L	T	P	C
3	0	0	3

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech V Semester
MS502HS: Engineering Economics and Accountancy
(Metallurgical and Materials Engineering)

Course Objectives: The objectives of the course are:

- To gain knowledge on basic utility concepts of economics and concepts of market dynamics namely Demand and supply.
- To learn the macroeconomic aspects like National Income, Inflation and New Economic Policy.
- To discuss the Capital Budgeting techniques for the feasibility of projects.
- To acquaint the students regarding Accounting and various books of accounts.
- To familiarize the cost accounting concepts and its relevance.

Course Outcomes: After completion of the course students will be able to:

- Analyze various aspects of Demand and supply along with utility concepts.
- Understand the impact of macroeconomic variables on the business.
- Identifythesignificanceof Investmentcriteriaanddecisionprocess
- Evaluate and compare various books of accounts.
- Equip with the knowledge of cost accounting concepts.

Unit I:

Introduction to Engineering Economics

Introduction to Engineering Economics- Objectives and importance- Basic Principles and Methodology of Engineering Economics– Fundamental Concepts- Demand – Demand Determinants - Law of Demand- Utility –types-Law of Diminishing marginal Utility - Elasticity of demand- Meaning, significance, types and measurement of elasticity of demand (Price, income cross and promotional)- -Demand Forecasting and Methods Theory of Firm – Supply- Elasticity of Supply.

Unit II:

Macroeconomic Concepts

Macroeconomic Concepts: Meaning, Scope and Limitations of Macro Economics. National Income Accounting - Methods of Estimation- Various Concepts of National Income - Inflation – Definition –Causes and Effects and Measures to Control Inflation - New Economic Policy 1991- Liberalisation-Privatization-Globalization (LPG).

Unit III:

Capital Budgeting

Sources of finance- Capital Budgeting: Significance of Capital Budgeting - Time Value of Money- Choosing between alternative investment proposals- Methods of Appraisal Techniques- Pay Back Period - Average Rate of Return – Net Present Value- Internal Rate of Return – Profitability Index. (Simple problems).

Unit IV:

Accounting

Accounting: Definition-objectives-importance-limitations- Accounting Principles- Concepts and conventions- Book-keeping vs. Double entry system - Journal- ledger-Trial balance- Trading and Profit and Loss account- Balance Sheet.

Unit V:

Cost Accounting

Meaning and Scope of Cost Accounting - Classification of costs – Cost Accounting vs Financial Accounting- Techniques of Inventory Control: Economic Order Quantity, ABC Analysis, VED Analysis, JIT inventory system - Valuation of Inventory-FIFO, LIFO, Weighted Average and Simple Average - Breakeven Analysis, Meaning and its application, Limitations. (Simple Problems).

Text Books:

1. Henry MalcomSteinar-Engineering Economics, Principles, McGraw Hill Pub, Revedition, 1993
2. Chaturvedi.D.D., S.L. Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
3. Gregory Mankiw. N, Mark P. Taylor, Andrew Ashwin, Business Economics, 3e, Cengage publication, 2019

Reference Books:

1. Arora, M.N., Cost Accounting, 12e Vikas Publication, 2018.
2. Maheshwari. S. N. Financial Management, Vikas Publishing House, 3e 2017.
3. Zahid A Khan, Arshad N Siddique, et.al, Principles of Engineering Economics with Applications, 2e, Cambridge University Press, 2019.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech.(MME) V Semester Syllabus

MM501PC: Metal Casting

L	T	P	C
3	1	0	4

Course Objectives:

- This course is mainly intended to introduce and explain various moulding, casting techniques and equipment used
- This course is mainly intended to introduce and explain various moulding, casting equipment used
- Principles of Solidification of castings
- Defects in castings and their remedies are also dealt in detail

Course Outcomes:

This course paved a platform for students to develop a thorough understanding on the,

1. Casting technologies,
2. Different Moulding process
3. Solidification of metals and alloys
4. Cupola, Induction furnace
5. Identified the casting Defects and found the suitable remedies

UNIT I: Introduction to Foundry -Types of Foundries and Patterns:

Materials for patterns, types of patterns, properties of pattern materials; functions and pattern allowance. Cores, core prints and core making, Moulding materials; moulding sands, properties and selection of bindingmaterials and additives.

Moulding Processes: Green and dry sand moulding; shell moulding, CO_2 moulding, Plaster moulding, Investment casting

UNIT II: Casting Methods:
Permanent and Expendable moulding, pressure die-casting, Gravity die casting, Vacuum die casting, Horizontal, Vertical and Semi centrifugal casting, Squeeze casting and Composite Casting

UNIT III: Melting and Solidification:
Solidification, Nucleation, and growth. Freezing of metals and alloys. Dendritic freezing. Progressive and Directional Solidification. Gating, Risering and their design

UNIT IV: Modern Developments:
Recently developed processes-V-Forming Full Mould Process, Furon-No-Bake Sand Moulds and Cores, Cold Setting, and Self Setting Processes. Cupola furnace, construction of cupola furnace, Melting of Gray Iron in cupola and Induction furnace Melting,

UNIT V: Casting Defects and Remedial Measures:
Casting defects arising due to moulding, cores, melting and pouring practice. Various NDT Inspection and Testing of castings

TEXTBOOKS:

1. Principles of Metal casting by Heine – Loper and Rosenthal, Tata Mc Graw Hill, 2nd Edition.
2. Metal Casting : Principles and practice – T.V. Ramana Rao, New Age, International, 2007

REFERENCES:

1. Foundry Technology – Dharmendra Kumar & S.K.Jain, CBS Publisher, 2007
2. Fundamentals of metals casting, P. C. Mukherjee, Oxford & IBH Pub. Co., 1988
3. Casting Technology and Cast Alloys – AK Chakrabarti – PHI 2011 Edition
4. Castings – John Campbell – Second Edition – Elsevier
5. Metal Casting : Principles and practice – T.V. Ramana Rao, New Age, International, 2007.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech.(MME) V Semester Syllabus

L	T	P	C
3	1	0	4

MM502PC: Mechanical Working of Metals

Course Objectives:

- To introduce students to the consequences of the application of loads on metals
- To analyse stress and strain at an inclined plane from the given three-dimensional stresses.
- To impart knowledge about principles and criteria of yielding during forming of metals
- To impart knowledge on analysis of different bulk metal forming processes.
- To understand the role of different controlling process parameters in metal forming processes

Course Outcomes:

1. To choose the best forming process for a specific product.
2. Use the Mohr's circle to graphically analyse stresses.
3. Analyze, compare, and finally gain theoretical experience for the advantages and limitations of different manufacturing processes
4. To practically appreciate the utilization of these fundamentals in industrial manufacturing processes.
5. To analyse metallurgical and mechanical aspects of forming of metals into useful shapes and properties.

Unit I: Stress-Strain Relationship-Elastic Behavior (12 hours)

Concept of stress and types of stresses. Resolution of total stress into its components. Concept of strain and types of strains. Description of stress at a point

Plane stress, State of stress in two dimensions: Construction of Mohr's circle of stress for two-dimensional state of stress. State of stress in three dimensions: Construction of Mohr's circle of stress for three-dimensional state of stress.

Description of strain at point. Hydrostatic and Deviator components of stress. Elastic stress strain relations. Calculation of stresses from elastic strains. Plane strain. Strain energy.

Unit II: Elements of Theory of Plasticity (12 hours)

Basics of the theories of plasticity. The flow curve. Idealized flow curves. True stress and true strain. Relationship between engineering stress and true stress,

engineering strain and true strain. Constancy of volume relationship. Advantage for true strain in metal working. Yielding criteria for ductile metals. Von Mises distortion energy criterion Maximum shear stress or Tresca criterion. The yield locus. Octahedral shear stress and shear strain. Plastic stress strain relations, Levy- Mises equations.

Unit III: Fundamentals of Metal Working (12 hours)

Classification of forming processes: High energy rate forming process, Explosive forming. Mechanics of metal working: slab method and uniform deformation energy method Flow stress determination, Plane strain compression test. Mean flow stress, Cold working, Recovery, recrystallisation and grain growth, Hot working Strain-Rate effects Work of plastic deformation. Stresses acting on an element during drawing of a wide sheet. Dynamic recovery and Dynamic recrystallisation. Friction and lubrication. Deformation zone geometry. Hydrostatic pressure.

