTREPRENEURSHIP	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2019

COURSE CONTENTS

Understanding the Entrepreneurship Mind-set • The revolution impact of Entrepreneurship • The individual Entrepreneurship Mind-set • Corporate Entrepreneurship Mind-set • The Social and Ethical perspectives of Entrepreneurship Launching Entrepreneurship Ventures • Creativity and innovations • Methods to initiate ventures • Legal challenges in Entrepreneurship • The search for Entrepreneurship Formulation of Entrepreneurship • The assessment of function with opportunities • The marketing aspects of new ventures • Financial statements in new ventures • Business plan preparation for new ventures Strategies perspectives in Entrepreneurship • Strategies growth in Entrepreneurship • Valuation challenges in Entrepreneurship • Final harvest of a new venture.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Explain** basic functions and importance of entrepreneurship	C2	Lifelong Learning
CLO-2	**Value** business ethics on entrepreneurial activities.	A3	Ethics
CLO-3	**Demonstrate** the entrepreneurial skills to develop business plan.	C3	Project Management

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

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Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MT–441: ADVANCE MATHEMATICAL TECHNIQUES	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2019

COURSE CONTENTS

Complex Variable Limit, continuity, zeros and poles of a complex function. Cauchy-Reimann equations, conformal transformation, contour integration. Error Analysis Types of errors (relative, Absolute, inherent, round off, truncation), significant digits & numerical instability, flow chart. Use any Computational tools to Analysis the Numerical Solutions. Finite Difference

Functions of operators, difference operators and the derivative operators, identities. Linear homogeneous and non-homogeneous difference equations. Numerical Differentiation, Forward Difference Method, Backward Difference Method, Central Difference Method.

Interpolation & Curve Fitting Lagrange's, Newton, Hermit, Spline, least squares approximation. (Linear and non-linear curve). With numerical problem in engineering. Numerical Integration & Differentiation Computation of integrals using simple Trapezoidal rule, 1/3th Simpson's rule, 1/8th Simpson's rule, Composite Simpson's and Trapezoidal rules, computation of solutions of differential equations using (Euler method, Euler modified method, Runge Kutta method of order 4). Improper Integrals Definitions, Types of improper integral and their convergence. Elliptic Integrals Introduction and identification of elementary elliptic integrals of first, second and third kinds. Simple applications

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	**Discuss** numerical differentiation, numerical integration, and complex variable.	C2	Problem Analysis
CLO-2	**Apply** Elliptic integral and complex variable in relevant engineering problems..	C3	Engineering Knowledge
CLO-3	**Apply** numerical differentiation and numerical integration in relevant engineering problems	C3	Problem Analysis

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
MM-404: PHASE TRANSFORMATIONS IN MATERIALS	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) MY-211: Metallurgical Thermodynamics and Kinetics	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2019

COURSE CONTENTS

Phase transformation in materials. Equilibrium transformations; first order & second order, Order-disorder transitions, transformations in complex structures, Driving force for phase transformation, Free energy changes during phase transformation, Concept of Gibbs's free energy, Volume free energy, & strain free energy Critical radius. Liquid-solid transformation, Solidification, Homogeneous nucleation; surfaces & interfaces; heterogeneous nucleation; polymer crystallization; nucleation rate; planar vs. dendritic interface growth; Gibbs-Thomson effect; dendrite velocity; alloy solidification; zone-refining; constitutional supercooling; solid- solid phase transformation; Nucleation & growth, homogeneous & heterogeneous nucleation, nucleation on crystalline defects & on grain boundaries. spinodal decomposition, Transformation in the Solid-State Precipitation reactions, GP zones, Intermediate & stable precipitate, Coherency strain, Diffusion-controlled transformations. Interfacial energy-controlled transformations, e.g., transformations far from equilibrium conditions. Nano-scale particles. Diffusion less transformations. Ordered & disordered transformation, Recovery, crystallization & grain growth. Phase transformations in non-metallic materials & its effect on mechanical & physical properties. Transformations in glasses & organic materials.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Demonstrate** an understanding thermodynamic concepts related to Phase transformations	C3	Problem Analysis
CLO-2	**Solve** problems related to microstructure and phase diagram	C3	Lifelong Learning
CLO-3	**Analyze** the nucleation and growth mechanism and distribution of phases	C4	Modern Tool Usage
CLO-4	**Work under supervision** on different heat treatment processes to nucleate desired phases in materials	P3	Project Management

