NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-105: INTRODUCTION TO ENGINEERING MATERIALS	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 26-05-2025	APPLIED FROM BATCH: 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure SDG 7 Affordable and Clean Energy

Introduction to engineering materials, their scope and role in industrial development. Classifications and life cycle of materials. The life cycle of materials 3Rs (reduce, reuse, recycle), materials (structure-processing-properties-performance relationship) tetrahedron, Atomic Arrangement and Atomic Movement, atomic bonding, crystal structure, Packing sequences in crystals, Atomic Packing Factor, and Miller indices (plane and direction). Imperfections in atomic arrangement: 0D Defects, Imperfections in atomic arrangement: 1D - 3D Defects, Fundamentals and mechanism of diffusion, Diffusion equations and factors controlling diffusion Properties of Materials, Introduction to properties, Mechanical properties, Elastic behavior of materials, Mechanical properties, Plastic behavior of materials, Mechanical properties, Bend test and hardness test of materials, Yielding in crystals, Strengthening mechanisms, Failure of Materials in Service, Fracture of materials, Fatigue and creep failure of materials, Controlling Structure and Properties of Materials.

Classification, Properties, and processing of metals, ceramics, polymers and semiconductors. Material processing (Manufacturing, casting, joining, heat treatment)

An introduction to advanced materials, e.g., shape memory materials, biomedical applications, smart & functional materials, electrical, magnetic and optical materials. Materials for energy storage, photovoltaics (Organic and Inorganic), and for batter applications, Laboratory activities

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Classify** engineering materials (metals, ceramics, polymers, semiconductors) and relate their properties to processing techniques.	C1	PLO-1 Engineering Knowledge
CLO-2	**Understand** atomic structures, crystal systems, atomic packing factor, and Miller indices.	C1	PLO 2- Problem Analysis
CLO-3	**Describe** the characteristics and applications of advanced and functional materials	C2	PLO 6- The Engineer & the World

REMARKS

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE ES-108: IDEOLOGY & CONSTITUTION OF PAKISTAN	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 4 Quality Education

COURSE CONTENTS

Two-Nation Theory Nation and Nationalism in British India. Inclusive nationalism, Exclusive nationalism, Freedom movement in British India, Two-Nation Theory, Ideology: definition and its significance, Difference between Philosophy, Ideology, and Theory. Evolution of Islamic ideology in British India. Pakistan movement: role of ideology. Ideological factors that shaped the Constitution(s) of Pakistan (Objectives Resolution 1949). Introduction to the Constitution of Pakistan, Definition and importance of a constitution. First Constituent Assembly of Pakistan. Main issues that delayed the Constitution-making in Pakistan. Dissolution of the Constituent Assembly. Second Constituent Assembly of Pakistan. Third Constituent Assembly of Pakistan, Constitution and State Structure, Federal form of State. Parliamentary form of government. Structure of Government (executive, legislature, and judiciary). Distribution of powers between federal and provincial governments, Fundamental Rights, Principles of Policy, and Responsibilities, Duty of the citizens of Pakistan (Article 5). Overview of fundamental rights to citizens of Pakistan guaranteed by the Constitution 1973 (Articles 8-28). Overview of Principles of Policy (Articles 29-40).

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 students are able to			
CLO-1	Analyze the historical evolution of the Islamic ideology in British India and critically **evaluate** its influence on the freedom movement and the basic principles of the constitution of Pakistan	C-6	**PLO6 - The Engineer and the World**
CLO-2	**Explain** the foundational concepts of the Constitution of Pakistan, including the structure of the state, system of governance, key institutions, fundamental rights, and civic responsibilities of citizens.	C-2	**PLO 11- Lifelong learning**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **PF-101: IT FUNDAMENTALS AND APPLICATIONS**	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 26-05-2025**	**APPLIED FROM BATCH: 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))
SDG 9 Industry, Innovation, and Infrastructure

Fundamentals of IT: Introduction to Information and Communication Technologies (ICT), Components and scope of ICT, ICT productivity tools, Emerging technologies and future trends, Ethical Considerations in Use of ICT Platforms and Tools, Applications of ICT in education, healthcare and finance. Digital citizenship.

Data Representation and Number Systems: Binary, octal, decimal, hexadecimal systems, data representation: characters, numbers, multimedia.

Databases: Fundamentals of databases, organization and storage, introduction to Information Systems (IS) and Management Information Systems (MIS), real world IS and MIS applications.

Data Communication and Computer Networking: Network topologies, types of network

Programming Languages: Evolution and structures: syntax, semantics, special purpose vs. general-purpose languages, comparative study of data types, control structures and algorithms, basics of coding, practical problem solving.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Describe** fundamental concepts in information technology and data management	**C2**	**PLO-1 Engineering Knowledge**
CLO-2	**Apply** programming constructs to solve complex problems using a modern high-level language	**C3**	**PLO- 5 Tool Usage**
CLO-3	**Practice** the application of ICT tools and computer programming in a laboratory environment	**C3**	**PLO -5 Tool Usage**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MT-116 CALCULUS & ANALYTICAL GEOMETRY	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 4 Quality Education

Set and Functions: Define rational, irrational and real numbers; rounding off a numerical value to specified value to specified number of decimal places or significant figures; solving quadratic, and rational inequalities in involving modulus with graphical representation; Definition 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 functions and continuous and discontinuous functions with graphical representation.

Differential Calculus: Differentiation and Successive differentiation and its application: Leibnitz theorem. Taylor and Maclaurin theorems with remainders in Cauchy and Lagrange form, power series. Taylor and Maclaurin series, L' Hopitals rule, extreme values of a function of one variable using first and second derivative test, asymptotes of a function, curvature and radius of curvature of a curve, partial differentiation, extreme values of a function of two variables with and without constraints. Solution of non-linear equation, using Newton Raphson method.

Integral Calculus: Indefinite integrals and their computational techniques, reduction formulae, definite integrals and their convergence. Beta and Gamma functions and their identities, applications of integration relevant to the field.

Sequence & Series: Sequence, Infinite Series, Application of convergence tests such as comparison, Root, Ratio, Raabe's and Gauss tests on the behaviour of series.

Analytical Geometry: Review of vectors, scalars and vector products, Three-dimensional coordinate system and equation of straight line and plane and sphere, curve tracing of a function of two and three variables, surface revolutions, coordinate transformation.

Complex Number: Argand diagram, De Moivre formula, root of polynomial equations, curve and regions in the comp plane, standard functions and their inverses (exponential, circular and Hyperbolic functions).

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Solve** real and complex numbers problems.	C3	PLO-2 Problem Analysis
CLO-2	**Apply** calculus and analytical geometry to engineering problems.	C3	PLO-2 Problem Analysis
CLO-3	**Carry out** calculations to discuss the behavior of sequence and series.	C3	PLO-2 Problem Analysis

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **PH-129: 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 **26-05-2025**	APPLIED FROM BATCH: 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

Vectors & Mechanics: Review of vectors, Newton Laws and their Applications, Frictional Forces and determination of Co-efficient of Friction, Work-Energy Theorem, applications of law of Conservation of Energy, Angular Momentum, Centre of Mass.

Waves and Oscillations: Simple Harmonic Oscillator, Damped Harmonic Oscillation, Forced Oscillation and Resonance, Types of Waves and Superposition Principle

Optics and Lasers: Huygens Principle, Two-slit interference, Single-Slit Diffraction, Types of Lasers, Applications of Laser.

Modern Physics: Planck's explanations of Black Body Radiation Photoelectric Effect, De-Broglie Hypothesis, Electron Microscope, Atomic structure, X-rays, Radioactive Decay and Radioactive Dating, Radiation Detection Instruments

Electrostatics and Magnetism: Electric field due to different Charge Distribution, Electrostatic Potential Applications of Gauss's Law, Lorentz Force Ampere's Law, Magnetism, Magnetization, Magnetic Materials.

Electrical Elements and Circuits: Review of electric current, voltage, power, and energy, Ohm's law, inductance, capacitance, Basic Electrical circuits, Electromechanical systems.

Semiconductor Physics and Electronics: Energy levels in a Semiconductor, Hole concept, P-N junction, Diodes, Transistors, Basic Electronic circuits (e.g. rectifier).

Thermodynamics: Review of Laws of Thermodynamics, conduction, convection, and radiation. Thermal conductivity, specific heat, and overall heat transfer coefficients. Heating, Ventilation and Air Conditioning (HVAC).

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**DISCUSS** principle of physics; and explain the concept of classical and modern physics to solve related problems	**C2**	**PLO-1 Engineering Knowledge**
CLO-2	**USE** the concept of Classical Physics for engineering problems	**C3**	**PLO -2 Problem Analysis**
CLO-3	**APPLY** the concept of Modern Physics to solve physical problems	**C3**	**PLO-2 Problem Analysis**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MT-221: LINEAR ALGEBRA AND ORDINARY DIFFERENTIAL EQUATION	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS: Linearity and linear dependence of vectors, basis, dimension of a vector space, field matrix and type of matrices (singular, non- singular, symmetric, non- symmetric, upper, lower, diagonal), Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix, determination of consistency of a system of linear equation using rank, matrix of linear transformations, eigen value and eigen vectors of a matrix, Diagonolization. Applications of linear algebra in relevant engineering problem. Basic concept: Formation of differential equations and solution of differential equations by direct integration and by separating the variables: Homogeneous equations and equations reducible to homogeneous from; Linear differential equations of the order and equations reducible to the linear form; Bernoulli's equations and orthogonal trajectories: Application in relevant Engineering. Special types of IInd order differential equations with constant coefficients and their solutions: The operator D; Inverse operator I/D; Solution of differential by operator D methods; Special cases, Cauchy's differential equations; Simultaneous differential equations; simple application of differential equations in relevant Engineering. Basic concepts and formation of partial differential equations: Linear homogeneous partial differential equations and relations to ordinary differential equations: Solution of first order linear and special types of second and higher order differential equations; D' Alembert's solution of the wave equation and two-dimensional wave equations: Lagrange's solution; Various standard forms. Periodic functions and expansion of periodic functions in Fourier series and Fourier coefficients: Expansion of function with arbitrary periods. Odd even functions and their Fourier series; Half range expansions.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme Learning outcome (PLO)
CLO-1	**Describe** formation of differential equations and system of linear equations to explain physical situations.	C-2	**PLO-1 Engineering Knowledge**
CLO-2	**Apply** appropriate methods to solve differential equations and systems of linear equations of relevant engineering problems.	C-3	**PLO-2 Problem Analysis**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE EE-124: BASIC ELECTRICITY AND ELECTRONICS	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

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)
CLO-1	Understanding of basic circuit analysis law and **Appl**y them to solve various electric circuits	C-3	**PLO-1 Engineering Knowledge**
CLO-2	To enable students to **Use** various techniques to Solve and **analyze** electric circuits and problems effectively	C-4	**PLO-2 Problem Analysis**
CLO-3	Have ability to manipulate various electrical circuits **Under guidance** and are able to verify different network theorem experimentally	P-3	**PLO-2 Problem Analysis**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **ES-105: PAKISTAN STUDIES**	SEMESTER □ **SPRING** ■ **FALL**	CREDIT HOURS TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S)	**DATE OF COURSE CONTENT APPROVAL** **26-05-2025**	**APPLIED FROM BATCH**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))
SDG 02 Zero Hunger
SDG- 16 Peace, Justice and Strong Institution

COURSE CONTENTS

Historical and Ideological Perspective of Pakistan Movement Two Nation Theory, Factors leading to the creation of Pakistan, Jinnah and demand for Pakistan.

Land of Pakistan Geophysical conditions of Pakistan, Geopolitical and strategic importance of Pakistan, Natural resources of Pakistan: mineral, water and power resources.

Constitutional process Early efforts to make a constitution (1947-1956), Salient features of the Constitution of 1956, 1962, Political and Constitutional crisis of 1971, Salient features of the Constitution of 1973, Constitutional amendments from 1973 to date.