Unit IV: Forging and Rolling of Metals (12 hours)

Forging: Classification of forging processes: Open-die, closed-die, impression die and isothermal forging. Forging operations: Swaging, fullering, edging, cogging, coining, drawing out, upsetting. Forging equipment. Forging of a rectangular slab in plane strain, Forging of a cylinder in plane-strain, Forging defects.

Rolling of Metals: Classification of rolling process, rolling mills, Classification of rolling mills, Hot rolling, cold rolling, Rolling of bars and shapes, Geometrical relationships in rolling, Simplified analysis of rolling load, rolling variables. Front tension and back tension, effect of strip tension on distribution of roll pressure, Rolling mill control. Problems and defects in rolled products. Theories of cold and hot rolling, torque and horsepower

Unit V: Extrusion and Drawing (12 hours)

Extrusion: Classification of extrusion processes-Direct extrusion, Indirect extrusion, Hydrostatic extrusion, and Impact extrusion. Extrusion equipment. Typical extrusion dies-Flat and conical dies. Patterns of metal flow in extrusion. Hot extrusion Deformation and defects in extrusion. Analysis of the extrusion process Cold extrusion of tubing and production of seamless pipe and tubing, Spider dies, Mannesmann mill process.

Drawing of Rods, Wires and Tube: rod, wire, and tube drawing processes. Drawing die. Analysis of wire drawing, Analysis of tube drawing. Maximum possible reduction in drawing, Defects in drawing, Residual stresses in rod, wire and tubes. Deep drawing of sheets.

Textbooks:

1. Mechanical Metallurgy by GE Dieter (3rd edition)
2. Metal forming mechanics of metallurgy, William F.Hosford, Robert M.Caddell. Cambridge, 3rd Edition.
3. Technology of Metal Forming Processes – Surender Kumar PHI 2008

Reference Books:

1. Mechanical Working of Metals - Avitzur.
2. Mechanical Properties and Working of Metals and Alloys, Amit Bhaduri, Springer

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech.(MME) V Semester Syllabus

L	T	P	C
3	1	0	4

MM503PC: Steel Making

Course Objective: This course is primarily of industrial oriented and designed to make the student to understand and demonstrate the

- Various types of primary steel making processes
- Hot metal route and scrap route, casting pit side practice,
- Continuous casting of steel and
- secondary steel making process to produce quality steels

Course Outcomes: The student would gain knowledge on different

1. To know the Primary steel making processes.
2. To know the importance of Secondary Steel making processes
3. To get the knowledge of producing quality steels with less cost
4. To improve the efficiency of Steel making

UNIT-I: Introduction to Steel Making

Current scenario of steel making in India and world, Raw materials of steel making. Factors affecting the efficiency of steel making. **Principles of Steel making**; Removal of Carbon, Silicon, Manganese, phosphorous and sulphur. Role of slag, types, and properties of slags. Molecular and ionic theory of slags. Principles of deoxidation. Precipitation and diffusion deoxidation.

UNIT-II: Primary Steel Making (Hot Metal)

Steel making by Acid and Basic Bessemer Processes, Construction and lining details, sequence of elimination of impurities, Steel Making by LD process, Construction, lining and process details in LD, LD-AC or OLP, Kaldo, LD-Kaldo, Rotor oxygen steel making, Oxygen bottom blowing (OBM), Hybrid process of steel making, Improvements and modification of the above steel making process.

UNIT-III: Primary Steel Making (From Scrap)

Open Hearth Steel Making: Construction and process details; Electric Arc Furnace (EAF); Construction and Process details: Induction furnace. Stainless steel making.

UNIT-IV: Secondary Steel Making

Secondary steel making processes. Electro Slag Remelting (ESR), Vacuum Arc Remelting (VAR). Brief outline of manufacture of alloy steels. Vacuum treatment of

steels. AOD, VOD, Synthetic slag treatments, De-carburization techniques de-gassing of steel Powder injection etc. methods

UNIT-V: Solidification of steels.

Ingot defects and remedies; Casting pit side practice: Types of Moulds, Teeming Methods, Killed, Semi Killed, capped and rimmed Steels, Continuous casting of steels.

TEXTBOOKS:

1. Steel Making – V. Kudrin
2. Modern Steelmaking – Dr. R.H. Tupkary and V.H. Tupkary
3. Steel Making – A. K. Chakravarthy (PHI) 2007

REFERENCES:

1. Iron Making & Steel Making Theory and Practice - Ahindra Ghosh & Amit Chatterjee
2. Secondary Steel Making; Principles and applications – Ahindra Ghosh
3. Physical Chemistry of Iron & Steel by Bodsworth.

L	T	P	C
3	0	0	0

V/VI-Semester

MC502ES /MC602ES: CYBER SECURITY

(Common to all Branches)

Prerequisites: NIL

Course objectives:

- To familiarize various types of cyber-attacks and cyber-crimes
- To give an overview of the cyber laws
- To study the defensive techniques against these attacks

Course Outcomes:

The students will be able

- To understand various cyber-attacks and cybercrimes.
- Knowledge about cyberlaws and cyber forensics.
- Summarize cyber crimes in mobile and wireless devices, how to protect them
- Knowledge about IPR issues in cyber space and cyber terrorism.

UNIT - I

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, IP spoofing, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Comprehensive Cyber Security Policy.

UNIT - II

Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT - III

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations.

UNIT- IV

Cyber Security: Organizational Implications: Introduction cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing.

Cybercrime and Cyber terrorism: Introduction, intellectual property in the cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

UNIT - V

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc.

TEXT BOOKS:

1. Nina God bole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, ComputerForensics and Legal Perspectives, Wiley, India 2012.
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles,Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

REFERENCES:

1. Mark F. Grady, Fransesco Parisi, " The Law and Economics of Cyber security", Cambridge University Press,2006.
2. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press, 2016.
3. Introduction to Cyber Security, Chwan - Hwa (john) Wu, J. David Irwin, CRC Press T&F Group.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech.(MME) V Semester Syllabus

L	T	P	C
0	0	3	1.5

MM551PC: Metal Casting Lab

Objective:

- This Laboratory course is designed to make the student to understand and demonstrate
- This lab course is mainly designed to provide hands on practice on the various foundry testing methods for evaluation of moulding sand properties

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Determine moulding sand dry, hot and green strength
2. Understand the preparation of moulding sand
3. Determine moulding sand properties by varying additives
4. Understand the Melting of Al alloys

LIST OF EXPERIMENTS

1. Preparation of gating system using green moulding sand.
2. Study of particle size distribution of the sand.
3. Study of the variation of permeability of the green sand with clay and water.
4. Determination of the variation of sand properties like green hardness, green compact strength with additives in sands.
5. Determination of the variation of hot compact hardness and hot shear strength with additives in sands.
6. Determination of clay content in sand.
7. Determination of the shatter index of green sand.
8. Melting of Al alloys in a pit furnace and casting into light components.
9. Study of Charge calculations and melting practice of cast iron in cupola.
10. Preparation of a shell-by-shell moulding process.
11. Study of Non-destructive testing of few components.

Equipment:

1. Mould Boxes, Patterns, Core Boxes, Tool Boxes.
2. Rotap Sieve Shaker with Sieves
3. Permeability Apparatus.
4. Universal Sand Testing Machine with Accessories.
5. Sand Hardness tester.
6. Clay Content Apparatus
7. Shatter Index test.
8. For Melting ; Pit Furnace; Electric Furnace
9. Shell Moulding Machine

10. Centrifugal Casting Machine
11. Ultra Sonic Tester
12. Ladles, Crucibles and other Accessories
13. Muffle Furnace 1000^0c

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech. V Semester Syllabus

L	T	P	C
0	0	3	1.5

MM552PC: Mechanical Working of Metals Lab

Course Objectives:

- This lab course is designed to know the various testing methods for evaluation of metal forming techniques.

Course outcomes: Upon successful completion of this course, the student will be able to

1. Determine strain hardening exponent from the stress-strain diagram.
2. Understand the difference between simple, progressive and compound dies.
3. Understand the effect of cold working and annealing on microstructure.
4. Illustrate the effect of friction and semi die –angle on metal flow in extrusion.
5. Practice various deformation processes like extrusion, deep drawing and redrawing

.