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-411: NANOMATERIALS AND NANOTECHNOLOGY	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2019

COURSE CONTENTS

Introduction & Scope of Nanotechnology, Units of Measurement, The Significance of the Nanoscale, Advancing beneficial nanotechnology, Nanoscale in Three Dimensions, Introduction to Molecular nanotechnology and Nanorobotics. Review of structures of Materials, Effects of Materials' Properties Change at the Nanoscale, Equipment for nano studies, tools for Characterization of Nanomaterials, Present Applications of Nanotechnology, Potential applications of Nanotechnology. Introduction to Nanoparticles, Nanomaterials and nanoproducts, Processing and Synthesis Techniques for Nanoparticles, Chemo-physical processes in nanoparticle, Lithographies. Design, production and application of Nanocomposite, devices and materials. Concept of a molecular assembly, Nobel Metal nanotechnology, Natural Nanoparticles. Carbon Nanostructures, Nanowires, Nanoindentation.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Compare and Contrast** the properties of nano structured materials with conventional materials	C4	Lifelong Learning
CLO-2	**Demonstrate** the equipment and processes available to synthesize and characterize the nanostructured materials	C3	Modern Tool Usage
CLO-3	**Carry out** necessary investigations in relation to synthesis, characterization and applications of nanomaterials	C3	Environment and Sustainability

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
MM-412: SURFACE ENGINEERING	☐ SPRING ■ FALL	TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S)	**DATE OF COURSE CONTENT APPROVAL**	**APPLIED FROM BATCH**
MM-301: Corrosion: Protection and Preventions	06-02-2017	2019

COURSE CONTENTS

Introduction to definition and types of surface, Introduction to the physics and chemistry underlying the deposition of surface coatings (films) for a variety of applications. Deposition and surface modification methods: Physical vapor deposition. Chemical vapor deposition, ALD (Atomic Layer Deposition). Methods of surface modifications. Nanostructured and nanocomposite coatings: Fundamentals of nanostructured thin films. Nanostructured coatings with enhanced chemical, mechanical and tribological characteristics. Advanced methods of surface and coating characterization: X-ray diffraction and electron microscopy. Spectroscopy. Advanced methods of surface and coating testing: Methods of contact and non-contact characterization of surface topography: Roughness. Mechanical characterization of nanofilms. Special application of surface engineering for tribological applications.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Compare and Contrast** conventional and advanced surface engineering methods for engineering applications	C4	Design/Development of Solutions
CLO-2	**Evaluate** merits and demerits of different coating processes keeping in view of the environmental concerns	C5	Environment and Sustainability
CLO-3	Work on a project to **formulate** a report to justify coating characterization/selection for a given application	A4	Project Management
CLO-4	**Operate under supervision** various euipments and techniques to determine surface properties	P3	Modern Tool Usage

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-413: NUCLEAR MATERIALS	☐ SPRING ■ FALL	TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2019

COURSE CONTENTS

Overview of Nuclear Systems, Nuclear energy, nuclear reactors. Introduction to nuclear power plant operation, nuclear fission and fusion reactions, neutron absorption cross section. Nuclear fuels: uranium, thorium, plutonium; Fuel cladding materials: Aluminum alloys, stainless steels, zirconium alloys; Reflecting materials: graphite, beryllium, moderators, light water, heavy water, graphite; Control rod materials: cadmium, boron. Overview of UO2, Irradiation hardening and embrittlement. Structural materials in nuclear power plants, overview of Materials used in nuclear power plants. Effect of radiations on properties of materials. Radiation hazards and their safety, Radiation Damage, health physics. Disposal of radioactive waste.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	**Illustrate** various types of nuclear reactors as per application , environmental impact and sustainable development	C3	Environment and Sustainability
CLO-2	**Analyze** health and safety issues in nuclear reactors and related materials	C4	Engineer and Society
CLO-3	**Select** materials for design and processing of nuclear reactors and disposal of nuclear waste, with emphasis on ethical and legal considerations	C5	Ethics

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
MM-414: TOTAL QUALITY MANAGEMENT	☐ SPRING ■ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2019