Contemporary issues of PakistanA brief Survey of Pakistan's economy, The Current Economic Situation of Pakistan: Problems & Issues and future perspective, Social Issues: Pakistan's society and culture: broad features, Literacy and education in Pakistan: problems and issues, Scientific and technical development in Pakistan, Citizenship: national and international. Environmental Issues: Environmental pollution: causes, hazards and solutions, National policy, International treaties, conventions and protocols.

Pakistan's Foreign Policy Pakistan's Foreign Policy from 1947 to present, Relations with immediate neighbors, Relations with major powers, Relations with the Muslim world.

Human Rights Conceptual foundations, Western and Islamic perspective of Human Rights, Human Rights in the Constitution of 1973, Human rights issues in Pakistan.

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:			
01	Explain the historical and ideological foundations of the Pakistan Movement and assess its contemporary relevance in both regional and global contexts.	**C-2**	**PLO-6 The Engineer and the world**
02	Discuss key issues related to Pakistan's natural resources, economy, governance, and climate change, and propose viable solutions to address these challenges	**C2**	**PLO-6 The Engineer and the world**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **ES-127: PAKISTAN STUDIES (FOR FOREIGNERS)**	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** **26-05-2025**	**APPLIED FROM BATCH**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 02 Zero Hunger

SDG- 16 Peace, Justice and Strong Institution

COURSE CONTENTS

Land of Pakistan: Land & People-Strategic importance- Important beautiful sights, Natural resources.

A Brief Historical Background: A brief Historical survey of Muslim community in the sub-continent, British rule & its impacts, Indian reaction, Two nation theory, Origin & development, Factors leading towards the demand of a separate Muslim state, Creation of Pakistan

Government & Politics in Pakistan: Constitution of Pakistan, A brief outline, Governmental structure, Federal & Provincial, Local Government Institutions, Political History, A brief account.

Pakistan & the Muslim World: Relations with the Muslim countries

Language and Culture: Origins of Urdu Language, Influence of Arabic & Persian on Urdu Language & Literature, A short history of Urdu literature

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:			
1	Describe the historical, ideological, socio-economic, and political aspects of Pakistan as a nation and state.	C2	**PLO-6 The Engineer and the world**
2	Discuss Pakistan's culture, issues, and challenges through appropriate actions and advocacy	C2	**PLO-6 The Engineer and the world**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE CY-100: ESSENTIALS OF CHEMISTRY	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 26-05-2025	APPLIED FROM BATCH 2023 onwards

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))
SDG 9 Industry, Innovation, and Infrastructure
SDG 13 Climate Action

Stoichiometry: Significant figures, mole and Avogadro number, empirical and molecular formulas, stoichiometry yield (theoretical and practical)
Atomic Structure and Bonding: Subatomic particles, Rutherford's and Bohr's atomic models, quantum numbers, electronic configuration, chemical bond, theories of covalent bond, shapes of molecules.
States of Matter: Kinetic molecular theory, gas laws, liquid properties, types of solids, types of crystals
Acid, Base and Salt: Theories of acids and bases, buffer solutions
Solutions and Colloids: Properties and types of solutions, concentration units, colloids, and its classification
Electrical Conductance: Redox reaction with balancing concept, electrode, electrode potential, and electrochemical series, corrosion
Organic Chemistry: Organic compounds and their classification, homologous series, functional groups, nomenclature of organic Compounds.
Inorganic Chemistry: Periodic classification of elements, periodic laws, group trends of various properties of s and p block elements, general characteristics of transition elements, IUPAC nomenclature of complexes.

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** the classification, periodic behavior, and nomenclature of organic, inorganic, and coordination compounds.	C2	**PLO-1 Engineering Knowledge**
CLO 2	**Explain** concepts of general chemistry stoichiometry, atomic structure, bonding, states of matter, acid-base theories, solutions, redox reactions, and electrochemistry for theoretical and practical problems.	C2	**PLO-2 Problem Analysis**
CLO 3	**Operate** the equipment with guidance to measure physical and chemical parameters	P3	**PLO-1 Engineering Knowledge**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-211: JOINING OF MATERIALS	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 26-05-2025**	**APPLIED FROM BATCH: 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))
SDG 9 Industry, Innovation, and Infrastructure

Introduction to Joining Processes and Classification. Fusion Welding Processes: Fusion Welding: Gas welding: Arc Welding Processes; Resistance Welding processes; Special Welding processes (Classification, Equipment, PPE, Testing and Defects) Solid State Joining: Brazing, Soldering, Adhesive Bonding, Friction stir welding, Laser, Plasma Classification, Equipment, PPE, Testing and Defect)

Advanced Welding: hydrogen welding, plasma arc welding electro slag welding under water shielded metals, arc welding, vapor shielded metal arc welding. Resistance welding, resistance spot welding, multiple spot welding, flash and upset welding, percussion welding. Thermite welding, equipment techniques Other Joining Processes: Mechanical Joints (Temporary and Permanent joints) Non-metallic Joining: Plastic welding, adhesive bonding, bonding materials, inspection and testing of weldment Cold welding, adhesive bonding, diffusion bonding, Joining of Polymers, Joining of Ceramics (Classification, Equipment, PPE)

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Describe** and compare fusion and non-fusion techniques, including equipment, safety measures (PPE), testing, and defect analysis.	**C2**	**PLO-1 Engineering Knowledge**
CLO-2	**Identify** and differentiate mechanical joining methods (permanent and temporary) used in engineering applications.	**C1**	**PLO-2 Problem Analysis**
CLO-3	**Apply** appropriate testing methods for evaluating joint quality and identifying defects in various joining processes.	**P1**	**PLO-4 Investigation**

REMARKS

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-210: MECHANICS IN MATERIALS ENGINEERING**	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 26-05-2025**	**APPLIED FROM BATCH: 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))
SDG 9 Industry, Innovation, and Infrastructure

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.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Apply** the laws of mechanics of Materials to determine stresses and strain in structures	**C3**	**PLO-1 Engineering Knowledge**
CLO-2	**Estimate** the elastic and plastic properties of materials in the given data	**C4**	**PLO-3 Design/Development of Solutions**
CLO-3	**Compute** shear and bending moment diagram for given conditions.	**C3**	**PLO-5 Tool Usage**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-201: PHYSICAL METALLURGY**	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** **26-05-2025**	**APPLIED FROM BATCH: 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

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)
CLO-1	**Discuss** fundamental concepts and properties of metals/alloys, crystal structure, phases, solid solution, diffusion, etc.	**C2**	**PLO-1 Engineering Knowledge**
CLO-2	**Illustrate** different type of phase diagrams for ferrous and nonferrous materials	**C3**	**PLO-3 Design/Development of Solutions**
CLO-3	**Apply** the knowledge of physical metallurgy to solve the related problems using quantitative and qualitative methods	**C3**	**PLO-4 Investigation**
CLO-4	**Use** under supervision various techniques of metallography to reveal macro and microstructures of metals	**P3**	**PLO-4 Investigation**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-212 ENGINEERING CERAMICS & GLASSES	SEMESTER ☐ SPRING ■ FALL	CREDIT HOURS TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) MM-105	DATE OF COURSE CONTENT APPROVAL 26-05-2025	APPLIED FROM BATCH: 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

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)
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	PLO-6 The Engineer and the World
CLO-2	**Compare** different ceramic materials for specific application.	C4	PLO-3 Design/Development of Solutions
CLO-3	**Analyze** the structure- property relationship of ceramics, glasses and refractories	C4	PLO- 4 Investigation

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **PF-301: PROFESSIONAL ETHICS**	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** **26-05-2025**	**APPLIED FROM BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 02 Zero Hunger

SDG- 16 Peace, Justice and Strong Institution

Introduction to Ethics. Professional Ethics, Engineering Ethics, Business Ethics: Ethics and Professionalism. Need and Scope of Engineering and Professional Ethics, Development of Engineering Ethics, Major issues in Engineering & Professional Ethics. Ethical Dilemma. Resolving Ethical Dilemmas and Making Moral Choices, Techniques to resolve issues, Codes of Ethics, Codes of local and international professional bodies including PEC, Ethical Theories, Utilitarianism, Rights Ethics and Duty Ethics, Moral Theories: Virtue Ethics Self- Realization & Self Interest, Ethical Problem Solving Techniques: Line drawing, flow Charting, Conflict Problems, Professional Responsibilities, Risk and Safety as an Ethical Concern for Engineers, Workplace Responsibilities and Ethics: Teamwork. Confidentiality and Conflicts of Interest. Whistleblowing, Bribe and Gift, Risk and Cost-Benefit Analyses. Gender Discrimination and Sexual Harassment Environmental Ethics. Plagiarism. Hacking. Spamming. Academic and Research Integrity, Honesty: Truthfulness, Trustworthiness.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Discuss** the contemporary frameworks of professional and engineering ethics in the light of ethical theories and dilemmas.	**C2**	**PLO-7 Ethics**
CLO-2	**Apply** principles, theories, and codes of ethics in situations related to professional practice.	**C3**	**PLO-7 Ethics**
CLO-3	**Value** continuous professional development, ethical practices, and an aspirational mindset for personal and collective growth in engineering, fostering lifelong learning.	**A3**	**PLO-11 Lifelong Learning**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE PF-201: CIVICS AND COMMUNITY ENGAGEMENT	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 26-05-2025	APPLIED FROM BATCH: 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 02 Zero Hunger

SDG- 16 Peace, Justice and Strong Institution

SDG-05 Gender Equality

Introduction to Civics and Citizenship: Definition of civics, citizenship, and civic engagement, Historical evolution of civic participation, Types of citizenship: active, participatory, digital etc., The relationships between democracy and citizenship

Civics and Citizenship: Concepts of civics, citizenship, and civic engagement, Foundations of modern society and citizenship, Types of citizenship: active, participatory, digital, etc

State, Government and Civil Society: Structure and functions of government in Pakistan, The relationship between democracy and civil society, Right to vote and importance of political participation and representation.

Rights and Responsibilities: Overview of fundamental rights and liberties of citizens under Constitution of Pakistan 1973, Civic responsibilities and duties, Ethical considerations in civic engagement (accountability, non-violence, peaceful dialogue, civility, etc.)

Community Engagement: Concept, nature and characteristics of community, Community development and social cohesion, Approaches to effective community engagement, Case studies of successful community driven initiatives.

Advocacy and Activism: Public discourse and public opinion, Role of advocacy in addressing social issues, Social action movements.

Digital Citizenship and Technology: The use of digital platforms for civic engagement., Cyber ethics and responsible use of social media, Digital divides and disparities (access, usage, socioeconomic, geographic, etc.) and their impacts on citizenship.

Diversity, Inclusion and Social Justice: Understanding diversity in society (ethnic, cultural, economic, political etc.), Youth, women and minorities' engagement in social development, Addressing social inequalities and injustices in Pakistan, Promoting inclusive citizenship and equal rights for societal harmony and peaceful co-existence.

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Explain** the concepts of civics and community engagement for individuals and groups recognizing civil rights, responsibilities, ethics and diversity for a better society	C2	PLO-6 Engineer and the World
CLO-2	**Recognize** the importance of diversity and inclusivity for long-term societal harmony and peaceful co-existence	A3	PLO-11 Lifelong Learning

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-213: MATERIALS THERMODYNAMICS**	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 **26-05-2025**	APPLIED FROM **BATCH: 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Introduction to Materials Thermodynamics, concept of system and surroundings, extensive and intensive properties. First Law of Thermodynamics, concept of Enthalpy, calculation of heat of reactions, concept of heat capacity and its variation with temperature, Kirchoff's equation and its applications in the calculation of heat of reaction at high temperatures. Concept of Entropy, Second Law of thermodynamics, Reversible and spontaneous processes, Third law of thermodynamics, calculation of entropy of elements and reactions at various temperatures.