LIST OF EXPERIMENTS:

1. To determine the formability of given materials by Erichson cup test
2. To manufacture washer components using fly press (progressive dies /compound dies)
3. Deep drawing of a cup with / without blank holder by hydraulic press
4. Redrawing of a cup with / without blank holder by hydraulic press
5. To determine the friction factor by ring compression test
6. Determination of strain hardening exponent ‘n’ and strength coefficient ‘k’
7. To verify Hall-Petch relation in MS specimen.
8. To determine the effects of cold working on the microstructure and mechanical properties of given metal.
9. To demonstrate the effect of friction and height-to-diameter ratio in the axi-
10. Symmetric compression of a cylinder to analyze the metal flow in extrusion with different friction conditions and semi- die angles.

List of Equipment:

1. UTM, 2. Hydraulic press, 3. Fly press, 4. Erichson cup Tester

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech. V Semester Syllabus

L	T	P	C
0	0	2	1

MM553PC: Metallurgical and Analytical chemistry Lab

Course objectives:

This course introduces chemical analysis of metallic alloys using laboratory practice

.**Course Outcomes:** At the end of this laboratory course, the student will be able to

1. Identify the major elements in a metallic alloy using chemical methods
2. Quantify specific elements in ferrous and non-ferrous alloys using titration
3. Interpret the results from different spectroscopy instruments to determine chemical composition
4. Application of Electrochemical principles
5. To understand the concepts of calorific values of different fuels

List of experiments:

1. Preparation of standard solutions and standardization of standard solutions.
2. Estimation of Iron in Iron ore by KMnO4 and $K_2Cr_2O_7$ methods.
3. Determination of Silicon in steel by gravimetric method.
4. Estimation of Manganese in Ferro-alloys by spectrophotometer.
5. Estimation of Sodium and Potassium in Chloride Salts by Flame Photometry.
6. Estimation of Copper in Brass by Electrochemical Analyzer.
7. Determination of Carbon and Sulphur in Ferrous Materials by “Stroheleins Apparatus”
8. Determination of viscosity of a given fluid by Viscometers (Redwood -I, Redwood – II and Saybolt viscometer).
9. Determination of calorific value of Solid and liquid fuels.

List of Equipment:

1. Flame Photometer 2. Spectrophotometer. 3. Electrochemical Analyzer.
4. Colorimeters. 5. Bomb Calorimeter 6. Chemicals and Glassware.
7 Junker’s gas calorimeter, 8. Redwood and Saybolt viscometers.

Textbooks:

1. A textbook of metallurgical analysis, B C Aggarwal, Khanna Publishers (2002)
2. Wilfred W. Scott ; Standard methods of Chemical Analysis

Reference Books:

1. Instrumental methods of analysis, Willard, CBS Publishers & Distributors (2004)
2. Young R.S.; Chemical Analysis in Extractive Metallurgy; Charles, Griffin & Co. Ltd, 1971

L	T	P	C
0	0	2	1

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY

B.Tech. V Semester

MA554BS: Finishing School-III

(Quantitative Aptitude & Analytical Ability)

(Common to CE, EEE, ECE, ME, MCT&MME)

Course Objectives:

This is a foundation course and aims to enhance employability skills in students.

- Students will be introduced to higher order thinking skills and problem-solving on the following areas - Arithmetic ability, Numerical ability and General reasoning.
- Students will be trained to work systematically with speed and accuracy while solving problems.

Course Outcomes:

At the end of the course students will be able to:

- Solve questions on the above-mentioned areas using shortcut and smart methods
- Understand the fundamental concepts of Aptitude skills
- Perform calculations with speed and accuracy

UNIT 1: QUANTITATIVE APTITUDE - NUMERICAL ABILITY

- Number system
  - Divisibility Rules
  - Square root
  - Cube root
  - Problems on numbers
  - LCM and HCF

UNIT 2: QUANTITATIVE APTITUDE- ARITHMETIC ABILITY-I

- Percentage
- Ratio proportions
- Averages
- Profit, loss and discounts
- Simple and Compound interest

UNIT3: QUANTITATIVE APTITUDE- ARITHMETIC ABILITY-II

- Pipes and Cisterns
- Ages
- Time-Work-Speed-Distance
- Clocks & Calendars
- Venn diagrams
- Tables and graphs

UNIT 4: REASONING ABILITY – GENERAL REASONING-I

- Coding decoding
- Directions
- Series completions - Letter, Number & Element Series
- Seating arrangements
- Symbols and Notations

UNIT 5: REASONING ABILITY- GENERAL REASONING -II

- Analogies
  - Alphabet Analogy
  - Numerical Analogy
- Classification
  - Alphabet Classification
  - Word Classification
  - Miscellaneous Classification
- Alphabet test
  - Arranging words in Alphabetical Order
  - Problems based on Letter-Word
  - Problems based on Alphabetical Quibble
- Blood Relations

REFERENCES:

1. R.S. Aggarwal - Quantitative Aptitude for Competitive Examinations.
2. Arun Sharma - Quantitative Aptitude for CAT.
3. Arihant Publications - Fast Track Objective Arithmetic.
4. Sarvesh K.-Quantitative aptitude
5. A New Approach to Reasoning Verbal & Non-Verbal, Book by B.S. Sijwalii and Indu Sijwali
6. A Modern Approach to Logical Reasoning, Book by Agarwala Vikas and R.S. Aggarwal

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech. VI Semester Syllabus

L	T	P	C
3	1	0	4

MM601PC: Welding Metallurgy

Course Objectives:

- To impart knowledge on various welding processes so that the students can apply them in engineering industry applications.
- Gain knowledge of the concepts, operating procedures, applications, advantages and limitations of various welding processes
- knowledge about the thermal and residual stresses associated with welding processes
- Gain knowledge of process, difficulties, and microstructures formed during welding of high carbon steels, cast irons, Stainless steels and Aluminum alloys and the remedial measures to minimize or eliminate the occurrence of weld defects
- To develop the knowledge on the the quality control of weldments.

Course Outcomes:

1. Understand the basics of various metal joining processes
2. Describe the development of the fusion and heat-affected zones during welding and how the weld variables and weld Microstructure affect the mechanical properties of the weld
3. Correlate the solidification behavior and structure of weld zone with the welding parameters
4. Understand the metallurgical compatibility in joining dissimilar metals and apply the suitable methods.
5. Apply remedial measures to minimize defects in welding of stainless steels, Al alloys, Cu alloys based on proper understanding of the processes used and microstructural study of weld joints.

Unit I: Welding Processes (12 hours)

Introduction to the process of welding Advantages Disadvantages and applications of welding

Classification of welding processes: Fusion vs Non fusion, Pressure Vs Non-Pressure, Fusion welding processes by energy source. Welding arc, arc plasma, Volt-Ampere characteristics for welding

Principles, advantages disadvantages and fields of application of the following welding processes: Gas Welding, MMAW, GTAW, GMAW, SAW, ESW & EGW

Resistance Welding: Principles, advantages disadvantages and fields of application of the following welding processes: Resistance spot welding, Resistance seam welding, Projection welding, Flash welding, Upset welding
Other metal joining techniques: Principle of Adhesive bonding, classification of adhesives Advantages disadvantages and applications of Adhesive bonding.
Brazing: Principle, Common brazing techniques Torch brazing, Induction Brazing, Vacuum Brazing and Furnace brazing. Advantages Disadvantages and Applications of Brazing.
Soldering: Principle, Advantages Disadvantages and applications. Soldering tools, Types of solders and Soldering Techniques.

Unit II: Solid-State welding and Advanced Metal Joining Techniques(12 hours)

Working principle. Advantages limitations and applications of the following solid state welding processes.
Friction: Linear friction, Rotary friction: continuous drive and inertia friction welding.
Friction stir: Process variables tool rotational speed, traverse speed and plunge depth.
Explosive welding: Types of explosives, cladder placement-parallel and angled.
Diffusion welding and ultrasonic welding.
Advanced Metal Joining Techniques:Plasma Arc Welding: Energy density in plasma, Keyhole mode, Transferred and Non-Transferred arc Working principle. Advantages limitations and applications

Unit III: Weldability concepts of ferrous and non-ferrous alloys (12 hours)
Weldability, Microstructure of fusion zone and heat affected zone in cold worked metals, precipitation. Metal transfer in non-consumable arc welding hardenable alloys, Transformation hardenable alloys
Heat input, effect of heat input on microstructure and mechanical properties. Effects on preheat and cooling rate. Importance of PWHT
Thermal and residual stresses: Origin of thermal stresses, Distortion Vs Residual stresses, Causes of residual stresses in weldments, residual stress effects, reduction and control
Weldability of high carbon steel, cast irons, stainless steels. Importance of Schaffler and Delong diagrams.
Welding of non-ferrous alloys - Properties of Aluminum alloys: Typical welding problems in Aluminum alloys, weldability of Al-Cu alloy. Cu-base alloys and weldability of phosphorous- deoxidised copper, Aluminum bronze and cupronickel alloys.

