Guru Nanak Dev Engineering College, Ludhiana
An Autonomous College under UGC Act 1956
B. Tech. (Mechanical Engineering)

Third semester

				L	T	P	
1	PCC	CME101	Strength of Materials	3	1	2	5
2	PCC	CME102	Applied Thermodynamics-I	3	1	0	4
3	PCC	CME103	Machine Drawing and CAD	1	0	4	3
4	PCC	CME104	Manufacturing Processes	4	0	2	5
5	PCC	CME105	Engineering. Materials & Metallurgy	3	0	2	4
6	MNC	MCME101	Environment Sciences & Sustainability	2	0	0	0
7	PW &S	SMME101	Seminar and Technical Report Writing for Engineers	0	0	2	1
8	MPD	MPD102	MPD	0	0	1	0
9	PW&S	TRME101	Training 1 (after 1st Year)				1
TOTAL (31 hrs)							23

Guru Nanak Dev Engineering College, Ludhiana
An Autonomous College under UGC Act 1956
B. Tech. (Mechanical Engineering)

Course Code: CME 101
Course Title: Strength of Materials

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 2	**Credits:** 5
Semester: 3	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+15(T)+30(P) = 90 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 30%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Formulate mechanics problems using calculus and differential equations.
2	Solve, analyze and design beams under bending stresses.
3	Understand the design considerations of structures subjected to different/wide range of loading conditions including thermal loads.
4	Relate the design problems with practical applications.
5	Solve problem involving simple and combined modes, including torsion.
6	Evaluate slope and deflection in different type of beams under different loading conditions

Contents

Part-A

Unit-1 Simple Stresses and Strains **08hrs**

Stress and Strain and their types, Hook's law, longitudinal and lateral strain, Poisson's ratio, stress-strain diagram for ductile and brittle materials, extension of a bar due to without and with self-weight, bar of uniform strength, stress in a bar, elastic constants and their significance, relation between elastic constants, Young's modulus of elasticity, modulus of rigidity and bulk modulus. Thermal stresses and strains: Temperature stress and strain calculation due to axial load and variation of temperature in single and compound bars.

Unit-2 Principal Stresses and Strains **08 hrs**

Two-dimensional stress system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle for stresses and strains, principal stresses related to principal strains. Strain energy: Introduction to strain energy, strain energy in simple tension and compression. Stresses develop due to a different type of loads. Strain energy in pure shearing, torsion, and due to bending; Theories of failure: Maximum principal stress theory, maximum shear stress theory, maximum principal strain theory, total strain energy theory, shear strain energy theory. Graphical representation and derivation of the equation for these theories and their application to problems related to two-dimensional stress systems.

Unit-3 Bending Moment (B.M) and Shear Force (S.F) Diagrams **08 hrs**

Shear force and Bending Moment definitions; relation between load, shear force and bending moment; B.M and S.F diagrams for cantilevers, simply supported beams with or without overhangs, and calculation of maximum bending moment, Shear force and Point of contra flexure under the following type of loads: a)

Concentrated loads b) Uniformity distributed loads over the whole span or part of span c) Combination of concentrated and uniformly distributed load d) Uniformly varying loads e) Application of moments..

Part-B

Unit-4 Bending Stresses and Deflection in Beams **09 hrs**

Bending theory; assumptions, derivation of bending equation and its application to beams of rectangular, circular and channel, I and T- sections. Combined, direct and bending stresses in afore-mentioned sections, composite / flitched beams. Relationship between moment, slope and deflection, Double integration method, Macaulay's method, moment area method and use of these methods to calculate slope and deflection for the following: a. Cantilevers b. simply supported beams with or without overhang under concentrated loads, uniformly distributed loads or combination of concentrated & uniformly distributed loads.

Unit-5 Torsion **06 hrs**

Derivation of torsion equation, its assumptions and application on the hollow and solid circular shafts. Torsional rigidity, combined torsion and bending of circular shafts, principal stresses and maximum shear stresses under combined loading of bending and torsion.

Unit-6 Thin cylinders and spheres **06 hrs**

Calculation of Hoop stress, longitudinal stress in a cylinder, the efficiency of joints, changes in dimensions due to internal pressure. Principal stresses in a spherical shell, change in diameter and internal volume.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Laboratory Work

Experiment No.	Experiment Title
1	To perform tensile test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.
2	To perform compression test and impact tests on the given specimen
3	To perform hardness test. (Aluminium, Mild steel and Hardened steel)
4	To perform torsion test and to determine various mechanical properties of the given material
5	To perform bending test on beam and to determine the Young's modulus and modulus of rupture
6	To determine buckling load of long columns with different end conditions.
7	To draw load/ defection curve for helical spring
8	To perform Fatigue test on circular test piece.