COURSE CONTENTS

Introduction to Total Quality Management. Defining quality, cost of quality, quality prizes. Standardization. Continuous improvement: 5S, Kaizen, Poka-Yoke, Six sigma, PDCA/PDSA cycle, lean manufacturing. Tools of Total quality management: statistics, seven QC (Quality Control) tools, statistical process control. Introduction to probability and its distribution. Sampling. Introduction to metrology and gauging. Introduction to industrial management and administration, Functions of Management, Project Management, Maintenance Management, Financial Management, Human Resources, Facility Location and Layout.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Apply** tools and techniques of quality management.	C3	Modern Tool Usage
CLO-2	**Compare and contrast** different quality management philosophies and frameworks.	C4	Engineer and Society
CLO-3	**Evaluate** projects using modern project management tools.	C5	Project Management
CLO-4	**Express** issue in management and their solutions with ethical consideration	A3	Ethics

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
MM-402: DESIGN AND SELECTION OF MATERIALS	■ SPRING ☐ FALL	TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2018

COURSE CONTENTS

Philosophy and practice of engineering selection of materials. Overview, the selection of materials, service conditions, materials and primary processes, secondary processes, welding, machining, thermal treatment, finishing operations, strength-to-density and modules-to-density ratios, reading and using specifications, safety and reliability, quality control and quality assurance, help from the computer, prototypes and experimentation, cost analysis for a component, the recycling and reuse of materials Selection of materials for specific applications, designing for corrosion resistant service, concept of passivity, designing for wear resistant service, designing for high temperature service and designing for high strength/weight applications. Introduction to the aluminum, copper, nickel, cobalt, stainless steel, cast irons, titanium, refractory materials, rubber, plastics, polymers and composites materials systems. Coating science and selection. Intelligent selection of materials for better design, manufacturing and performance. Case studies of real-life engineering problems and solutions.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Carry out** the process of material selection using Material property charts	C3	Engineer and Society
CLO-2	**Evaluate** the role of function, material, process, and shape during design and selection of materials	C5	Lifelong Learning
CLO-3	**Work** as a team member on a relevant project and **present** the findings.	A4	Individual and Teamwork
CLO-4	**Practice** different software tools to assist in design and selection of materials	P3	Modern Tool Usage

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Program Bachelors in Materials Engineering

Course Profile

F/QSP 11/17/01

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
MY-402: Advanced Materials	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 07-01-2022	**APPLIED FROM BATCH** 2018

COURSE CONTENTS

Introduction: Development of new breeds of engineering materials, smart materials and functionally gradient materials, biomaterials. Semiconductors, superconductors, optical and magnetic materials. **Magnetics Materials:** Classification of materials according to magnetic properties. Magnetic fields, flux density and magnetization. Magnetic materials, magnetic measurements. Magnetic properties of materials, hysteresis. Technological application, soft magnetic materials for electromagnets, hard magnetic materials, permanent magnets, magnetic recording technology. **Biomaterials:** Basic chemical and physical properties of biomaterials, including metals, ceramics, and polymers, as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

High Temperature Materials: Overview Elevated-Temperature Characteristics of Materials, Mechanical Properties at Elevated Temperatures, Corrosion at Elevated Temperatures. Processing and Properties of Superalloys. Directionally Solidifies and Single-Crystal Superalloys. Elevated-Temperature Corrosion of Superalloys. Microstructural Instabilities. Heat-Resistant Materials, Titanium Alloys, Refractory Metals and Alloys Structural Intermetallics Ceramics Carbon-Carbon Composites. Materials for Aerospace applications. Materials for nuclear applications. **Nanomaterials:** Overview of Nanomaterials and their classification. Mechanically alloyed Nanomaterials, ODS alloys, Nanostructured materials, Fuel cell Materials, Materials for Hydrogen Storage, Ceramic and Ceramic matrix composites, Metal Matrix composites. Shape memory alloys Application of Computer in Advanced materials.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Demonstrate an understanding** of properties and applications of advanced materials	C3	Engineering Knowledge
CLO-2	**Compare and Contrast p**rocessing and characterization on different types of advanced materials	C4	Investigation
CLO-3	**Solve** problems related to the design and manufacturing processes of advanced materials.	C3	Environment and Sustainability

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Program Bachelors in Materials Engineering

F/QSP 11/17/01

Course Profile

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-415: MATERIAL DEFORMATIONS AND FAILURES: MECHANISMS AND ANALYSIS	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) MM-205: Mechanics of Materials	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2018