Unit IV: Dissimilar metal welding and Joining of Ceramics (12 hours)

Welding of dissimilar metals: Importance and applications of dissimilar metal welding, Challenges in welding of dissimilar metals, metallurgical compatibility, Heating process during dissimilar joining, weld dilution in dissimilar metal welding, interlayers in dissimilar metal welding, Buttering Technique. Examples of dissimilar metal welding: Welding Aluminum to steel, Copper to steel, P91 to AISI 304.

Joining of ceramics: Properties of ceramics, Problems in joining ceramics, Metal/ceramic joining techniques-Active metal Brazing, Metallization, solid state diffusion with case studies.

Unit V: Defects and Quality testing of weldments (12 hours)

Defects in weldments-Misalignment, porosity, Reinforcement, crater, slag inclusions, spatter, under bead crack, incomplete penetration, Burn-Through, overlap, their causes, effects and remedies.

Weld decay /sensitization and knife line attack in Austenitic stainless steel, stress corrosion cracking, causes, effects, and remedial measures.

Hot cracking and cold cracking causes and remedies.

Introduction to quality testing of weldments: Principle of dye penetrant test and Radiography. Quality testing of weldments using dye penetrant and Radiography.

Textbooks:

1. Principles of welding, Robert W. Messler,Jr. Wiley-VCH
2. Metallurgy of Welding, J.F.Lancaster
3. Parmer. R. S. “Welding Engineering and Technology”, Khanna Publications

Reference Books:

1. R.S. Parmer: Welding Processes and Technology, Khanna Publishers
2. G. den Ouden M.J.M. Hermans,VSSD
3. Nadkarni S.V., “Modern Arc Welding Technology”, Oxford IBH Publishers

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech. (MME) VI Semester Syllabus

L	T	P	C
3	1	0	4

MH602PC: Materials Characterization

Course Objectives:

- To obtain knowledge on various structural and microstructural characterization techniques of materials.
- To study the principles, theory and practice of various characterization techniques.
- The latest advancement in microscopy for getting structural and elemental analysis of materials.

Course Outcomes:

1. To analyze microstructure of the materials by operating Optical Microscope and, also, quantitative metallography.
2. To make out the basic operational modes of a Scanning Electron Microscope.
3. To identify the basic operational modes of a Transmission Electron Microscope and the diffraction patterns.
4. To comprehend the production of x-rays and the principles of diffraction (Bragg's Law).
5. To realize the applications of X-ray diffraction - Determinations of Crystal Structure, Precise Parameter, Phase Diagram, Order-Disorder Transformation and Residual Stress.

UNIT I: Optical Microscopy

Optical Principle – Image formation, Resolution, Numerical aperture, Magnification, Components of Optical microscope, Illumination System – Electric Lamps Optical microscope, Important lens defects and their corrections, Specimen Preparation – Sectioning, Mounting, Grinding and Polishing and Etching, Imaging Modes – Bright and Dark Field, Principle of Phase Contrast, Polarized light microscopy, Differential Interference Contrast and Confocal Microscopy, Elements of quantitative Metallography.

UNIT II: Scanning Electron Microscopy

Principle – Construction and Working principles SEM, Electron Sources – Thermionic Emission Gun and Field Emission Gun, Electromagnetic Lenses, Working Distance, Depth of field, Depth of focus, Signal Detection, Contrast Formation - Interaction of electron beams with matter, Topographic Contrast, and Compositional Contrast, Different types of modes used in SEM (SE and BSE) and their applications, Specimen preparation for SEM, Advantages, limitations, and applications of SEM.

UNIT III: Transmission Electron Microscopy

Principle – Construction and Working principle of TEM, Resolving power and Magnification, Depth of field and Depth of focus Image, Specimen Stage, Specimen preparation for the TEM – Pre-Thinning, and Final Thinning – Electrolytic Thinning, Ion Milling, and Ultramicrotomy, Modes: Bright and Dark field, Mass – Density Contrast and Diffraction Contrast – Selected Area Diffraction, Applications of TEM, Advantage and Limitations of TEM.

UNIT IV: X - Ray Diffraction

Introduction of X-rays, Production – Filament tube method and properties of x-rays – Continuous and Characteristic Spectrum, Bragg's law of diffraction, Diffraction under non-ideal conditions, Experimental Methods of Diffraction – Transmission and Back-Reflection Laue method, Powder method, Diffractometer, Intensity of Diffracted beams – Scattering by an electron, by an atom, by a unit cell, Structure-factor calculations – Simplest unit cell, Base, Body and Face-Centered and Hexagonal unit cells, Examples of NaCl, Factors affecting Diffraction Intensities – Multiplicity and Absorption factors, Temperature factor, Lorentz factor.

UNIT V: Application of XRD

Orientation of single crystals – Schultz methods, Effect of plastic deformation; The structure of Polycrystalline Aggregates-Crystal size: Grain size and Particle size, Crystal Perfection: Quality, Crystal Orientations: Texture of Wire and Sheet, Determination of crystal structure – Indexing pattern of Cubic and Non-Cubic crystals, Determination of No. of Atoms in a unit cell and Atom Position, Precise lattice parameter measurements - Cubic and Non-Cubic crystals, Stress measurement: Principle and Experimental Technique: Diffractometer, Order-disorder transformation – Long range ordering in $AuCu_3$, Au-Cu.

TEXTBOOKS:

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods – Yang Leng – John Wiley and Sons (Asia) Pvt. Ltd. 2008
2. Elements of X-ray diffraction – Bernard Dennis Cullity and Stuart R Stocks, Prentice Hall, 2001 – Science
3. Materials Characterization (Vol. 10), George M. Crankovic, Kathleen Mills, Ruth E. Whan, ASM Handbook Committee

REFERENCES:

1. Microstructural Characterization of Materials – David Brandon, Wayne D Kalpan, John Wiley and Sons Ltd., 2008.
2. The Principles of Metallographic Laboratory and Practices (Metallurgy) – George L. Khel- McGraw-Hill, 1949.
3. Experimental Techniques in Materials and Mechanics – C. Suryanarayana, CRC Press, Taylor & Francis Group, 2011.
4. Metallography: Principles and Practices – George F. Vander Voort, ASM International, 1984 – Technology and Engineering

5. X-ray diffraction: A Practical Approach – C. Suryanarayana and M Grant Norton, Springer Science Business Media, LLC, 1998.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech.(MME) VI Semester Syllabus

L	T	P	C
3	0	0	3

MM603PC: Powder Metallurgy

Course Objectives:

- This course is designed to impart various principles of metal powder processing applied to fabrication of structural and commercial products.
- It is also intended to elucidate the process variables in powder metallurgy technology and develop concepts of intellectual thinking for future applications

Course Outcomes: This course creates a platform for students to develop a thorough understanding on
(At the conclusion of the course, the student will be able to have thorough understanding on)

1. Powder Manufacturing techniques
2. Powder characterization
3. Powder consolidation
4. Major applications of P/M

UNIT I: Introduction.
Importance and emergence of powder metallurgy Metal powder technology, comparison of powder metallurgy with other manufacturing techniques. Merits, limitations, and applications.
Powder Production methods: chemical reduction (tungsten, iron), carbonyl decomposition (iron, nickel), atomization (pure metal and multicomponent alloy powders), milling (oxides), and electrolysis (elemental powders).

UNIT II: Powder Characterization
Determining powder characteristics: particle shape, size, size distribution (Sieve analysis, Fisher Sub sieve), specific surface area, apparent and tap density (Hall Flow meter), angle of repose, compressibility/compactibility. Influence of the manufacturing process on powder characteristics.

UNIT III: Consolidation of Metal Powders: Compaction:
Introduction and importance of Compaction**,** Die compaction, Single die and double die compaction. Theory of compaction: Pressure transmission in powders. Pressure dependence of densification. Green strength, Green Density.

UNIT IV: Consolidation of Metal Powders: Sintering:
Introduction to Sintering, Mechanisms of solid state and liquid phase sintering. Effect of powder characteristics on compaction and sintering. Hot Pressing, Sinter forging.

Properties of P/M parts: mechanical properties (UTS, YS and ductility) and Physical properties (thermal and electrical conductivity, density). Principles of Spark Plasma sintering.