Free-energy, and the concept of driving-force behind a chemical or physical reaction,

Equilibrium constant, Le-Chatlier's Principle, Factors affecting the equilibrium position, Relationship of equilibrium constant with free energy, Calculations of equilibrium partial pressures. Ellingham diagrams and their application to commercially important reactions Behavior of solutions, concept of activity, ideal and non-ideal solutions, Raoult's and Henry's Law, Free energy of mixing, Gibbs Phase Rule, Clausius Clapeyron Equation, Concept of diffusion, Phase diagrams. Introduction to electrochemistry, Chemical and electrical driving force, EMF, determination of thermodynamic properties from electrochemical data.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Describe** the basic terms and laws related to thermodynamics	**C1**	**PLO-1 Engineering Knowledge**
CLO-2	**Calculate** enthalpy/entropy of reaction, heat capacity and Gibbs free energy	**C3**	**PLO-2 Problem Analysis**
CLO-3	**Analyze** the feasibility of various reactions and phase transformations using Ellingham and Binary Phase diagrams	**C4**	**PLO-2 Problem Analysis**
CLO-4	**Practice** different manufacturing and foundry techniques under supervision	**P3**	**PLO-8 Individual and Collaborative Team Work**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-202: PRODUCTION AND REFINING OF MATERIALS	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 26-05-2025	APPLIED FROM BATCH: 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure SDG-12 Responsible Consumption & Production

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 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. Chemical Methods of reduction, Recycling of Materials: Metals, wood, Plastics etc, recycling of precious materials.

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
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	PLO-6 The Engineer and the World
CLO-2	**Describe** basic chemistry and operations for production and refining of materials	C2	PLO- 3 Design/Development of Solutions
CLO-3	**Conceptualize** the knowledge of Production and Refining through effective communication	A4	PLO- 9 Communication
CLO-4	**Compare** appropriate and economical production and refining techniques for materials	C4	PLO-11 Lifelong Learning

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-208: FUNDAMENTALS OF MODERN MANUFACTURING AND FOUNDRY	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 26-05-2025	APPLIED FROM BATCH: 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Scope and importance of manufacturing processes; Melting and Casting: Introduction to melting and casting Practice, pattern making. 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 - 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. Introduction of Metal Machining Industry 4.0 in Manufacturing: Automation, IoT, AI applications. Additive Manufacturing: 3D printing of metals, ceramics, polymers.

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Describe** fundamental concepts of casting, hot/cold working, and non-conventional manufacturing processes.	C2	PLO-1 Engineering Knowledge
CLO-2	**Illustrate** various casting techniques and manufacturing processes	C3	PLO-4 Investigation
CLO-3	**Select** appropriate manufacturing and casting techniques for a given component based on its shape and functional requirements.	C3	PLO-2 Problem Analysis
CLO-4	Practice different manufacturing and foundry techniques under supervision	P3	PLO-8 Individual and Collaborative Team Work

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-214: MACHINE LEARNING IN MATERIALS ENGINEERING	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 26-05-2025	APPLIED FROM BATCH: 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure SDG 12: Responsible Consumption and Production

Introduction to machine learning in metallurgical and materials engineering: Materials discovery, property prediction, structure-property relationships, materials design, and materials informatics Basic Math: Review of Linear Algebra, Statistics, and Probability Programming and Data Science Tool: Introduction to Python (scikit-learn, pytorch, Jupyter notebook), Materials Databases (Materials Project, Citrination) Linear Regression: Univariate, Multivariate, Polynomial Regressions Clustering data/classification: K-means/db-scan, classification trees/forests Computer vision: applying concepts from clustering data, training models and Evaluating results with validation methods(e.g. Cross-validation) Deep Neural Network: Basic architecture of neural networks, different types of neural networks, Retraining hyper parameter modification Excursion: Big data in Materials science, Inverse design of materials, DFT MlPotentials, Integrations of machine learning, simulations, and experiments

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Explain** the fundamental principles of machine learning, including techniques such as regression, clustering, and neural networks, and their application in materials engineering problems.	C2	PLO-1 Engineering Knowledge
CLO-2	**Apply** machine learning models and tools such as Python, scikit-learn, and databases like Materials Project to analyze materials-related data and predict properties.	C3	PLO-2 Problem Analysis
CLO-3	**Design** and optimize machine learning models for materials discovery, structure-property relationships, and materials design through data-driven approaches.	C3	PLO-4 Investigation
CLO-4	**Practice** different machine learning techniques under supervision	P3	PLO-8 Individual and Collaborative Team Work

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-309: CONSTRUCTION MATERIALS	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 26-05-2025	APPLIED FROM BATCH: 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9: Industry, Innovation & Infrastructure SDG 12: Responsible Consumption & Production
SDG 13: Climate Action SDG 11: Sustainable Cities & Communities

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)
CLO-1	**Describe** the fundamental properties, types, production, and processing of various construction materials.	C3	PLO-6 The Engineer and the World
CLO-2	**Identify** and evaluate the use of raw construction materials considering environmental sustainability and local resources	C4	PLO-4 Investigation
CLO-3	**Compare** various construction materials based on health, safety, legal, and cultural considerations in the built environment	C3	PLO-10 Project Management and finance

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **PF-205: COMMUNITY SERVICE (NC)**	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** **26-05-2025**	**APPLIED FROM BATCH: 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 01 No Poverty, SDG 02 Zero Hunger, SDG 04 Quality Education

Orientation to Community Service: [Taught component]

Introduction to the concept and practice of community service. Need, objectives and benefits of community service. Foundational theories (educational, undergraduate curriculum, humanities, social science, corporate social responsibility etc.). Tools and skills needed in community service. Contextual examples in community service; case examples. Professional and ethical conduct during community service

Community Service Attachment

Completing 30-35 hours of formal assignment at an organization

Community Service Experience Documentation

Writing a report documenting the experience and submitting it on the prescribed format.

NOTE: Total contact hour for theory (thought component 8 + documentation activity 6) will be 14 hours.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Express** an interest in contributing to the community and society individually and collectively through social projects.	**A3**	**PLO-6 Engineer and the World**
CLO-2	**Volunteer** to help make a difference to a specific group, community, or organization.	**A2**	**PLO-11 Lifelong Learning**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MT-330: APPLIED PROBABILITY AND STATISTICS	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Introduction, Types of data & variables, presentation to data, object, classifications, Tabulation, Frequency distribution, Graphical representation, Simple & Multiple Bar diagrams, Pie-Diagram, Histogram, Frequency Polygon, Frequency Curves & their types. MEASURES OF CENTRAL TENDENCY AND DISPERSION: Statistics Averages, Median Mode, Quartiles, Range, Moments, Skew ness & Kurtosis, Quartile Deviation, Mean Deviation, Standard Deviation, Variance & its coefficient, Practical Significance in related problems. Introduction, fitting of a first- and second-degree curve, fitting of exponential and logarithmic curves, related problems. Principle of least squares, Second order Statistics & Time series not in bit detail. SIMPLE REGRESSION & CORRELATION Introduction, Scatter diagrams, Correlation & its Coefficient, Regression lines, Rank Correlation & its Coefficient, Probable Error (P.E), Related problems. Sampling and sampling distribution Introduction, Population, Parameter & Statistic, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non-Sampling Errors, Random Sampling, Sampling with & without replacement, Sequential Sampling, Central limit theorem with practical significance in related problems. Statistical inference and testing of hypothesis Introduction, Estimation, Types of Estimates, Confidence interval, Tests of Hypothesis, Chi- Square distribution/test, one tails & two tails tests. Application in related problems. PROBABILITY Basic concepts, Permutation & Combination, Definitions of probability, Laws of probability. Conditional probability, Bayes' rule. Related problems in practical significance. RANDOM VARIABLES Introduction, Discrete & Continuous random variables, Random Sequences and transformations. Probability distribution, Probability density function, Distribution function, Mathematical expectations, Moment Generating Function (M.G.F.), Markov random walks chain/ Related problems. Introduction, Discrete probability distributions, Binomial Poisson, Hyper geometric & Negative binomial distributions. Continuous probability distribution, Uniform, Exponential & Normal distributions & their practical significance.

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 students are able to			
CLO-1	**Discuss** the fundamental concepts in Probability and statistics.	C-2	**PLO-1 Engineering Knowledge**
CLO-2	**Analyze** data to produce mathematical models in relevant engineering problems	C-4	**PLO-2 Problem Analysis**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-304: HEAT TREATMENT OF MATERIALS	SEMESTER ☐ SPRING ■ FALL	CREDIT HOURS TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) MM-201: PHYSICAL METALLURGY	DATE OF COURSE CONTENT APPROVAL 26-05-2025	-APPLIED FROM B-ATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))
SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS
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 nonferrous 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	**C-4**	**PLO-3 Design/Development of Solutions**
CLO-2	**Demonstrate** the use and synthesis of information from various transformation diagrams	**C-3**	**PLO-4 Investigation**
CLO-3	**Select** an appropriate heat treatment process to tailor microstructure for a particular application	**C-5**	**PLO-6 The Engineer and the World**
CLO-4	**Under supervision**, perform various heat treatment processes	**P-3**	**PLO-5 Tool Usage**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-311: COMPUTATIONAL MATERIALS SCIENCE**	SEMESTER ☐ SPRING ■ FALL	CREDIT HOURS TH ☐3 ☐2 ■1 ☐0 PR ☐3 ■2 ☐1 ☐0
PREREQUISITE COURSE(S) **MM-210: Mechanics for Engineering Materials**	**DATE OF COURSE CONTENT APPROVAL 26-05-2025**	**APPLIED FROM BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Basic concepts of atoms and molecules. Types of atomic structures in metals and alloys (crystal lattices). Visualizing atomic structures using simple software (like Jmol or online tools). Overview of computational methods in materials science. Basic linear algebra, numerical methods, and statistical analysis relevant to material simulations.

Molecular dynamics simulations, Density functional theory (DFT) and calculations using Monte Carlo simulations, Finite Element Analysis (FEA). Stress-strain behavior in materials: elasticity, plasticity, and fracture. Computational techniques for studying phase transformations in metallurgical processes, Phase diagram calculations and phase transformation kinetics, Applications of computational methods in predicting phase changes.

Simulation projects using software tools e.g. Python/MATLAB, Solidworks/ Materials Studio/Comsol/ABAQUS/ANSYS, LAMMPS, and others. Case studies on materials design and process optimization through computational methods

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 principles of computational materials science	**C-2**	**PLO-1 Engineering knowledge**
CLO-2	**Explain** the process of finite element analysis and interpret the role of modelling and simulation softwares in metallurgical engineering.	**C-4**	**PLO-2 Problem Analysis**
CLO-3	**Apply** different computational techniques to predict behavior of different materials.	**C-3**	**PLO-4 Investigation**
CLO-4	**Develop** critical thinking skills for evaluating and optimizing material performance through different computational software	**P-3**	**PLO-5 Tool usage**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-312: POLYMERIC MATERIALS**	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 **26-05-2025**	APPLIED FROM **BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))
SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS Polymer raw materials and synthesis of common polymers (such as PE, PP, PVC, PET, PS), Polymer chemistry, Polymerisation, Co-polymerisation, Vulcanisation, Kinetics of polymerisation. Polymer blending and compounding. Polymer structure, properties (mechanical, thermal, chemical) and applications of thermoplastic and thermosetting polymers, elastomers and rubber, additives, adhesive and fillers. Mechanism of polymer deformation. Thermal transition in polymers. Polymer crystallinity, Liquid crystal polymers. Polymer processing; Injection molding, Blow Molding, Compression Molding, Film Insert Molding, Gas Assist Molding, Rotational Molding, Structural Foam Molding, Thermoforming, extrusion, spinning, etc. Elastomeric Materials, types of elastomers, processing of elastomers, coloring of elastomers, application of elastomers in tires, seals, gaskets, sports, etc. Polymer testing and characterization; DSC, TGA, UTM, DMA, Shore hardness, etc. Application of different polymers such as PE, PP, PS, PET, PMMA, ABS, Polyamides, Polyester, etc. in domestic and commercial use. Polymer paints and adhesives. Polymers in packaging. Polymeric foams. Advanced polymers; conducting, smart and bio degradable polymers. Degradation of polymers. Environmental considerations.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING

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 general features including physical, chemical, and mechanical properties of polymers and solve the related numerical problems.	**C-3**	**PLO- 1 Engineering Knowledge**
CLO-2	**Compare** different polymeric materials and their manufacturing processes with respect to their advantages, limitations, and suitability for a given situation.	**C-4**	**PLO- 6 The Engineer and the World**
CLO-3	**Under Supervision**, determine the physical, chemical, and mechanical properties and study the working principle of different manufacturing techniques of polymers.	**P-3**	**PLO- 4 Investigation**

OUTCOME
REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **EA-304: BUSINESS COMMUNICATION AND ETHICS**	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** **26-05-2025**	**APPLIED FROM BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG- 4 Quality Education , SDG-8 Decent Work and Economic Growth

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.	**A-3**	**PLO- 9 Communication**
CLO-2	**Compose** effective business messages for various purposes and audiences.	**C-6**	**PLO- 9 Communication**
CLO-03	**Apply** principles, theories, and codes of ethics in situations related to professional practice.	**C-3**	**PLO- 7 Ethics**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MT-442: NUMERICAL METHODS**	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** **26-05-2025**	**APPLIED FROM BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Error Analysis, Types of errors (relative, absolute, inherent, round off, truncation), significant digits and numerical instability, flow chart. Use any Computational tools to Analysis the Numerical Solutions. Difference Equations: Functions of operators, difference operators and the derivative operators, identities, Linear homogenous and non-homogenous difference equations. Interpolation & Curve Fitting: Lagrange's, Newton, Hermit, Spline, least squares approximation. (Linear and Non-Linear Curves). Solution of Linear Equations; Numerical methods for finding the solutions of system of linear equations (Gauss Elimination, Gauss-Jordan Elimination, Triangularization, Cholesky, Jacobi and Gauss-Seidel). Solution of Non-linear Equations; Numerical methods for finding the roots of transcendental and polynomial equations (Secant, Newton – Raphson, Chebyshev and Giraffe's root squaring methods), rate of convergence and stability of an iterative method. Numerical Integration & Differentiation; Computation of integrals using simple Trapezoidal rule, 1/3th Simpson's rule, 3/8th Simpson's rule. Composite Simpson's and Trapezoidal rule, computation of solutions of differential equations using (Euler method, Euler modified method Range Kutta method of order 4). Numerical Solutions of PDE & Optimization; Partial differential Equations, Optimization problem (Simplex Method), Steepest Ascent and steepest Descent Methods.

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** Numerical Methods to solve system of linear equations and non-linear equations C-2 Engineering Knowledge	**C-2**	**PLO-1 Engineering Knowledge**
CLO-2	**Apply** Numerical Methods to solve system of linear equations and non-linear equations in relevant engineering problems	**C-3**	**PLO- 2 Problem Analysis**
CLO-3	**Apply** numerical differentiation and numerical integration in the relevant engineering problems	**C-3**	**PLO- 2 Problem Analysis**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-316: MATERIALS CHARACTERIZATION & ANALYTICAL TECHNIQUES**	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** **26-05-2025**	**APPLIED FROM BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Introduction to characterization techniques and their application in Materials science and Engineering. Production and absorption of X-rays; use of filters; X-ray diffraction and Bragg's law; structure factor calculations; diffraction methods; rotating-crystal method. XRD spectrum and its Indexing; Precise lattice parameter determination; Particle size and micro/macro strains calculations. Chemical analysis by X-ray fluorescence. Scanning electron microscope (SEM); construction and working principle; interaction of electrons with matter; modes of operation; image formation of plane and fractured surfaces. Energy Dispersive X-rays and wavelength dispersive X-rays systems; Electron diffraction and basics of transmission electron microscopy (TEM); Image formation; resolving power and magnification; depth of focus; elementary treatment of image contrasts; important lens defects and their correction. Introduction to Scanning Tunneling microscope and its various types e.g Atomic force microscopy; Piezo-force microscopy; Magnetic force microscopy etc. Introduction to Raman spectroscopy and its use in materials science. Spectroscopic techniques, spark emission spectroscopy, absorption spectroscopy etc. Thermal analysis of materials. Fourier Transform Infrared Spectroscopy, UV Vis Spectroscopy, Xray photoelectron spectroscopy, cyclic voltammetry and electrochemical techniques.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Demonstrate** an understanding of advanced materials characterization techniques such as XRD, SEM, TEM, and spectroscopy, and explain their principles, applications, and limitations.	**C-2**	**PLO-1 Engineering Knowledge**
CLO-2	**Apply** materials characterization methods to interpret experimental data, including X-ray diffraction patterns, microstructural imaging, and spectroscopic results.	**C-3**	**PLO- 4 Investigation**
CLO-3	**Analyze** and solve materials-related engineering problems by selecting appropriate characterization techniques and utilizing their results to assess particle size, strain, etc.	**C-4**	**PLO-2 Problem Analysis**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-314: COMPOSITE MATERIALS**	SEMESTER ■ SPRING ☐ FALL	CREDIT HOURS TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) **MM-312 POLYMERIC MATERIALS**	**DATE OF COURSE CONTENT APPROVAL** **26-05-2025**	**APPLIED FROM BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))
SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Types of reinforcements, their mechanical properties and functions; ceramics, glass, carbon, boron, silicon carbide, metal, aramid. Forms of reinforcements; particulate, fibre, filaments, whiskers, flakes. Pre-fabricated forms – preforms, prepregs, fabrics, honeycomb and other core materials. Type of matrix, its mechanical properties and functions – polymers (thermosets and thermoplastics), metals, ceramics, glass and carbon. Basic principles in the design of composites and selection of matrix and reinforcement. Bonding mechanisms. Anisotropic Behaviour and relationship between structure-mechanical properties. Mechanical testing; tensile, compressive, Intra-laminar shear, Inter-laminar shear and fracture. Polymer Matrix Composites: Types of thermoset and thermoplastic resins. Principles in the selection of matrix and the reinforcements. Process selection criteria. Mould and tool making. Basic manufacturing steps; impregnation, lay-up, consolidation and solidification. Manufacturing processes for polymer composites; lay-up, compression moulding, extrusion, injection moulding, sheet forming, pultrusion, hot press & autoclave techniques and filament winding. Applications; industrial, automotive, marine and aerospace. Metal and ceramic matrix composites; wettability of reinforcement to matrix and bonding, methods of manufacturing reinforcements with intermediate wetting layer. Manufacturing processes for metal matrix composites: casting methods; gravity & low pressure die, investment, squeeze, spray forming, compression moulding and thixo-moulding. Manufacturing processes for ceramic matrix composites: reaction sintering, electro-deposition, spray forming, infiltration. Applications; industrial, automotive and aerospace.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Compare** and Contrast different composite materials with respect to their fundamental's properties, manufacturing route and area of application.	**C-4**	**PLO- 1 Engineering Knowledge**
CLO-2	**Select** a composite material and its manufacturing route to replace a conventional material in specific application.	**C-5**	**PLO- 3 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

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-315: INSTRUMENTATION AND CONTROL**	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** **26-05-2025**	**APPLIED FROM BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Basic Concepts about instrumentation and process control Pressure Measurement: Pressure units, Manometers, Diaphragms, Bellows, Bourden Tubes, Secondary transducers (strain gauge and LVDT). Temperature Measurement: Introduction and units. Liquid Expansion. Thermometers (Mercury in Glass, Liquid in glass), Bimetallic strip Thermometers, Pressure-Spring thermometers, Resistance Temperature Detectors, thermistors, Thermocouples. Pyrometers. Level Measurement: Differential Pressure, Displacer, Bubbler, Capacitance, Conductance, Ultrasonic, Flow Measurement: Head type flow meters (Orifice plate, Venturi tube, pilot tube) Rotameter, Anemometers, Electromagnetic flow meters, Mechanical Meter (turbine type), Ultrasonic type flowmeter. Weight, force, stress, and strain measurement. Introduction to process control: Process Control, Definitions of the Elements in a Control Loop, Units and Standards, Instrument Parameters, Control types.

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	**Differentiate** between different temperature and pressure measurement instruments and select an appropriate one for a particular application.	**C-4**	**PLO-5 Tool Usage**
CLO-2	**Evaluate** different level, flow, weight, stress measurement techniques, components of process control systems, including control loops, units, and standards.	**C-5**	**PLO- 4 Investigation**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-303: INSPECTION AND TESTING OF MATERIALS**	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 **26-05-2025**	APPLIED FROM **BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9: Industry, Innovation & Infrastructure SDG 12: Responsible Consumption & Production

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. Non Destructive Testing Methods for Concrete; Surface Hardness Methods Rebound Hammer Test , Penetration Tests on Concrete (Windsor Probe System), Resonant Frequency Test , Ultrasonic Pulse Velocity Test. Introduction to standards. Familiarization of standards for testing of materials, ASTM, BS, JIS GOST and ISO. Pakistan Standards.

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 scope, importance, and principles of DT and NDT techniques for various materials.	**C-2**	**PLO- 7 Ethics**
CLO-2	**Analyze** mechanical behavior of materials under tensile, compression, bend, torsion, fatigue, and creep testing	**C-4**	**PLO- 4 Investigation**
CLO-3	**Select** and justify an appropriate destructive or non-destructive testing technique for a given material and application	**C-5**	**PLO- 11 Lifelong Learning**
CLO-4	**Perform** standard DT and NDT using appropriate tools, equipment, and international standards	**P-3**	**PLO- 5 Tool Usage**

Recommended by: _____ **Approved by:** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

REMARKS (if any):

COURSE CODE & TITLE **MM-301: CORROSION: PROTECTION & PREVENTION**	**SEMESTER** ■ SPRING ☐ FALL	**CREDIT HOURS** TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) **MM-213: MATERIALS THERMODYNAMICS**	**DATE OF COURSE CONTENT APPROVAL 26-05-2025**	**APPLIED FROM BATCH 2025**
MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s)) SDG 11 Sustainable Cities and Communities		
COURSE CONTENTS Introduction and basic definitions, Economic impact and cost of corrosion damage. Electrical double layer, Metal solution interface, Concept of Electrode Potential, Reference electrodes, EMF series, Free energy concepts, Galvanic series, Passivation. Nernst Equation & its applications, Electrochemical Cells and their types (such as Galvanic Cell, Metal-Ion Concentration Cell and Differential Concentration Cell) Pourbaix diagrams (Al, Fe, Zn). Polarization and its types, Exchange current density, Kinetics of Electrochemical reactions, Evans diagrams and "E-log i" plots, Tafel equations. Types of corrosion such as uniform corrosion, Atmospheric corrosion, Galvanic corrosion, Intergranular corrosion and sensitization, Crevice corrosion, Pitting, Erosion corrosion, Cavitation damage, Fretting, Hydrogen embrittlement, Stress corrosion cracking, selective leaching, Corrosion fatigue, High temperature corrosion. Corrosion rate expressions and its units. Corrosion control by appropriate materials selection, design. Cathodic protection & design of CP system, Anodic Protection, Corrosion Inhibitors, their types and protection mechanism. Protective coatings. Corrosion testing; weight loss method, salt spray tests, electrochemical methods, corrosion testing in soils, galvanic corrosion test, intergranular corrosion test, crevice corrosion test, Stress corrosion cracking test.		