COURSE CONTENTS

Introduction & overview of the deformation behaviours of materials, Review of types of defect/imperfections, Burgers Vectors, Dislocations in crystal structures, Forces on Dislocations, Movement of Dislocation, Critical Resolved Shear Stress, Deformation by Slip & Climb, Intersection of Dislocations, Multiplication of Dislocations. Deformation by Twinning, Stacking Faults and Grain Boundaries, Yield Point Phenomenon, Bauschinger Effect, Strengthening mechanism of materials. Stress concentration at a notch and at a crack. Plane stress and plane strain fracture toughness. Fracture toughness parameters and testing. The theoretical cohesive strength of solids. Theories of creep and fatigue fracture mechanism in ductile and brittle materials. Micro Mechanism of crack nucleation and propagation. Mechanisms of deformation of materials like polymers, rubbers, plastics and composites. Characteristics of fracture observed in ductile and brittle material. The crack opening displacement approach. The approach to failure analysis of Materials. Case Studies.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	**Demonstrate** the role of crystal structure and defects in deformation behavior of materials	C3	Problem Analysis
CLO-2	**Analyze** the role of different parameters on failure mechanism of different materials	C4	Lifelong Learning
CLO-3	**Formulate** a report on root cause analysis of a particular failure and present the findings	A4	Communication

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

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Course Profile

COURSE CODE& TITLE	**SEMESTER**	**CREDIT HOURS**
MM-416: BIOMEDICAL AND FUNCTIONAL MATERIALS	■ SPRING ☐ FALL	TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2018

COURSE CONTENTS

Introduction to biomaterials, Basic physical and chemical properties of biomaterials. Introduction to the Protein and cell structure and their interactions with biomaterial surface. Surface chemistry and physics of biomaterial. The modification of biomaterials surfaces. The Selection of biomaterials and design of artificial organs, implants, and prostheses. Biosensors, drug delivery and tissue engineering. Introduction to Functional materials. Designing and selection of functional materials. Specific properties of functional materials. Shape memory metals, Chromogenic materials, Magnetic material, environmental sensitive polymers, Conducting thermoplastics and Smart ceramics

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Demonstrate** the basic knowledge of naturally occurring sustainable biomedical materials	C3	Environment and Sustainability
CLO-2	**Evaluation** of biomedical materials as per ethical issues, and functional materials as per applications	C5	Ethics
CLO-3	**Synthesize** of the biomaterials and functional materials by applying knowledge and skills	C6	Lifelong Learning

REMARKS (if any):

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Course Profile

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
IM-417: HEALTH, SAFETY AND ENVIRONMENT	■ SPRING ☐ FALL	TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 06-02-2017	**APPLIED FROM BATCH** 2018

COURSE CONTENTS

Safety Management: Understanding accident and hazard, Hazard control and loss control, Company policy and management responsibilities, Direct and indirect cost, Accident causes and their control, Principles and processes of lost control, Knowledge of existing safety codes and standards. Accident Prevention and Control: Fire safety, Electrical Safety, Safety in boilers and unfired pressure vessels and high pressure systems, Safety in material handling and storage, Safety in production operations (hand portable power tools, Wood working machinery, welding and cutting, metal working machinery, cold and hot forming of metals, automated lines system and processes). Process Safety Management: Development of facility operation and procedures, Analysis of process hazard, Permit to work systems, Hazard communication (Material safety data sheet), Chemical inventory record, Accident reporting and investigation, Ensuring mechanical integrity, Industrial Hygiene and Workers Protection: Understanding industrial hygiene, various hazards encountered in workplace, Types of personal protective equipment (PPE), Availability in market their design standards and selection criteria. Environment Management: Environment pollution, Air emission management, Waste management, Waste water treatment and control, Soil and ground water protection, Introduction to Pakistan Environment Protection Act 1997 and National Environmental Quality Standards, Key elements of ISO 14000 machinery, cold and hot forming of metals, automated lines system and processes). Process Safety Management: Development of facility operation and procedures, Analysis of process hazard, Permit to work systems, Hazard communication (Material safety data sheet), Chemical inventory record, Accident reporting and investigation, Ensuring mechanical integrity, Industrial Hygiene and Workers Protection: Understanding industrial hygiene, various hazards encountered in workplace, Types of personal protective equipment (PPE), Availability in market their design standards and selection criteria. Environment Management: Environment pollution, Air emission management, Waste management, Waste water treatment and control, Soil and ground water protection, Introduction to Pakistan Environment Protection Act 1997 and National Environmental Quality Standards, Key elements of ISO 14000.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	**Define** and Explain the fundamentals of Health and safety based on OHSAS 18000 or other equivalent standards applied in different workplace environment.	C2	Engineering Knowledge
CLO-2	**Apply** the ISO 14000 or equivalent standards to the real-world problem.	C3	Environment and Sustainability
CLO-3	**Comply** with the OHSAS 18000 or equivalent standard to analyze the hazardous conditions and practices to implement effective hazard control strategies in workplace environment.	A3	Lifelong Learning
CLO-4	**Exhibit** the proper use of safety instruments/equipment and Personal Protective Equipment (PPE) as per defined standard	P3	Individual and Teamwork