UNIT V: Powder Metallurgy Products:

I. Porous Parts: Filters, Self-lubricating bearings (CuSn).

II. **Dispersion strengthened materials**: (Al_2O_3, Ni-ThO_2).

III. **Electrical materials** - Tungsten lamp filaments, Thoriated tungsten welding electrodes, tungsten automobile electrical contacts

IV. **Magnetic materials**: Fe-Ni soft magnets, ALNICO and $SmCo_5$ permanent magnets.

V. **Cutting Tools**: Cemented carbides (WC-Co). VI. Special Products: Heavy alloys (W-Ni-Fe).

TEXTBOOK:

1. Powder metallurgy – Anil Kumar Sinha, Dhanpat Rai & Sons, NaiSarak, 110006, 1981

REFERENCES:

1. Powder Metallurgy Science- Randall M German , Metal Powder Industries Federation, 1994 - Technology & Engineering ,USA,1994
2. Powder Metallurgy Science, Technology and Materials, Anish Upadhaya, GS Upadhaya, University Press, IIM, 2011
3. Introduction to powder metallurgy – J.S. HirshhornAmerican ***Powder Metallurgy*** Institute, Princeton NJ, 1969
4. Treatise on Powder metallurgy – Claus Guenther Goetzel Vol 1& II Interscience Publishers, 1950
5. Powder Metallurgy principles – Fritz V. Lenel , Princeton, 1986
6. ASM Handbook on Powder Metallurgy, Metals Park, Ohio, USA

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech.(MME) VI Semester Syllabus

Professional Elective – I

L	T	P	C
3	0	0	3

MM611PE: Introduction to Numerical Analysis

Course objectives:

- This course introduces numerical analysis, which is the backbone of Computational Materials Engineering

Course Outcomes:

At the end of the course, the student should be able to

- Understand interpolation and curve fitting
- Understand numerical differentiation and integration
- Solve algebraic and transcendental equations
- Find roots of polynomial equations
- Find Eigen values and Eigen vectors

Unit 1

Approximations and errors in computation, finite differences-divided differences, Newton-Gregory forward and backward interpolation formulae, Newtons divided difference interpolation, Lagrange's interpolation, inverse interpolation, curve fitting by the method of least squares, linear and quadratic curve fitting.

Unit 2

Numerical differentiation and numerical integration, trapezoidal and Simpsons rules, numerical double integration. Numerical solution of initial value problems in ordinary differential equations by Taylors series method, modified Eulers method, Runge-Kutta methods of second and fourth orders, predictor-corrector method, Adams Bashforth and Adams Moultan methods.

Unit 3

Numerical solution of algebraic and transcendental equations, rate of convergence and condition of convergence, Methods of ordinary iteration, Regula-falsi and Newton-Raphson methods

Unit 4

Multiple roots of polynomial equations by generalized Newtons method, Solution of systems of linear equations by Newton-Raphson method. Solution of systems of linear equations, Gauss-Jacobi, Gauss-Seidel and relaxation methods

Unit 5

Eigenvalues and eigenvectors, finding the largest eigen value by power method. Solving difference equations with constant coefficients

Textbooks

1. Richard L. Burden and J. Douglas Faires, Numerical Analysis - Theory and Applications, Cengage Learning, Singapore.

2. S.S. Sastry, Introductory Methods of Numerical Analysis, Fourth Edition, Prentice-Hall, India.

References

1. David Kincaid and Ward Cheney, Numerical Analysis - Mathematics of Scientific Computing, American Mathematical Society, Providence, Rhode Island.

2. Kendall E. Atkinson, An Introduction to Numerical Analysis, Wiley India.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech.(MME) VI Semester Syllabus

L	T	P	C
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Professional Elective I

MM612PE: Nanomaterials

Course objectives:

- This course is primarily intended to expose the students to a highly interdisciplinary subject.
- This would emphasize on the classification, synthesis and applications of Nano materials.

Course outcomes: After completing this course, the student should be able to:

1. Indicate the differences between nanomaterials and conventional materials
2. Indicate how specific synthesis techniques can result in nanomaterials
3. Give examples of specific nanomaterials and explain the scientific reasons for the properties displayed by them
4. Describe how specific characterization techniques can be used to analyze nanomaterials

UNIT – I: Introduction

Importance of Nanotechnology, Emergence of Nanotechnology, Bottom-up and Top- down approaches, merits, challenges and applications of Nanotechnology. Important classes of Nanomaterials, description with appropriate examples. Significant characterization methods involved for these Nanomaterials.

UNIT – II: Zero dimensional nanostructures

Nanoparticles-synthesis through homogenous nucleation; growth of nuclei, Fundamentals of heterogeneous nucleation, synthesis of metallic Nanoparticles through heterogeneous nucleation, synthesis of nanoparticles using micro emulsions and Aerosol.

UNIT – III: One dimensional nanostructures

Nanowires and nanorods, Spontaneous growth: Evaporation and condensation growth, vapor-liquid-solid growth, stress induced recrystallization. Template based synthesis: Electrochemical deposition, Electro-phoretic deposition. Electro-

spinning and Lithography.

UNIT – IV: Two dimensional nanostructures

Fundamentals of film growth. Physical vapour Deposition (PVD), Chemical Vapour Deposition (CVD), Typical chemical reactions, Reaction kinetics, transport phenomena involved in CVD methods, deposition of diamond films by CVD. Evaporation molecular beam epitaxy (MBE), Sputtering, Comparison of Evaporation and sputtering. Thin films, Atomic layer deposition (ALD), Electrochemical deposition (ECD), Sol-Gel films.

UNIT – V: Three dimensional nanostructures

Nanocomposite materials, synthesis, characterization, and applications. Special Nano Materials, Carbon fullerene and nano tubes: carbon fullerenes, formation, properties, and applications. Carbon nano tubes: formation and applications.

TEXTBOOKS:

1. Nano structures and Nano materials: Synthesis, properties and applications - Guozhong Cao- Imperial College press in 2004, 2nd edition.
2. Textbook of Nano Science and Technology, B S Murthy, Universities press-IIM series in Metallurgy and Material Science

REFERENCE BOOKS:

1. Springer Handbook of Nanotechnology
2. Nano Materials Synthesis, Properties and applications, 1996 Edlstein and Cammarate.
3. Nano Materials A.K. Bandhopadyay/ New age Publications
4. Nano Essentials T Pradeep / TMH

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech.(MME) VI Semester Syllabus

L	T	P	C
3	0	0	3

Professional Elective – I

MM613PE: Alloy Steels

Course Objective:

Understand the basic concepts of advanced steels

Course Outcome:

1. Understand the structure and properties automotive applications
2. Understand the properties and applications of stainless steels
3. Understand the processing, properties, and application of Maraging steels
4. Know the Steels used in fossil fired power plants, pipes and railways
5. Know the steels used in Fission and Fusion power plant

UNIT-I
Steels for Automobile applications, comparative study of interstitial free, dual phase steels , HSLA steels, TRIP steels, TWIP steels, $\acute{r}$-values, bainitic steels and heat treatments

UNIT-II
Composition properties and application of stainless steels, ferritic martensitic, austenitic steels, semi austenitic steels, precipitation hardening steels, duplex steels

UNIT-III
Maraging steels, composition, heat treatment, melting, fabrication, and applications

UNIT-IV
Steels for fossil fired power plants, oil and gas industries, long products, railways

UNIT-V
Steels for nuclear fission reactors: Temperature and Pressure requirements, Low alloy ferritic steels, Austenitic stainless steels, role of alloying elements, Radiation damage, Steels for nuclear fusion reactor: Alloying elements and Activation, RAFM steels, ODS steel, irradiation embrittlement

TEXTBOOKS:

1. Physical Metallurgy and Designing of Steels, F B Pickering
2. The Physical Metallurgy of Steels, W C Leslie
3. Steels: Metallurgy and Applications – D.J. Llewellyn and R.C. Hudd

REFERENCES:

1. Physical Metallurgy of Metals & Alloys - Bricks & Philips
2. Making Shaping and Treating of Steel Vol.- II “Steel Making and Refining Process” - U. S. Steel Co.
3. Fundamentals of Radiation Materials Science, Gary S. Was

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech.(MME) VI Semester Syllabus

L	T	P	C
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Professional Elective – II

MM614PE: Non-Metallic Materials

Course objectives:

- To introduce the student to the range of non-metallic materials available for engineering.
- To understand the classification and significance of nonmetallic materials to apply them in Industries
- To get an exposure to the techniques associated with the synthesis, processing and characterization of these materials and
- To become aware of the applications where these materials are preferred

Course outcomes:

After completing this course the student can:

1. List the prominent non-metallic materials available for engineering applications
2. Indicate the uses for which these materials are preferred
3. Indicate the structure property relations in these materials
4. Indicate the synthesis and processing steps associated with these materials

UNIT I: Non-metals of periodic table

Introduction, structure and properties, advance applications (aerospace, automobile, fuels, electronics, pesticides, household appliances, etc.,):Hydrogen, Carbon Nitrogen, Oxygen, Fluorine, Phosphorus, Sulfur, Chlorine, Bromine, Astatine, Helium, Neon, Argon, Boron, Silicon, Germanium, Arsenic, Antimony, Tellurium.