Recommended by: _____ **Approved by:** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Solve** the numerical problems related to corrosion thermodynamics and corrosion rate calculation based on electrochemical principles in different situations.	**C-3**	**PLO- 1 Engineering Knowledge**
CLO-2	**Analyze** various corrosion processes and their underlying mechanisms.	**C-4**	**PLO- 2 Problem Analysis**
CLO-3	**Select** the most suitable method to protect the material from corrosion.	**C-5**	**PLO- 3 Design/Development of Solutions**
CLO-4	**Under supervision**, determine the corrosion rates and effectiveness of different types of corrosion prevention methods, including inhibitors, coatings, and cathodic protection by using various tools.	**P-3**	**PLO- 5 Tool Usage**

OUTCOME

REMARKS (if any):

COURSE CODE & TITLE **MM-402: DESIGN AND SELECTION OF MATERIALS**	**SEMESTER** **■ SPRING □ FALL**	**CREDIT HOURS** **TH □3 ■2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **MM-316 Materials Characterization & Analytical Techniques**	**DATE OF COURSE CONTENT APPROVAL** **26-05-2025**	**APPLIED FROM BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

Introduction – Materials and design: Materials design, the design process, types of design, design tools and materials data. Interaction of Function, material, shape and process, Families of materials, Introduction to the aluminum, copper, nickel, cobalt, stainless steel, cast irons, titanium, refractory materials, rubber, plastics, polymers and composites materials systems. Elements of materials selection: Materials information for design, material property charts, selection strategy, attribute limits and material index, the selection procedure, computer-aided selection, Material selector, materials data resources (ASM, ASME standards and codes references, websites) the structural index. Effect of process on properties and cost, factors affecting cost of design and materials. Design prototyping Constraints and conflicting objectives: Selection and multiple constraints, conflicting objectives. Material life-cycle and its assessment, sustainability. Case studies of real-life engineering problems and solutions.

Recommended by: _____ **Approved by:** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO-1	**Carry out** the process of material selection using Material property charts	C3	PLO- 6 The Engineer and the World
CLO-2	**Evaluate** the role of function, material, process, and shape during design and selection of materials	C5	PLO- 11 Lifelong Learning
CLO-3	Work as a team member on a relevant project and present the findings	A4	PLO- 8 Individual and Collaborative Team Work
CLO-4	Practice different software tools to assist in design and selection of materials	P3	PLO- 5 Tool Usage

REMARKS (if any):

COURSE CODE & TITLE PF-401: ENTREPRENEURSHIP	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-5 Gender Equality , SDG-9 Industry, Innovation and Infrastructure , SDG-12 Responsible Consumption and Production

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

Introduction to Entrepreneurship: Definition and concept of entrepreneurship; Why to become an entrepreneur? Entrepreneurial process; Role of entrepreneurship in economic development.

Entrepreneurial Skills: Characteristics and qualities of successful entrepreneurs (including stories of successes and failures); Areas of essential entrepreneurial skills and ability areas such as creative and critical thinking, innovation and risk taking.

Opportunity Recognition and Idea Generation: Opportunity identification, evaluation and exploitation; Idea generation techniques for entrepreneurial ventures.

Marketing and Sales: Target market identification and segmentation; Four P's of Marketing; Developing a marketing strategy; Branding.

Financial Literacy: Basic concepts of income, savings and investments; Basic concepts of assets, liabilities and equity; Basic concepts of revenue and expenses; Overview of cash-flows; Overview of banking products including Islamic modes of financing: Sources of funding for startups (angel financing, debt financing, equity financing etc.)

Team Building for Startups: Characteristics and features of effective teams; Team building and effective leadership for startups.

Regulatory Requirements to Establish Enterprises in Pakistan: Types of enterprises (e.g., sole proprietorship; partnership; private limited companies etc.); Intellectual property rights and protection; Regulatory requirements to register an enterprise in Pakistan, with special emphasis on export firms; Taxation and financial reporting obligation.

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
1.	**Describe** the entrepreneurial process and its role in economic development, identifying opportunities in diverse economic contexts	**C2**	**PLO- 6 The Engineer and The World**
2.	**Demonstrate commitment** to identifying, evaluating, and exploiting entrepreneurship opportunities through brainstorming, group discussions and applying idea generation techniques.	**A3**	**PLO- 9 Communication**
3.	**Apply** creative and critical thinking to generate innovative ideas and continuously improve entrepreneurial ventures.	**C3**	**PLO- 11 Lifelong Learning**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-411: NANOMATERIALS AND NANOTECHNOLOGY**	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

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. Introduction to Nanoparticles, Nanomaterials and nanoproducts, Processing and Synthesis Techniques for Nanoparticles, Chemo-physical processes in nanoparticle, Lithographies. Equipment for nano studies, tools for Characterization of Nanomaterials, Potential present and future applications of Nanotechnology. 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)
CLO-1	**Compare and Contrast** the properties of nano structured materials with conventional materials	**C4**	**PLO- 11 Lifelong Learning**
CLO-2	**Demonstrate** the equipment and processes available to synthesize and characterize the nanostructured materials	**C3**	**PLO- 5 Tool Usage**
CLO-3	**Carry out** necessary investigations in relation to synthesis, characterization and applications of nanomaterials	**C3**	**PLO- 6 The Engineer and the World**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-413: NUCLEAR MATERIALS	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Overview of Nuclear materials and 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)
CLO-1	**Illustrate** various types of nuclear reactors as per application, environmental impact and sustainable development	C3	PLO- 6 The Engineer and the World
CLO-2	**Analyze** health and safety issues in nuclear reactors and related materials	C4	PLO- 2Problem Analysis
CLO-3	**Select** materials for design and processing of nuclear reactors and disposal of nuclear waste, with emphasis on ethical and legal considerations	C5	PLO-7 Ethics

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-418: PHASE TRANSFORMATIONS & KINETICS**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **MM-213 Materials Thermodynamics**	DATE OF COURSE CONTENT APPROVAL **26-05-2025**	APPLIED FROM **BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-04 Quality Education SDG-09 Industry Innovation and Infrastructure

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)
CLO-1	**Demonstrate** an understanding thermodynamic concept related to Phase transformations	**C3**	**PLO- 2 Problem Analysis**
CLO-2	**Solve** problems related to microstructure and phase diagram	**C3**	**PLO- 11 Lifelong Learning**
CLO-3	**Analyze** the nucleation and growth mechanism and distribution of phases	**C4**	**PLO- 10 Project Management and Finance**

REMARKS (if any):

Recommended by: _____ **Approved by:** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-421: SURFACE ENGINEERING**	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 **26-05-2025**	APPLIED FROM **BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure SDG-12 Responsible Consumption and Production

COURSE CONTENTS

Tribology of surfaces: surface integrity; surface roughness and waviness; measurement of surface roughness and texture; friction and theories; types of wear and their mechanisms; lubrication and its regimes; applications of lubrications in wear Mechanical surface treatment: Propelling abrasive media; blasting techniques; selection of abrasive media; different peening techniques. Surface finishing methods: selection and applications; tumbling; vibratory finishing; belt Sanding; wire brushing, buffing and electro-polishing. Chemical cleaning of surfaces: selection and applications; alkaline cleaning; solvent cleaning and vapor degreasing; molten salt bath cleaning; ultrasonic cleaning; acid cleaning; pickling and descaling. Coatings: Paints and organic coatings; powder coating; hot-dip coating; chemical conversion coatings; blackening; coloring of metals; electroplating, electrophoretic deposition; anodizing; electroless-plating; mechanical plating; Chemical vapor deposition (CVD) and Physical vapor deposition (PVD) techniques; Thermal and cold spraying methods; Sputtering; sol gel method. A brief overview of surface hardening methods. Cladding techniques; roll bonding; explosive welding; applications of cladding in nuclear, marine and other technological fields.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO 1	**Explain** the principles of tribology, including surface integrity, roughness, friction theories, wear mechanisms, lubrication regimes, and their applications in materials engineering.	**C4**	**PLO- 10 Project Management and Finance**
CLO 2	**Apply** techniques for mechanical surface treatments, surface finishing, chemical cleaning, and coatings to improve material performance and evaluate their effectiveness systematically.	**C3**	**PLO- 5 Tool Usage**
CLO 3	**Design** and optimize surface engineering solutions, including coatings, cladding techniques, and surface hardening methods, for applications in advanced engineering fields.	**C6**	**PLO- 2 Problem Analysis**

REMARKS (if any):

Recommended by: _____ **Approved by:** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-419: QUALITY & PROJECT MANAGEMENT**	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-08 Decent Work and Economic Growth SDG 11 Sustainable Cities and Communities

COURSE CONTENTS

Introduction to Quality and project Management, Quality management principles. Quality management systems (ISO 9001), Total Quality Management (TQM), Quality Tools and Techniques, Project Management Fundamentals, importance and their concepts. Project Proposal development. Project Feasibility. Project Selection Criteria. Project Contract & Procurement Management. Project management life cycle, Project management knowledge areas (PMBOK), Project Planning and Scheduling, Project Execution and Monitoring and execution strategies, Earned Value Management (EVM). Project Costing & Estimation. Project HRM & Communication Management. Project Risk Management. Computer Application in Project Management. Project Quality Management, Quality planning and assurance, Quality control and improvement, Agile Project Management and Agile principles and methodologies such as Scrum framework and Kanban. Project Closure & Project Evaluation and Termination.

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**	**PLO- 5 Tool Usage**
CLO-2	**Compare and contrast** different quality project Management philosophies and frameworks.	**C4**	**PLO- 6 The Engineer and the World**
CLO-3	**Evaluate** projects using modern project Management tools.	**C5**	**PLO- 10 Project Management and Finance**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-422 BIOMATERIALS	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure SDG 03 Good Health and Wellbeing

COURSE CONTENTS

Introduction to biomaterials and biochemistry; classification of natural and synthetic materials used in medical applications. Structure-property relationships of metals, ceramics, polymers, and composites. Key concepts include biocompatibility, bioactivity, biodegradability, bio-resorbable and bio-erodible materials. Study of hydrogels, smart polymers, and biomimetic materials. Basics of cell biology, surface properties, and intermolecular forces in biological systems. Material responses in the human body, mechanical effects on cells and tissues, and the role of water in biomaterials. Overview of biocompatible metals such as titanium alloys, stainless steels, Co-Cr-Mo alloys, and nitinol. Protein interaction with surfaces, porous and textured materials. Introduction to bioactive glasses, bio-resorbable ceramics, adhesives, and sealants. Applications in orthopedic, dental, cardiovascular, and tissue replacement. Overview of drug delivery systems, corrosion, blood-material interaction, and tumor responses.

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** natural and synthetic biomaterials (metals, ceramics, polymers, composites) and explain their structure-property relationships.	**C4**	**PLO- 10 Project Management and Finance**
CLO-2	**Analyze** biocompatibility, biodegradation, and biological interactions (e.g., protein adsorption, immune response) of biomaterials.	**C3**	**PLO- 6 The Engineer and the World**
CLO-3	**Apply** applications of biomaterials in various medical fields (e.g., orthopedic, cardiovascular) considering relevant material properties	**C4**	**PLO- 7 Ethics**

REMARKS (if any):

Recommended by: _____ **Approved by:** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-423: HEALTH, SAFETY AND ENVIRONMENT	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure SDG 11: Sustainable Cities and Communities

COURSE CONTENTS

Introduction, overview and importance of HSE, HSE regulations and standards, Roles and responsibilities, Occupational Health,, Workplace hazards (chemical, physical, biological, Health risk assessment, Occupational health standards, Safety Management, Safety policies and procedures, Risk assessment and mitigation, Incident investigation and reporting, Environmental Management and their regulations and standards, Environmental impact assessment, Waste management and pollution control, Hazard Identification and Risk Assessment and their methodologies and mitigation strategies, Emergency Response and Planning, Fire safety and prevention, first aid and medical emergencies, HSE Regulations and Standards, Overview of relevant regulations (OSHA, EPA), Compliance requirements, Auditing and inspection, Environmental sustainability practices.