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	in the workplace environment.		

REMARKS (if any):

Recommended by: _____
(Chairperson/Date)

Approved by: _____
(Dean/Date)

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Course Profile

COURSE CODE& TITLE	SEMESTER	CREDIT HOURS
MY-411: VACUUM METALLURGY	☐ SPRING ■ FALL	TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 07-01-2022	**APPLIED FROM BATCH** 2018

COURSE CONTENTS

Vacuum principles, their Importance, classification and application in the metallurgical field, Different units of measuring pressure vacuum regimes, mean free path, collision frequency. Vacuum pumps: Water pumps, positive displacement pumps, rotary and roots pump, vapor ejector and vapor entrainment pumps, diffusion pump, turbo-molecular pump, introduction to vacuum measuring devices, Vacuum degassing Plant and Different techniques, Electron Beam Melting and Casting, Production of Nickel Titanium Alloys by Electron beam Technique, Vacuum arc Skull Melting and Casting, Button Melting, Drip Melting of Refractory metals, Continuous Flow Melting, Introduction to Vacuum in Scanning Electron Microscopy, Introduction to the Mass Spectrometer, Vacuum Sintering, Physical Vapor deposition, Chemical vapor deposition Synthesis of Graphene, Vacuum Heat treatment. vacuum coating

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
CLO-1	To **demonstrate** basics of vacuum physics and different vacuum levels.	C-3	Engineering Knowledge
CLO-2	To **analyze** importance of vacuum in metallurgical processes.	C-4	Problem Analysis
CLO-3	To **evaluate** various vacuum parameters for characterization techniques.	C-6	Investigation

REMARKS (if any):

Recommended by: _____
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Approved by: _____
(Dean/Date)

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Course Profile

COURSE CODE& TITLE MY-412: METALLURGY OF ADVANCED STEEL	**SEMESTER** ☐ SPRING ■ FALL	**CREDIT HOURS** TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) N/A	**DATE OF COURSE CONTENT APPROVAL** 07-01-2022	**APPLIED FROM BATCH** 2018

COURSE CONTENTS

Ni steel, Cr steel, Ni-Cr steel , Mn- Steels, Steel containing, MO, V, W, B, Si, Cu, Reconstructive, Displacive and diffusion less transformation product in steel, characteristics and microstructural of phases, High strength low Alloy (HSLA) steels, Advanced High Strength Steels (AHSS), Dual Phase (DP), Transformation Induced Plasticity (TRIP), Twinning Induced Plasticity (TWIP), Ferrite Bainitic, Other HSLA-micro alloyed steels, stainless steels, duplex steels, Martensitic-Stainless steel, Maraging steels, Bainitic steel, Thermomechanical processing, advantages and limitations, TMT and Thermomechanical Controlled Processing (TMCP) and steels, IF (interstitial-free) and ultra-low carbon steels for structural and automotive applications, ultra-low-carbon bainitic steels (ULCB),orthopedic steels, duplex and super duplex, corrosion stainless steels, tool steels, die steels, Steels for low to moderate temperature applications for nuclear and thermal power plants, heat-resistance steels.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	**CLOs**	**Taxonomy level**	**Programme learning outcome (PLO)**
At the end of the course, the student will be able to:			
CLO-1	To **use** the advanced steel making techniques in order to achieve various characteristics for betterment of steel sector.	C-3	The engineer and society
CLO-2	To **compare** advanced steels for specific engineering application.	C-4	Environment and sustainability
CLO-3	To **propose** alloying elements, heat treatment, strengthening mechanism and their stability for the use in intended engineering application.	C-5	Project management

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)