UNIT II: Fibers

Definition and classification of non-metallic materials, Introduction to Fibers: Concept of Fibers, Types (Properties, and application): natural – cotton, wool, jute, sisal, wood, silk, angora, and asbestos, artificial – nylon, polyester, rayon, fiber glass, polyethylene, aramid, linen, C, SiC,Al_2O_3.Production of natural and artificial fibers: Cotton, Silk, Wool, Nylon, Aramid, C, SiC, Fiberglass.

UNIT III: Glasses

Introduction, thermodynamics and formation of glasses, structural features of glasses, classification, processing, and applications of glasses. Manufacturing methods of glasses.

UNIT IV: Textiles

Textiles. Adhesives, and Foams: Introduction, classification, and applications, manufacturing methods of industrially important textiles, adhesives, and foams.

UNIT V: Advanced materials

Materials used for lasers, integrated circuits, magnetic information storage, liquid crystal display, fiber optics, nano-engineered, quantum computing, fuel, bio and smart applications.

Textbooks:

1. V. Raghavan: Materials Science and Engineering, Prentice-Hall.
2. W.D. Callister, Materials Science and Engineering, 10th Edition, 2020, Wiley and Sons.

Reference Books:

1. W.S. Smith: Principles of Materials Science and Engineering, McGraw-Hill.
2. Ajit Behera, Advanced Materials: An Introduction to Modern Materials Science, Springer International Publishing, 2021.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech.(MME) VI Semester Syllabus

Professional Elective – II

L	T	P	C
3	0	0	3

MM615PE: ADVANCES IN SURFACE ENGINEERING

Course Objectives:

This course primarily focuses on understanding, analyzing and controlling the properties of solid surfaces. It provides knowledge about techniques for altering surface properties. The advancements that have taken place in the recent times will be discussed in detail.

Course Outcomes: At the conclusion of this course, the student will be able to

1. Understand the significance of surfaces and surface characteristics
2. Design a method of surface coating for the given material
3. Evaluate the surface characteristics to correlate with the behavior of the engineering component
4. Recommend the surface engineering technique suiting to the application

UNIT-I: History and background of Surface Engineering

Fundamental approach to surface engineering; scope and emergence; current trends in surface engineering and future scope of surface engineering; factors influencing the surfaces; Types of surface modification treatments; Industry oriented applications of surface engineering; Advantages and Limitations.

UNIT-II: Surface Characterization Techniques

Surface characterization techniques: Principles and procedures involved; Equipment and process design; Classification; Determination of Surface characteristics viz., thickness, continuity, hardness, adhesion, porosity, and bond strength.

UNIT-III: Advances in Surface Coatings-I

Necessity of advances in surface coatings; generation of water repellent surface coatings-techniques to improve wetting and surface characteristics; creation of biocompatible surfaces-techniques, principles and procedures involved.

UNIT-IV: Advances in Surface Coatings-II

Factors that are responsible for the requirement of thin film coatings; Significance of thin films; Plasma assisted, and Plasma enhanced Chemical Vapor deposition (CVD) and Physical Vapor Deposition (PVD) techniques; Laser supported thin film coating techniques; Liquid phase techniques.

UNIT-V:

Synthesis, processing and Characterization of nanostructured coatings; Applications of advanced surface coatings in medical filed. Polymer coatings; Futuristic view of these advanced surface coating techniques.

TEXTBOOKS:

1. K G Budinski, Surface Engineering for wear resistance, Prentice Hall, New Jersey, 1998
2. Surface Engineering, Process fundamentals and applications, Vol I and II, Lecture Notes of SERC school of Surface Engineering
3. Polymer Surfaces, From Physics to Technology, F. Garbassi, M. Morra, E. Occhiello, Wiley, New York, ISBN 0471971006

REFERENCES:

1. Intermolecular and Surface Forces, J.N. Israelachvili, Academic Press 2011, ISBN 9780123751829
2. Electroplating: Basic Principles and Practice - Kanan. N (Elsevier) 2004

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech.(MME) VI Semester Syllabus

Professional Elective – II

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MM616PE: Fracture Mechanics and Failure Analysis

Course objectives:

- Gain an understanding of fundamentals of fracture mechanics, Griffith crack theory.
- Analyse the crack behavior in various conditions.
- Obtain a working knowledge of failure analysis.

Course Outcomes:

CO 1	Fundamental understanding of fracture mechanics.
CO 2	Awareness about crack formation and crack growth in materials under various conditions.
CO 3	Able to analyze and take remedial steps in case of failure by fracture.
CO 4	Gaining theoretical knowledge on different techniques to find properties of failure.
CO 5	Designing a material to withstand different loading and service conditions.

UNIT I: Introduction to fracture mechanics

Fracture criteria, theoretical strength, stress-concentration factor, Griffith crack theory, strain-energy release rate. Stress Concentration effect of flaws, Effect of material properties on fracture, Cleavage, Brittle and Ductile fracture, ductile brittle transition, Modes of fracture, Stress corrosion cracking, Damage tolerance, Fracture in different materials, Fractography, Case studies.

UNIT II: Introduction to LEFM

Atomic view of fracture, modes of fracture, Griffith theory, Energy release rate, instability and R Curves, compliance, tearing modulus, Stress and Displacement field in isotropic elastic materials, Airy stress function, Stress analysis of crack, Stress intensity factor (SIF), relation between K and global behaviour. Miner's rule.

UNIT III: Elastic-Plastic Fracture Mechanics

Crack tip deformation and plastic zone size, plane stress vs plane strain, effective crack length, Irwin plastic zone correction, Dugdale approach, effect of plate thickness. J Contour Integral: Relevance and scope, J as a path-independent line integral, J as a stress intensity parameter, J-Controlled fracture, Laboratory measurement of J, Crack Tip Opening Displacement (CTOD), Relationship between CTOD, K and G, Equivalence between CTOD and J, Determination of CTOD from strip yield model.

UNIT IV: Fatigue

Introduction to fatigue, factors affecting fatigue performance, fatigue loading, constant and variable amplitude loading, some characteristics of fatigue crack, Paris Law, Mayer's Law.

UNIT V: Creep

Introduction to creep, stages of creep, deformation mechanisms (dislocation, diffusion, grain boundary sliding), elevated temperature fracture conditions, equicohesive temperature, creep tests, designing criteria of components. Nabarro-Herring creep, Coble creep, Monkman and Grant equations.

Textbooks:

1. Fracture Mechanics: Fundamentals and Applications, T.L. Anderson, CRC Press, Inc., 1995.
2. Fracture and Fatigue Control in Structures, S.T. Rolfe and J.M. Barsom, Prentice-Hall, 1972.
3. Case Histories in Failure Analysis, ASM, Ohio, 1979.

Reference Books:

3. ASM Handbook: Fatigue and Fracture, S.R. Lampman, (Rechnical Ed.), ASM International, 1996.
4. Elementary Engineering Fracture Mechanics, David Broek, Scjtoff & Noordhoff, 1978.
5. Failure Analysis – R.W. Hertzberg, Deformation of Fracture Mechanics of Engineering Materials – John Wiley & Sons Publications, 1995.

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MAHATMA GANDHI INSTITUTE OF TECHNOLOGY

B.Tech. VI Semester

MC601HS: Intellectual Property Rights

(Common to CIVIL, EEE, ECE, MEC, MCT &MME)

Course Objectives: The objectives of the course are:

- To enable the students to have an overview of Intellectual Property Rights
- To provide comprehensive knowledge to the students regarding Trademarks Registration process and law related to it.
- To disseminate knowledge on Copyrights, its related rights and recent developments.
- To make the students understand Patent Regime in India and abroad.
- To understand the framework of Trade secrets

Course Outcomes: After completion of the course students will be able to:

- Gain knowledge on Intellectual property rights and their importance.
- Understand Indian and international Trademark Law and procedure for registration of Trademarks.
- Acquire knowledge on Copyright Law, and the privileges awarded to the copyright owners.
- Familiarized with the process of acquiring the patent and relevant laws.
- Learn the importance of trade secrets for business sustainability.