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 students are able to			
CLO-1	**Apply** (V) the ISO 14000 or equivalent standards (S) to the real-world problem (C).	C-3	**PLO- 7 Ethics**
CLO-2	Comply and **prefer** (V) with the OHSAS 18000 or equivalent standard (S) to analyze the hazardous conditions and practices to implement effective hazard control strategies in workplace environment (C).	A-3	**PLO- 11 Lifelong Learning**

REMARKS (if any):

Recommended by: _____ **Approved by:** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-426: MATERIALS FOR BATTERY APPLICATIONS	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 7: Affordable and Clean Energy, SDG 9: Industry, Innovation, and Infrastructure, SDG 11: Sustainable Cities and Communities

COURSE CONTENTS

Introduction to Energy Storage: Importance, classification, applications (grid, EVs, consumer electronics), Fundamentals of Electrochemistry: Redox reactions, electrochemical cells, potentials, Nernst equation, Conventional Batteries I – Lead-Acid Batteries: Construction, working, advantages, limitations, Conventional Batteries II – Nickel-based Batteries (NiCd, NiMH): Chemistry, performance, issues, Lithium-Ion Batteries – Non-Aqueous Systems: Working principle, components, intercalation materials, Sodium-Ion and Aqueous Batteries: Recent trends, advantages, comparison with Li-ion, Solid-State and Polymer Batteries: Solid electrolytes, safety benefits, challenges, Metal-Air Batteries: Zn-air, Li-air, chemistry, design considerations, Battery Assembly Techniques: Coin cell fabrication, pouch/prismatic formats, safety protocols, Battery Testing and Characterization: Charge/discharge, cyclic voltammetry, impedance, capacity fade, Battery Management Systems (BMS): Components, SOC estimation, thermal management, balancing, Hydrogen Generation Techniques: Electrolysis, photoelectrochemical methods, reforming, Hydrogen Storage Technologies: Compressed gas, metal hydrides, cryogenic systems, Fuel Cells: PEMFC, SOFC, components, working, 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 principles and mechanisms of energy storage systems, electrochemistry, and various types of batteries, including their classifications, advantages, and limitations.	C2	PLO- 9 Communication
CLO 2	**Apply** testing techniques and tools to characterize batteries and hydrogen storage systems, including charge/discharge protocols, cyclic voltammetry, and impedance analysis.	C3	PLO- 4 Investigation
CLO 3	**Analyze** and optimize energy storage technologies, such as solid-state batteries, fuel cells, and hydrogen storage systems, for applications in grid, EVs, and consumer electronics.	C4	PLO- 6 The Engineer and the World

REMARKS (if any):

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Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-424: QUANTUM MATERIALS	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))
SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS
Introduction & Overview of Quantum Materials (Definition and classification (topological materials, superconductors, quantum magnets)), Key properties (electron behavior, band structures), Fundamental Quantum Mechanics for Materials, Basic principles (wave-particle duality, Schrödinger equation, Blochs theorem), Quantum states and band theory, Density functional theory (DFT), Superconductivity (BCS theory, Cooper pairs, Meissner effect, High-temperature superconductors), Topological Materials (Topological insulators and semimetals, Edge states and surface vs. bulk conductivity), Experimental Techniques (X-ray diffraction, ARPES, and STM in quantum materials), Applications (Quantum computing, spintronics, and quantum sensors), Emerging Quantum Materials such as Topological, spin liquids and 2D materials (graphene, TMDs).

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** fundamental differences between quantum and classical technologies and describe basic quantum phenomena mathematically.	**C1**	**PLO- 1 Engineering Knowledge**
CLO-2	Interpret quantum signatures in experimental data and **analyze** engineering challenges of quantum technologies.	**C4**	**PLO- 2 Problem Analysis**
CLO-3	**Demonstrate** the potential quantum materials for improved quantum technologies and understand current research and job opportunities in quantum sciences.	**C4**	**PLO- 4 Investigation**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-427: ADVANCED RECYCLING TECHNIQUES	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Introduction, market analysis, environmental impact, wet and dry recycling processes Recycling and reusing of; (i) glass and ceramics,(ii) polymer and plastics, (iii) polymer based composite, (iv) metals and alloys, (v) electronics waste, (vi) paper, (vii) construction materials Recycling and reusing of aircraft and ship materials application of nanotechnology in recycling, Role of AI technologies for enhancing recycling.

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** different recycling techniques with respect to cost, health, safety and environment.	C4	PLO- 6 The Engineer and the World
CLO-2	**Select** suitable material recycling technique keep in view the national/international laws and health safety and environment concerned.	C5	PLO- 7 Ethics

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

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Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-428: ADDITIVE MANUFACTURING OF MATERIALS	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Introduction to Additive Manufacturing, Overview, History, evolution, benefits and limitations of additive manufacturing (AM), Conventional methods vs AM technologies, AM Technologies such as Powder Bed Fusion (PBF), Directed Energy Deposition (DED), Material Extrusion (ME), Vat Photopolymerization (VP) and Sheet Lamination (SL) and its type. Materials for AM, Metals (Ti, Al, steel), Polymers (thermoplastics, thermosets), Ceramics, Composites and Biomaterial. Design for AM, AM Process Parameters and Control (temperature, speed, power), Process monitoring, control and assurance, Post-Processing and Finishing, Applications of AM, Future Directions, Challenges and limitations and 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	**Compare and Contrast** AM technologies in relation with accessories/equipment/principles	C-4	PLO- 5 Tool Usage
CLO-2	**Select** an appropriate AM method for particular applications	C-5	PLO- 4 Investigation

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

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Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-430: MECHANICAL BEHAVIOUR OF MATERIALS	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Introduction and review of the structure of materials and crystalline imperfections. Elasticity (review of stress and strain concepts, Hooke's law, Elastic strain energy); Plasticity (Analysis of Stress-strain behavior, Yielding criteria of Metals and Hardness); Notches (Stress concentration factor, Neuber's rule, Tensile testing of notched specimens). Theoretical cohesive strength and Griffith criteria; Plastic deformation and role of Dislocations; types of dislocations; Slip systems; Critical resolved shear stress; Taylor factor; Dislocation interaction; Thermally activated processes; Intersection of dislocations. Ductile-brittle transition. Strengthening Mechanisms. Severe plastic deformation. Fracture behavior of metallic materials (ductile, brittle fractures); different types of embrittlements; Stress-corrosion cracking. Fatigue and creep deformation and fracture (Structural changes; theories and mechanism of crack initiation and propagation; Materials' selection). Mechanical behavior of thin films and coatings; Mechanical behavior of Polymers, Ceramics, glasses and composites; Weibull Modulus

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	PLO- 1 Engineering Knowledge
CLO 2	**Outline** the theory of dislocations and its types and mechanisms of fracture in materials.	C4	PLO- 3 Design/Development of Solutions
CLO 3	**Investigate** an analyses the mechanical design problems and failures using knowledge of deformation	A3	PLO- 4 Investigation

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

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Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-431: FRACTURE MECHANICS AND FAILURE ANALYSIS**	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Introduction & overview of the fracture mechanics, Fracture and its types, ductile, brittle (intergranular and transgranular), Plane stress and plane strain conditions, Griffith's and Orowan theory of fracture. Linear elastic and elastoplastic fracture mechanics. Fracture Toughness Testing, stress intensity factor and its range. Paris Law. Determination of K1c, Compact Tension, J-integral and Crack Opening Displacement (COD) methods. Tensile, Creep, Fatigue and environmental fractures. Stress corrosion cracking. Ductile to Brittle Transition Temperature and its determination. Fracture toughness testing of composites materials. Fracture toughness testing of reinforced/composite materials. Failure analysis procedures; Fractography and Case studies of fractured components; different types of mechanical/industrial failures (aerospace, automotive, biomedical); root cause analysis and remedial actions

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 fracture and its types on materials properties	**C3**	**PLO- 2 Problem Analysis**
CLO-2	**Analyze** the role of different parameters on failure mechanism of different materials	**C4**	**PLO- 11 Lifelong Learning**
CLO-3	**Formulate** a report on root cause analysis of a particular failure and present the findings	**A4**	**PLO- 9 Communication**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-432: POWDER METALLURGY	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 26-05-2025	APPLIED FROM BATCH

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Advantages and design limitations of powder metallurgy Powder particles sampling, dispersion & de-agglomeration; Sieve and microscopic analysis; sedimentation; laser light; particle size distributions; data presentation Characterization of powders: microstructure; particle shape; pycnometer; surface area test; internal structure and chemistry Production of powders: mechanical methods; electrolytic methods; Atomization techniques; chemical methods Powders modification and handling; mixing and blending; different lubricants and binders; Powders molding, shaping and compaction (cold and hot compacting methods physical characteristics of powder compacts, compaction defects). Sintering theory and practices, solid state and liquid phase sintering, modern sintering techniques, sintering atmospheres, thermodynamics of sintering. Inspection and quality control for P/M parts, the economics of P/M production, new development in powder metallurgy processes

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 applications, advantages, limitations and design considerations of PM products	**C2**	**PLO- 2 Problem Analysis**
CLO 2	**Evaluate** and design different approaches for the sustainability of the process.	**C5**	**PLO- 6 The Engineer and the World**

REMARKS (if any):

Recommended by: _____
(Chairperson/Date)

Approved by: _____
(Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-433 THIN FILMS AND PACKAGING MATERIALS	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 26-05-2025	APPLIED FROM BATCH

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))
SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS
Introduction to Thin Films, Thin Film Deposition Techniques, Thin Film Characterization Techniques Packaging Materials Overview, Food and Pharmaceutical Packaging, Characterization of Packaging materials, Electronic and Semiconductor Packaging, Environmental Considerations and Sustainability, Regulatory and safety concerns (national and international standards)

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** and evaluate various packaging materials used in food, pharmaceuticals, and electronics.	C1	PLO- 4Investigation
CLO-2	**Apply** synthesis and characterization techniques to analyze the properties and quality of thin films.	C3	PLO- 5 Tool Usage

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-422: CRYSTALLOGRAPHY AND X-RAY DIFFRACTION	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Overview and scope of crystallography techniques used in materials engineering. Production of X-Rays, Absorption of X-Rays, Use of filters, X-Ray diffraction, Bragg's law, Structure factor calculations, X-ray scattering by atoms, crystal axes and reciprocal lattice, diffraction by small crystals, Diffraction methods, the powder method, Debye-Scherrer, the Laue back /reflection and rotating crystal method, the rotation method, scattering by non-crystalline form of matter, effect of temperature vibration on X-ray diffraction, x-ray studies of order-disorder, diffraction by imperfect crystals and perfect crystal theory, X-Ray diffractometer, Introduction to the crystal structure of materials. Symmetry, lattice directions and planes, crystal shapes, Crystal structure determination, Orientation of single crystal, Preferred orientation and Texture, Pole figures, Applications of X-Ray diffraction, Stereographic projections; Orientation of crystal with respect to a reference, Rotation of crystal around and axis, Planes of a zone. Texture and stress analysis. Advanced X-Ray Diffraction Techniques, Small-angle X-ray scattering (SAXS), X-ray absorption spectroscopy (XAS). Practical examples of X-ray studies in materials engineering.

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** fundamental principles of crystallography	C1	**PLO-1 Engineering Knowledge**
CLO-2	Interpret XRD experimental data and **analyze** engineering challenges for applications	C4	**PLO-2 Problem Analysis**
CLO-3	**Demonstrate** the potential examples and applications of X-Ray diffraction for phases analysis	C4	**PLO- 4 Investigation**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MY-418: ADVANCED MATERIALS**	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 **26-05-2025**	APPLIED FROM **BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Introduction to advanced materials, the structure-property co-relationships of advanced materials, Characterization techniques for nanomaterials (TEM, XRD, etc.), Introduction to magnetic Materials and their Applications, Biomaterials: Basic chemical and physical properties of biomaterials, including metals, ceramics, and polymers. 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. Nanomaterials: Overview of Nanomaterials and Their Classification. Mechanically alloyed Nanomaterials, ODS alloys, Fuel cells and Materials, Materials for Hydrogen Storage, Ceramic and Ceramic matrix composites, and Metal-Matrix 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 students are able to			
CLO-1	**Analyze** the structure-property relationships of advanced materials	C-4	**PLO- 4** Investigation
CLO-2	**Evaluate** the potential benefits and limitations of advanced materials in various industries	C-6	**PLO- 6** The Engineer and the World

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MY-411: VACUUM METALLURGY	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

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 students are able to			
CLO-1	**Analyze** importance of vacuum in metallurgical processes.	C-4	**PLO- 2 Problem Analysis**
CLO-2	**Apply** the principles and classifications of vacuum systems and their measurement techniques to design and develop appropriate vacuum-based solutions for metallurgical processes.	C-3	**PLO- 3 Design/Developments of Solutions**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

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) MY-212	DATE OF COURSE CONTENT APPROVAL 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-9 Industry, Innovation, and Infrastructure

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 students are able to			
CLO-1	**Use** the advanced steel making techniques in order to achieve various characteristics for betterment of steel sector.	C-3	**PLO-6 The Engineer and the World**
CLO-2	**Propose** alloying elements, heat treatment, strengthening mechanism and their stability for the use in intended engineering application.	C-5	**PLO- 3 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

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **EA-321: LOGIC AND CRITICAL THINKING** (Elective)	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** **26-05-2025**	**APPLIED FROM BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 4 Quality Education

COURSE CONTENTS

Introduction to the Study of Logic: Definitions, Terminology, Concepts of Logic & Critical Thinking. Scope and Impact. Why study logic and critical Thinking- Intellectual Moral Virtues. Basic Principles of Logic: Structure of an Argument, Valid/Invalid versus Sound/Unsound argumentation, Deduction versus Induction, Three classical Aristotelian Laws of Logic, Principle of sufficient reason; Deductive reasoning- Syllogism, Linear ordering, Tree diagrams; and Inductive Reasoning -Valid and invalid arguments. Fallacies. Thinking process while working towards goals, making decisions and analyzing issues. Thinking tools and their applications. Simple tools (e.g. facts and opinions, verification of sources and credibility of authorities etc.); Theoretical Frames (e.g. Scientific Methods/Approach etc.) and Formal Tool (e.g. PMI, STAR method, Shewhart Cycle, Socratic Method, RW & D, Quality Thinking- Paul & Elder Framework etc.) Thinking Critically Critical Thinking standards: clarity, precision, accuracy, relevance, consistency, logical correctness, completeness, and fairness. Barriers to Critical Thinking: Egocentrism, sociocentrism, unwarranted assumptions and stereotypes, relativist thinking, and wishful thinking. Critical Thinking Approach: Thinking actively, using questions for probing situations, evaluating our evidences and their types, Impartial versus adversarial critical thinking. Critical Thinking in Everyday Life Problem Solving: Defining a problem, attitudes towards problems-general and desired, Problem solving process, case studies on problem analysis Perceiving: Defining perception and its prominence in succeeding through life, Critical thinking and perception, Evaluating the differences in perception (through tests, optical illusions etc.), Perception processes, Factors governing perception, Difficulties / errors in perception process (perceptual errors). Believing and Knowing: Believing versus knowing, values and their types, identifying one's values in life; defining and classifying beliefs, Accuracy scale for evaluating thoughts, thinking patterns and organizing concepts, Ways to Organize Thoughts, Types of causal relationships – causal chains, contributory and interactive causes.

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 students are able to			
CLO-1	**Explain** key concepts of logic and critical thinking along with thinking process**.**	C-2	**PLO- 11 Life long Learning**
CLO-2	**Apply** critical thinking approach and problem solving to day-to-day experiences, issues and scenarios to identify and avoid fallacies.	C-3	**PLO- 2 Problem Analysis**
CLO-3	**Analyze c**ritically real life and hypothetical decisions regarding social and professional life to differentiate between good and bad reasoning.	C-4	**PLO- 11 Lifelong Learning**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MG-228: SOCIOLOGY AND DEVELOPMENT	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG- 4 Quality Education, SDG-8 Decent Work and Economic Growth

COURSE CONTENTS

Introduction to Sociology: Importance and scope, study of social life, exploring the global village, Sociology as a science, relationship with other social sciences, the sociological imagination, development of sociology, pioneers of sociology, brief historical development of sociology, Society and community, Social interaction processes. Social Groups & Social Institutions: Definition, functions and types of social groups, Structure and function of social institutions. Culture and Related Concepts: Definition, types and elements of culture, Role of culture in organization, socialization and personality. Social Stratification: Factors of social stratification, approaches to study social stratification, power, prestige, and authority, social mobility, migration. Social and Cultural Change: Definition and dynamics of social change, impact of globalization on society and culture, resistance to change. Sociology of Development: Significant sociological questions, measures of inequality and development, modernization theory and explanation of underdevelopment, education, industrialization & development.

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 students are able to			
CLO-1	**Discuss** key concepts and theoretical perspectives of sociology.	C-2	The Engineer and the World
CLO-2	**Evaluate** contemporary social and developmental issues in purview of sustainable practices.	C-6	Ethics
CLO-3	**Express** ideas and plans for socioeconomic changes in society.	A-3	Lifelong Learning

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MG-257: ORGANIZATIONAL BEHAVIOR	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG- 4 Quality Education , SDG-8 Decent Work and Economic Growth

COURSE CONTENTS

Introduction to Organizational Behavior: What is Organizational Behavior? The Individual: Diversity in Organizations, Attitudes and Job Satisfaction, Emotions and Moods, Personality and Values, Perception and Individual Decision Making, Motivation Concepts, Motivation: From Concepts to Applications. The Group: Foundations of Group Behavior, Understanding Work Teams, Communication, Leadership, Power and Politics, Conflict and Negotiation, Foundations of Organization Structure. The Organization System: Organizational Culture, Human Resource Policies and Practices, Organizational Change and Stress Management.

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 students are able to			
CLO-1	**Discuss** key organizational behavior concepts and its implications in engineering profession.	C-2	Lifelong Learning
CLO-2	**Apply** organizational behavior skills with reference to engineering profession.	C-3	The Engineer and the World

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE ME-433: LAW FOR ENGINEERS	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-8 Decent Work and Economic Growth, SDG-9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Introduction to legal studies, concepts and sources of law, Industrialization and role of Law, Development and role of contract legislative intervention. Intellectual property, Designs, Trademark, Patents, Copyright in Engineering, Enforcing rights to intellectual property. Engineering Contracts, Rights & Obligations, Legal documentation, Tendering and sub-contracting, Claims Concept of negligence Dispute Resolution in Domestic and International dealings. Liability for defective products, Role of Insurance. International Aspects of Laws, Law of Agency, Law of property. Taxation, Service Tax, Income Tax, VAT, Excise Duty. Aspects of employment law, Labour laws Environmental Law for Engineers, Need for a Environmental Protection Policy, Environmental Policy Act, Air and Water Pollution Acts, ISO 14000. Public Procurement Rules, Procurement planning, pre-qualification, bidding documents, evaluation criteria, Re-bidding.

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 students are able to			
CLO-1	**Explain** key legal concepts including contracts, intellectual property, and industrial law relevant to engineering.	C-2	The Engineer and the World
CLO-2	**Analyze** professional obligations, dispute resolution processes, and liabilities within engineering contexts.	C-4	Ethics
CLO-3	**Interpret** laws concerning environment, employment, and taxation as applied to engineering decisions.	C-3	The Engineer and the World

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE& TITLE **MM-103 Workshop Practice**	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 26-05-25	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9: Industry, Innovation & Infrastructure

SDG 12: Responsible Consumption & Production

COURSE CONTENTS

This is designed to provide students with hands-on exposure to fundamental manufacturing and fabrication techniques. The course begins with the use of basic carpenter's tools, where students perform exercises in preparing simple joints, bench fitting, and accurate marking and fitting operations, emphasizing proper workmanship and dimensional accuracy through the use of standard measuring instruments. The course further familiarizes students with essential joining and processing techniques such as soldering and brazing, welding, heat treatment, and molding and casting processes, highlighting their applications in materials engineering. In addition, students gain practical experience with simple machine shop operations, including turning, shaping, milling, and sheet metal work, enabling them to understand basic machining principles, tool functions, and process capabilities relevant to metallurgical and materials engineering applications.

COURSE LEARNING OUTCOMES (CLOs) WITH PROGRAMME LEARNING OUTCOMES (PLO) MAPPINGS

CLO No.	CLO Statement	Taxonomy level	Mapped PLO
At the end of the course, the student will be able to:			
CLO-1	Operate equipment and tools in wood working distinguish between their applications.	P3	**PLO-5 Tool Usage**
CLO-2	Operate equipment and tools in metal working and distinguish between their applications	P3	**PLO-6 Engineer and World**
CLO-3	Participation in workshop activities individually as well as in a group	P1	**PLO-11 Lifelong Learning**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **ES-206: ISLAMIC STUDIES**	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 15-05-2024	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 02 Zero Hunger
SDG- 16 Peace, Justice and Strong Institution

COURSE CONTENTS

Fundamentals of Islam, including Tauheed, its impact on human life, the place of man in the universe, and the purpose of creation, with references to Quranic verses such as Al-Ambiya-22, Al-Baqarah-163-164, and Al-Israa-70. It addresses Prophethood, the need and characteristics of prophets, finality of Prophethood (Al-Imran-79, Al-Hashr-7, Al-Maidah-3), and the concept of the Hereafter. Topics on Ibadah include Salat, Zakat, Hajj, and Jihad (Al-Hajj-5, Al-Baqarah-48, Al-Mu'minun-1-11, Al-Anfaal-60). The Basic Sources of Shariah include the Quran, Hadith, Ijmaa, and Qiyas. Moral and Social Philosophy of Islam covers good vs. evil, Akhlaq-e-Hasna (Al Imran-110, Al Nahl-125), and professional ethics with verses from Surah Al-Hujrat (10-13), Al-Taha-81, and Al-Baqarah-188. The Seerat of the Holy Prophet (PBUH) is explored through moral teachings (Hajjat-ul-Wida, political and economic aspects), personal traits like honesty, humility, mercy, and engagement with others through events like the Charter of Madina and the Treaty of Hudaibya. It highlights social values (peace, tolerance, inclusivity) and leadership skills (vision, empathy, communication, justice). The course also includes the Teaching of the Holy Quran, focusing on tafseer of Surah Fatiha, parts of Surah Al-Furqan (63-77), and Surah Luqman (12-19), as well as Nazirah and Tajweed of Surah Fatiha, Ayatul Kursi, and the last ten surahs with Tajweed rules like Ghunna, Qalqalah, and Noon Sakinah.

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 students are able to			
CLO-1	**Explain** the provided Quranic verses and Hadiths and their functional meaning and about the specified topics.	C-2	**PLO-7 Ethics**
CLO-2	**Describe** the foundational principles of Shariah sources and the exemplary characteristics of Seerat-un-Nabi (SAW) in personal and professional life.	C-2	**PLO-7 Ethics**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE EA-128: FUNCTIONAL ENGLISH	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG- 4 Quality Education

COURSE CONTENTS

Listening skills and subskills: Effective listening techniques: listening for gist, details, and specific information in a range of situations (AV lectures, interviews, documentaries etc. Speaking skills: Speaking with fluency and accuracy in a variety of situations including conversations, group discussion, academic and social interaction, public speaking, presentation skills, and interviews; Pronunciation improvement exercises (through websites, apps, and in class worksheets) Reading and subskills: Reading strategies: Skimming, scanning, and detailed reading, identifying main ideas, supporting details, and inferences (multiple genres including newspapers, books, stories, documentaries etc). Reading Practice: Reading comprehension tasks. Reading output tasks (notes, summary, discussion, counter argument etc.) Study skills: Effective note-taking strategies for lectures, meetings, and reading texts. Taking in varied forms paragraph, lists, infographics etc.) ; Interpreting instructions oral and written. Effective examination taking technique (comprehending instructions, planning, and writing answers ensuring relevance and precise Writing skills: Writing process, Pre-writing strategies (Mindmapping, cubing, outlining, clustering etc.); Writing to describe, argue, compare and contrast, persuade through writing prompts; Writing academic and professional genres: emails, letters, short report, resume, cover letter, building profiles on various job portal; Writing accuracy: Identifying and overcoming grammatical problems. Vocabulary and grammar development: Vocabulary Development strategies. Exposure and practice to develop everyday and academic vocabulary for formal contexts.