UNIT – I

Introduction to Intellectual property

Introduction of IPR-Meaning of intellectual property, types of intellectual property-trademarks, copyrights, patents, trade secrets, importance of intellectual property rights, International organizations-WTO-WIPO-USPTO-INTA, International Conventions, agencies and treaties- Paris Convention-Berne Convention- Madrid Protocol-NAFTA-PCT-GATT-TRIPS.

UNIT – II

Trademarks

Trademarks: Purpose and functions of Trademarks-Categories of marks, acquisition of Trademark rights - Protectable matter - Selecting and evaluating Trademark- Trademarks registration process – Trademark Infringement - Remedies for infringement in Trademarks-New developments in Trademark Law- International Trademarks Law.

UNIT III

Copyright

Copyrights-Fundamental of Copyright Law -Requirements of Copyrightability- Originality of material, fixation of material, Authorship works, exclusions from copyright protection- Rights of Copyright Owner-Right of reproduction of copyrighted work, right to do derivative works ,right to distribute copies of the copyrighted work, right to perform the work publicly, right to display the copyrighted work, – Copyright Ownership issues – Joint Works, Works made for Hire, Specially commissioned works, Copyright Registration - Notice of Copyright – Copyright Infringement -

Remedies for infringement in Copyrights- New developments in Copyright Law- International Copyright Law.

UNIT IV:

Patents

Patents: Concept of Patent - Classification – Utility Patents – Design Patents and Plant Patents, Patent searching process-Types of Patent Applications-Patent Registration Process, Ownership, Transfer, Assignment and Licensing of Patent-Patent Infringement, Remedies for Infringement of Patents, New developments in Patent Law- International Patent Law.

UNIT – V:

Trade Secrets & Law of Unfair Competition

Trade Secrets: Trade secret law, determination of trade secrete status, measures for protecting trade secret status-Liability for misappropriations of trade secrets, protection for submissions, trade secret litigation. New developments in Trade secrets Law- International Trade Secrets.

Law of Unfair competition: Passing off, Misappropriation, right of publicity, dilution of trademarks, product disparagement, false advertising.

Text Books:

1. Deborah. E. Bouchoux, Intellectual property, 4 e,Cengage learning India Pvt.Ltd., 2013
2. Prabuddha Ganguli, Intellectual property right, 8e,Tata McGraw Hill Publishing company, 2016
3. Dr.B.L.Wadehra, Law Relating to Intellectual Property,5 e, Universal Law Publishing Co. 2011.

References

1. Richard Stim, Intellectual Property, 3e Cengage learning India Pvt.Ltd., 2017
2. Vinod.V.Sopele, Asoka K.Ghosh,Managing Intellectual Property, 2 e,2010
3. Ananth Padmanabhan, Intellectual Property Rights – Infringement and Remedies, Lexis Nexis Publishers, 2012

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V/VI Semester Syllabus

MC501ES/ MC601ES: ARTIFICIAL INTELLIGENCE
(Common to all Branches except CSE(AI&ML))

Course Objectives:
- To learn the distinction between optimal reasoning Vs. human like reasoning
- To understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.
- To learn different knowledge representation techniques.
- To understand the applications of AI, namely game playing, theorem proving, and machine learning.

Course Outcomes:
- Ability to formulate an efficient problem space for a problem expressed in natural language.
- Select a search algorithm for a problem and estimate its time and space complexities.
- Possess the skill for representing knowledge using the appropriate technique for a given problem.
- Possess the ability to apply AI techniques to solve problems of game playing, and machine learning.

UNIT - I

Introduction: AI Definition, Agents and Environments, Structure of Agents, Types of Agents. Problem Solving Agents: Problem spaces, states, goals and operators.

Uninformed Search Strategies: Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening depth first search, Bidirectional Search.

UNIT – II

Informed Search: Heuristic Search strategies, Hill Climbing, A*, Hill climbing search.
Game Playing: Adversarial Searches. Two player games. Min-max Search: Algorithm, Problems. Draw Back of Min-Max Algorithm. Alpha-beta pruning: Algorithm, Problems.

Constraint Satisfaction Problems: Definition, Crypt-Arithmetic Problems, Map Coloring, Backtracking.

UNIT - III

Basic Knowledge Representation and Reasoning: Propositional Logic: Basics of logic, truth tables and sentence conversions.

First order logic: Difference between Proposition & First order logic. Conjunctive Normal form. Disjunctive Normal Form. Conversion of English sentences into First order logic. Resolution and theorem proving. Problems of Resolution. Forward Chaining: Definition, Example problems. Backward Chaining: Definition, Example problems.

UNIT – IV

Planning: Classical Planning: Definition of Classical Planning, Algorithms for Planning with State-Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches.

Planning and Acting in the Real World: Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multi agent Planning.

UNIT – V

Uncertain knowledge and Learning Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its use.

Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First-Order Probability

Learning: Forms of Learning, Supervised Learning, Learning Decision Trees.

Knowledge in Learning: Logical Formulation of Learning, Knowledge in Learning, Explanation-Based Learning, Learning Using Relevance Information, Inductive Logic Programming.

Text Books:

1. Artificial Intelligence: A Modern Approach by S. Russell and P. Norvig, Prentice Hall. 2010, third edition.
2. Artificial Intelligence by Elaine Rich, Kevin Knight and Shivashankar B Nair, Tata McGraw Hill.

Reference Books:

1. Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, Pearson Education.
2. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson
Education, 6th ed., 2009.
3. Artificial Intelligence – Patric Henry Winston – Third Edition, Pearson Education

NOTE: For CSE and allied branches Artificial Intelligence is in V Semester and Cyber Security is in VI Semester.

For other branches Cyber Security is in V Semester and Artificial Intelligence is in VI-semester.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B.Tech.(MME) VI Semester Syllabus

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MM651PC: Metal Joining Lab

Objective:

- This Laboratory course is designed to make the student to understand and demonstrate the various types Welding processes and its variables, testing methods and correlation between microstructure and Mechanical properties of the Welded joints.

Course Outcomes:

1. Select process parameters by bead on plate trial.
2. Gain knowledge in practical aspects of SMAW, GMAW SAW
3. Gain knowledge on welding of carbon steel,
4. To carryout characterization and testing techniques for welded joints.

Experiments

1. Study of gas welding equipment and process. Identification of flames, making Butt joint with gas welding.
2. Study of Arc welding process, comparison of the bead geometry with DCSP, DCRP and A.C.
3. Study of resistance spot welding process and plot the variation of spot area with time and current variation
4. Study of Tungsten Inert Gas (TIG) welding process and measurement of temperature during TIG welding process.
5. Study of fundamental aspects of Submerged Arc Welding (SAW) process and finding out deposition efficiency of the process.
6. Study of fundamental aspects of MIG welding process
7. To conduct tests on weld joints to evaluate the mechanical properties of the joints, like bend test and ram tensile test.
8. To evaluate the microstructure of welded joint and understand the structural difference in Weld zone, Heat Affected Zone and Base metal.