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 students are able to			
CLO-1	**Employ** effective study skills and strategies for various academic functions.	A-3	**PLO- 9 Communication**
CLO-2	**Comprehend** explicit and implicit information through reading and listening strategies.	C-2	**PLO-9 Communication**
CLO-3	**Produce** various spoken and written genres for different academic and professional settings.	C-6	**PLO-11 Lifelong Learning**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE& TITLE **MM-434: Crystallography and X-Ray Diffraction**	SEMESTER ■ SPRING ☐ FALL	CREDIT HOURS TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S)	**DATE OF COURSE CONTENT APPROVAL**	**APPLIED FROM BATCH** 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Overview and scope of crystallography techniques used in materials engineering. Production of X-Rays, Absorption of X-Rays, Use of filters, X-Ray diffraction, Bragg's law, Structure factor calculations, X-ray scattering by atoms, crystal axes and reciprocal lattice, diffraction by small crystals, Diffraction methods, the powder method, Debye-Scherrer, the Laue back /reflection and rotating crystal method, the rotation method, scattering by non-crystalline form of matter, effect of temperature vibration on X-ray diffraction, x-ray studies of order-disorder, diffraction by imperfect crystals and perfect crystal theory, X-Ray diffractometer, Introduction to the crystal structure of materials. Symmetry, lattice directions and planes, crystal shapes, Crystal structure determination, Orientation of single crystal, Preferred orientation and Texture, Pole figures, Applications of X-Ray diffraction, Stereographic projections; Orientation of crystal with respect to a reference, Rotation of crystal around and axis, Planes of a zone. Texture and stress analysis. Advanced X-Ray Diffraction Techniques, Small-angle X-ray scattering (SAXS), X-ray absorption spectroscopy (XAS). Practical examples of X-ray studies in materials engineering.

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** fundamental principles of crystallography	C1	**PLO-1 Engineering Knowledge**
CLO-2	Interpret XRD experimental data and **analyze** engineering challenges for applications	C4	**PLO-2 Problem Analysis**
CLO-3	**Demonstrate** the potential examples and applications of X-Ray diffraction for phases analysis	C4	**PLO-4 Investigation**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE& TITLE **MM-429: Functional Materials**	SEMESTER ■ SPRING ☐ FALL	CREDIT HOURS TH ☐3 ■ 2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) Engineering Ceramic & Refractory Materials	**DATE OF COURSE CONTENT APPROVAL**	**APPLIED FROM BATCH** 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))
SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS
Introduction to functional materials and their classifications: magnetic, optical, piezoelectric, thermoelectric, and shape memory materials. Fundamentals of magnetism ferro, para, and antiferromagnetism and their applications in sensors and data storage. Basic principles of piezoelectricity and ferroelectricity with emphasis on perovskite structures and functional devices. Thermoelectric effects including Seebeck and Peltier phenomena, and the concept of figure of merit (ZT). Overview of shape memory alloys and their role in actuation and smart systems. Relationship between crystal structure and functional properties, with emphasis on electrical and thermal conduction mechanisms involving phonons. Study of material properties: electrical, thermal, magnetic, optical, and photovoltaic. Surface and interface properties, nanostructure growth, photocatalysis, antibacterial and self-cleaning surfaces, and bio ceramics. Introduction to synthesis methods of common functional materials and discussion of their applications in electronics, energy devices, and other advanced technologies

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	**Use** functional materials (magnetic, optical, piezoelectric, thermoelectric, shape memory) and explain their fundamental properties and operating principles.	C2	**PLO-1 Engineering Knowledge**
CLO-2	**Analyze** the relationship between crystal structure and functional properties, including electrical/thermal conduction mechanisms and phonon interactions.	C4	**PLO-2 Problem Analysis**
CLO-3	**Design** synthesis methods for functional materials and evaluate their applications in electronics, energy devices, and smart systems, considering societal and environmental impacts.	C6	**PLO-6 The Engineer and the World**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE& TITLE MM-207 QUALITY CONTROL	SEMESTER ■ SPRING ☐ FALL	CREDIT HOURS TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S)	DATE OF COURSE CONTENT APPROVAL	APPLIED FROM BATCH

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure, SDG-8 Decent Work and Economic Growth

COURSE CONTENTS

Set theory & set operations; Venn diagram; Definition of probability; Probability laws; Conditional probability, Deterministic & probabilistic data; Grouping of data; Measures of central tendency & dispersion; calculation of mean, mode, median; standard deviation, & range, weighted average, & coefficient of variation. Random variable; discrete & continuous random variable; Mathematical expectation; Laws of expectation, Discrete probability distributions: Uniform, Binomial, Multinomial, Hyper geometric & Poisson distribution, Continuous probability distributions: Normal & Exponential distributions; Transformation of variables; Random sampling; Sampling distribution of mean; Central limit theorem, Properties of the distribution of sample means, sample range estimation of standard deviation, chance and assignable causes, control charts for mean & range, control charts for mean & standard deviation, control charts for proportion defective & defects per assembly. Tests of significance to compute confidence limits, Introduction, OC curve, consumer & producer risks, AQL & LTPD, sampling errors, acceptance sampling for continuous production, acceptance by variables, single, double, & sequential sampling, Introduction to standards. Familiarization of standards for testing of materials, ASTM, BS, JIS GOST and ISO. Pakistan Standards, Quality assurance for final products, Measures for quality control

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 control on different processes.	C3	PLO-5 Tool Usage
CLO-2	**Compare and contrast** different quality tools and methods.	C4	PLO- 6 The Engineer and the World

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-104: ENGINEERING DRAWING & COMPUTER GRAPHICS**	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** **26-05-2025**	**APPLIED FROM BATCH: 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

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. Multiview projection and drawing using first and third angle projection methods, Types of pictorial views and drawing, isometric view. 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 settings, 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)
CLO-1	**Draw** geometric curves, simple machine parts, sections and assembly drawings	**P3**	**PLO- 1 Engineering Knowledge**
CLO-2	**Demonstrate** design details, forms and proportions of different mechanical parts/structures and assemblies for design documentation.	**C3**	**PLO – 9 Communication**
CLO-3	**Use** software for simple 2D and 3D drawings.	**C3**	**PLO- 5 Tool Usage**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE MM-425: ENERGY HARVESTING MATERIALS: ORGANIC & INORGANIC	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 26-05-2025**	**APPLIED FROM BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure SDG 11: Sustainable Cities and Communities

COURSE CONTENTS

Introduction, overview and importance of energy harvesting, Types of energy harvesting materials, Organic Energy Harvesting Materials, Organic photovoltaics (OPVs), Organic thermoelectric materials, Organic piezoelectric materials, Inorganic Energy Harvesting Materials, Inorganic photovoltaics (solar cells), Inorganic thermoelectric materials and Inorganic piezoelectric materials, Energy Harvesting Mechanisms, Photovoltaic, Thermoelectric and. Piezoelectric effects, Flexible and wearable energy harvesting, Energy storage materials and Hybrid energy harvesting systems, Applications of Energy Harvesting Materials such as Solar energy, Waste heat, Mechanical energy and Self-powered devices, Future challenges, Directions and Challenges and limitations

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
CLO 1	**Explain** the principles and mechanisms of energy harvesting, and their types, including their classifications, advantages, and limitations.	C2	PLO- 9 Communication
CLO 2	**Apply** testing techniques and tools to characterize harvesting materials.	C3	PLO- 4 Investigation
CLO 3	**Analyze** and optimize the role of energy harvesting for advanced application	C4	PLO- 6 The Engineer and the World

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering
Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE **MM-313: ELECTRONIC, MAGNETIC AND OPTICAL MATERIALS**	**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** **26-05-2025**	**APPLIED FROM BATCH 2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 9 Industry, Innovation, and Infrastructure

COURSE CONTENTS

Classification and concept of Electrical and Electronic Materials. Metallic materials and their electrical properties. Semiconductor materials and their electrical properties. Semiconductor devices. Ceramic materials used in electronic applications. Magnetic materials and their classification. Magnetization curve, hysteresis loop. Types of magnetic behavior. Ferromagnetic domains. Experimental evidence for domains. Domain wall motion. Hindrances to wall motion. Soft Magnetic Materials: Desirable properties for soft magnetic materials. Potential applications of soft magnetic materials. Hard Magnetic Materials: Properties of Hard magnetic materials. Origin of Ferromagnetism in Rare Earth based permanent magnets. Potential applications of permanent magnets. Characteristics of optical materials, Types of optical 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	**Describe** the fundamentals of electrical, magnetic, and optical materials.	**C-2**	**PLO-1 Engineering Knowledge**
CLO-2	**Characterize** and analyze different properties of electrical, magnetic and optical materials	**C-4**	**PLO-2 Problem Analysis**
CLO-03	**Select** different electrical, magnetic, and optical materials for a given application	**C-5**	**PLO-3 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

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE ES-209: ETHICAL BEHAVIOUR (FOR NON-MUSLIMS)	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 06-02-2017	APPLIED FROM BATCH 2021

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG 02 Zero Hunger,
SDG- 16 Peace, Justice and Strong Institution

COURSE CONTENTS

Nature, Scope and Methods of Ethics: Ethics and Religion, Ethical teachings of World Religions

Basic Moral Concepts: Right and Wrong, Good and Evil

Ethical Systems in Philosophy: Hedonism, Utilitarianism, Rationalism & Kant, Self-Realization Theories, Intuitionism

Islamic Moral Theory: Ethics of Qur'an and its Philosophical basis, Ethical precepts from Qur'an and Hadith and Promotion of Moral Values in Society.

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:			
1.	EXPLAIN the ethical teachings of the world's major religions.	C2	**PLO7 - Ethics**
2.	DESCRIBE the importance and implications of ethics on individuals and societies.	C2	**PLO7 - Ethics**

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Materials Engineering

Programme Bachelor in Materials Engineering

Course Profile

F/QSP 11/17/02

COURSE CODE & TITLE PF-206: ENGINEERING ECONOMICS AND MANAGEMENT	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 26-05-2025	APPLIED FROM BATCH 2025

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-8 Decent Work and Economic Growth SDG- 9 Industry Innovation and Infrastructure

COURSE CONTENTS

Introduction: Basic Concepts and principles of Economics, Micro- and Macro-economic theory, the problem of scarcity. Basic concepts of Engineering Economy, Financial effectiveness and non-monetary factors. Economic Environment: Consumers and producer goods, Goods and services, Demand & Supply concept. Market Equilibrium, Elasticity of demand, Elasticity of Supply, Measures of Economics worth, Price, supply-demand-relationship, Revenue, Cost and profit function. Elementary Financial Analysis: Basic accounting equation. Development and interpretation of financial statements-Income Statement, Balance Sheet and Cash Flow, Working capital management, Financial Ratio Analysis. Time Value of Money and Financial Returns: Concepts of simple, compound and effective interest rates, Less often than compounding period and more once a year; Present Value, Future Value and Annuities concepts, Uniform gradient and geometric sequence of cash flow. Depreciation and Taxes: Depreciation concept, Economic life, Methods of depreciation, Gain (loss) on the disposal of an asset, Depreciation as a tax shield. Basic cost concepts and Break Even Analysis: Types of costs and cost curves; Determination of Cost/Revenues. Numerical and graphical presentations. Practical applications, BEA as a management tool for achieving financial/operational efficiency. Management: Project Management; Integration of Organization Strategy with Projects, Defining the project, developing a network plan, managing risk, reducing project time, project selection and comparing alternatives techniques scheduling resources.

Introduction to System, Application and Products (SAP) in Data processing.

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 students are able to			
CLO-1	**Understand** the basic concepts of engineering economics and economic environment keeping in view the local and global markets.	C-2	The Engineer and the World
CLO-2	**Analyze** financial statements to improve the financial and operational efficiency of an organization by reducing the cost and increasing the profit	C-4	Lifelong Learning
CLO-3	**Apply** project management principles to business and economic scenarios	C-3	Project Management and Finance

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)