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B.Tech.(MME) VI Semester Syllabus

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MM652PC: Metallurgical Computations Lab

Objective:

- This Laboratory course is designed to make the student to understand and demonstrate
- This lab course is mainly designed to provide hands on practice onthe computational methods for evaluation of metallurgical and materials engineering properties

Course Outcomes:

Upon successful completion of this course, the student will be able to write simple computational methods

1. For phase rule, ASTM grain size and packing factor
2. For Calculation of UTS and YS, elongation and reduction in area and Hall Petch relation
3. For determination of heat transfer data
4. For determination of free energy, entropy and enthalpy

LIST OF EXPERIMENTS: Programming of

1. Estimation of proportion of phases using Lever rule, ASTM grain size and packing factor for bcc, fcc and hcp
2. Determination of ΔH using Kirchhoff's equation, ΔG from thermal dataand Entropy
3. To solve the problems on conductions
4. Calculation of UTS and YS and Hall Petch relation
5. Functions in computing free energy of common metallurgical systems from enthalpy and entropy or heat capacity and determination of temperature of reduction of metal oxides.
6. Computation of % CO/CO2 at different heights with a given function of temperature profile along the height of BF and Simulations of Blast furnace reduction reactions at various heights

7. Write a program to simulate mechanical properties of pure metal or simple binary isomorphous / eutectic system from given composition, heat treatment condition, % cold working etc.
8. Write a program to design sacrificial anode cathodic protection of underground pipeline with user given pipe dimension & electrochemical properties

TEXTBOOKS:

1. Computer oriented Numerical methods – V. Rajaraman (PHI Publicatons)
2. Computer programming and Numerical methods – S. Saran
3. Numerical methods in engineering – Mario G. Salvadori and Melvin L. Baron
4. Matrix operation on Computer – L.L. Brirud (LCUE Publication)

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MAHATMA GANDHI INSTITUTE OF TECHNOLOGY
B. Tech. VI Semester
EN653HS: Finishing School-IV
(Advanced Communication Skills Lab)
(Common to CE, EEE, ECE, ME, MCT and MME)

Course Objectives:

This Lab focuses on using multi-media instruction for language development to meet the various needs of the students. The objectives of the course are as follows:

- To improve students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- To enable them to communicate their ideas relevantly and coherently in writing.
- To facilitate placement activities for the students.
- To make the students participate in both oral as well as written presentation skills.
- To equip the students to be efficient in Group Discussions, Presentation Skills and Interview Skills.

Course Outcomes:

Students will be able to:

- Acquire English language vocabulary and use it contextually
- Listen and speak effectively in English language
- Develop proficiency in academic reading and writing skills
- Increase possibilities of job prospects in their respective domain
- Communicate confidently in formal and informal contexts

INTRODUCTION:

Advanced English Communication Skills Lab is considered essential as the students need to prepare themselves for their careers which may require them to listen, speak, read and write in English both for their professional and interpersonal communication in the globalized context. This course would enable students to use English effectively and perform the following:

1. Gathering ideas and information to organize ideas relevantly and coherently.

2. Participating in group discussions.

3. Facing interviews.

4. Writing project/research reports/technical reports.

5. Making oral presentations.

6. Writing formal letters.

7. Transferring information from non-verbal to verbal texts and vice-versa.

8. Taking part in social and professional communication.

Unit – I

Inter-personal Communication – Building General, Technical and Business English Vocabulary – Formal meeting–planning and circulating agenda–opening the meeting–during the meeting–closing the meeting-responding appropriately and relevantly – using the right body language-general-technical-business- vocabulary, analogy.

Unit – II

Reading Comprehension: Reading for facts-skimming-scanning-guessing meanings from context, inferring meaning, critical reading, effective online navigation, sample passages from TOEFL/GRE/IELTS.

Unit – III

Writing Skills: Planning for writing, structure and presentation of different types of writing - letter writing/resume writing, email netiquette, project report writing – feasible/business/ periodical/academic reports.

Unit – IV

Presentation Skills: Brief speeches-introduction to a structured talk– **o**ral presentations (individual and group) /PPTs, gambits of presentation skills – use of tag questions, summarising after a brief talk, opening/during/concluding a presentation.

Unit – V

Group Discussion and Interview Skills: Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation - concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and mock interviews.

Text Books:

1. Effective Technical Communication by M Ashraf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd Edition

2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5th Edition.

References:

1. Learn Correct English – A Book of Grammar, Usage and Composition by Shiv K. Kumar and Hemalatha Nagarajan. Pearson 2007
2. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
3. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
4. Technical Communication by Paul V. Anderson. 2007. Cengage Learning Pvt. Ltd. New Delhi.
5. English Vocabulary in Use Series, Cambridge University Press 2008.
6. Handbook for Technical Communication by David A. Mc Murrey & Joanne Buckley, 2012, Cengage Learning.
7. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
8. Job Hunting by Colm Downes, Cambridge University Press 2008.
9. English for Technical Communication for Engineering Students, AyshaVishwamohan, Tata Mc Graw-Hill 2009.
10. How to Write and Speak Better, Reader's Digest, 2003
11. Cambridge IELTS 16 Academic student's book with answers, 2017
12. TOEFL Reading & Writing Workout, The Princeton Review.
13. GRE Reading Comprehension: Detailed Solutions to 325 questions. Vibrant Publishers, 2017
14. How to prepare for Group Discussions and Interviews by Harimohan Prasad and Rajneesh Prasad, Tata Mcgraw Hill.
15. Keep Talking, Frederick Klippel, Cambridge University Press, South Asian edition (6 May 2010),
16. Objective English, Edgar Thorpe & Showick Thorpe, Pearson; 5th edition (1 August 2013).

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B.Tech. I Semester
MC601ESC: Environmental Science
(Common to CE, EEE, ME, ECE, MCT & MME)

Course Objectives

- To understand the natural resources and their conservation.
- To understand the importance of ecosystem, biodiversity and ecological balance for sustainable development.
- To gain knowledge about environmental pollution, effects and controlling measures.
- To study about global environmental problems and global issues.
- To understand the environmental policies, regulations and sustainable development.

Course Outcomes

After completing the course, the student will be able to:

- Learn about different types of natural resources and take up the measures to protect the resources.
- Get the information about ecosystem, biodiversity and their usage and conservation.
- Get the information about the types of pollution, understand their effects and controlling measures.
- Gain the knowledge about current global environmental issues and initiations to be taken to protect the environment.
- Gain the knowledge about environmental acts, EIA, sustainable development and follow the rules and regulations.

Unit-I: Natural Resources

Classification - Renewable and Non-renewable resources.
Forest Resources - Uses, deforestation- causes, effects and preventive measures.
Water Resources - Uses and over utilization of ground water, rain water harvesting, dams - benefits and problems. Causes, effects and management of floods and drought.
Mineral Resources - Uses and Impacts of mining.
Energy Resources - Growing energy needs, renewable and non-renewable energy resources, use of alternate energy resources.

Unit-II: Ecosystem and Biodiversity

Ecosystem: Concept of ecosystem - Structure and functions of ecosystem. Food chain, food web and ecological pyramids - significance. Primary and secondary production - Energy flow models: universal and single channel. Biogeochemical Cycles: Carbon cycle and Nitrogen cycle.
Biodiversity: Definition, Levels of biodiversity, Values of biodiversity, Hotspots of biodiversity, Threats to biodiversity, Conservation of biodiversity: In-Situ and Ex-Situ conservation methods.

Unit-III: Environmental Pollution

Pollution - Definition and classification.
Air pollution: Definition, sources, causes, effects and control measures. Ambient air quality parameters, Case Study.
Water pollution: Definition, sources, causes, effects and control measures. Waste water treatment. Case study (Namami Ganga Project)
Soil pollution: Sources, Land degradation - Soil erosion – effects and control measures. Impacts of modern agriculture on soil. Biomagnification and Bioaccumulation (Minamata disease).
Noise pollution: Sources, effects and control measures.
Solid Waste: E-Waste and Municipal solid waste management.

Unit-IV: Global Environmental Issues and Global Efforts

Global warming: Greenhouse effect - definition, sources and effects of greenhouse gases. Ozone layer depletion -

Importance of ozone layer, Ozone depleting substances - sources and effects. Acid rain - causes and effects. Climate change - National Action Plan on Climate Change (NAPCC) – Government of India Initiatives. International conventions/protocols: The Earth summit, Kyoto Protocol and Montreal Protocol. Carbon credits - Emission trading, Green Chemistry Principles. Biodiesel-concept - transesterification and advantages.

Unit-V: Environmental Acts, EIA & Sustainable Development

Environmental Protection Act - Legal aspects: Air (Prevention and control of pollution) Act 1981, Water (Prevention and control of pollution) Act -1974, Wildlife (Protection) Act - 1972, Biodiversity Act - 2002. Environmental Impact Assessment (EIA) - Concept, structure and flow chart of EIA. Concept of sustainable development - Environmental education, Concept of green building, Ecological foot print, Low carbon life style, Life cycle assessment (LCA) and Clean development mechanism.

Project Work: Related to current environmental issues.

Suggested Readings:

1. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, University Grants Commission, Universities Press, 3rd Edition.
2. Kaushik A., Kaushik C.P., Text Book of Environmental Studies, New age International Publishers, 4th Edition.

Reference Books:

1. Anji Reddy M., Textbook of Environmental Sciences and Technology, BS Publication.
2. Rajagopalan R., Environmental Studies, Oxford University Press, 3rd Edition.
3. Raghavan Nambiar K., Text Book of Environmental Studies, Scitech Publications 2nd Edition.