Text Books

1. S.S. Rattan, "Strength of Materials", Tata McGraw Hill, 11th Edition, 2014 (E-Book).
2. R.S. Lehri, "Strength of Materials", Katson, 11th Edition, 2012.
3. Egor P. Popov, "Engineering Mechanics of Solids", Prentice Hall of India, 2nd Edition, 2001.
4. R. Subramanian, "Strength of Materials", Oxford University Press, 3rd Edition, 2 2007.
5. Timoshenko, "Mechanics of Materials", CBS Publication, 2nd Edition, 2006.

Reference Books

1. Kirpal Singh, "Mechanics of Materials", Standard Publishers, 7th Edition, 2013.

2. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, "Mechanics of Materials", Tata Mc-GrawHill Publishing Co. Ltd., 2005.
3. Sadhu Singh, "Strength of Materials", Khanna Publication, 11th Edition, 1978.
4. Russell C. Hibbeler, "Mechanics of Materials", Pearson Publications, 10th Edition, 2016.

Online Learning Materials

1. https://youtu.be/GkFgysZC4Vc Accessed on May 11, 2025
2. https://youtu.be/L04cOewVpEs Accessed on May 11, 2025
3. https://www.youtube.com/embed/rTkJydxVbFQ Accessed on May 11, 2025
4. https://www.youtube.com/embed/xSM2E98T5wk Accessed on May 11, 2025
5. https://www.youtube.com/embed/xyZ29zDdvCE Accessed on May 11, 2025
6. https://www.youtube.com/embed/aQM8d7kzdXU Accessed on May 11, 2025
7. https://www.youtube.com/embed/Zt3ENh1xwak Accessed on May 11, 2025

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Strength of Materials	Prof. Sriman Kumar Bhattacharyya	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc19_ce18/preview
2	Strength of Materials	Prof. K Ramesh	IIT Madras	https://onlinecourses.nptel.ac.in/noc25_me73/preview
3	Structural Analysis-I	Prof. Amit Shaw	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc25_ce54/preview

Experiments to be performed through Virtual Labs

Sr. No.	Experiment Name	Experiment Link(s)
1	To measure strains on a beam in bending at fixed locations along the length of the beam, on tensile and compressive fibres.	https://vlab.amrita.edu/index.php?sub=77&brch=299&sim=1627&cnt=1
2	To determine experimentally, the ultimate shear strength in double shear of mild steel rod.	https://sm-nitk.vlabs.ac.in/exp/direct-shear-test-steel-rod/
3	To study the behaviour of mild steel rod subjected to gradual increasing equal loads at 1/3rd span and to determine its mechanical properties.	https://sm-nitk.vlabs.ac.in/exp/bending-test-mild-steel/
4	To find the Rockwell hardness number of mild steel, cast iron, brass, aluminium and spring steel etc.	https://sm-nitk.vlabs.ac.in/exp/rockwell-hardness-test/
5	To Study the beam under different loads acting on it.	https://bsa-iiith.vlabs.ac.in/exp/single-span-beams/objective.html
6	To determine the Column stability using boundary conditions.	https://bsa-iiith.vlabs.ac.in/exp/column-analysis/objective.html

Guru Nanak Dev Engineering College, Ludhiana
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B. Tech. (Mechanical Engineering)

Course Code: CME-102
Course Title: Applied Thermodynamics-I

Programme: B.Tech.	**L:** 3**T:**1**P:**0	**Credits:**4
Semester:3rd	**Theory/Practical:** Theory	**Teaching Hours:**45(L)+15(T) =60hrs
Total Max.Marks:100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) : Marks:** 60
Minimum Percentage of Numerical/Design/Programming Problems in ESE:50%		
Duration of End Semester Examination (ESE):3hours		
Course Type: Core Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: Scientific Calculator, Steam Table/Charts

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Understand the basic concepts of thermodynamics and Zeroth Law of Thermodynamics.
2	Apply the knowledge of First law of thermodynamics for various engineering applications.
3	Analyze the concept of Second law of Thermodynamics and related properties for the feasibility of engineering systems and solve engineering problems.
4	Evaluate and analyze the performance of Air Standard cycles for the particular applications in IC Engine.
5	Recognize the nature of substance from the understanding of its properties and use related Tables and Charts.
6	Evaluate and analyze the performance of Vapor power cycles.

Contents

Part-A

Unit-1. Basic concepts of Thermodynamics **09 Hrs**

Brief concept of continuum, Thermodynamic System, Boundary and Surroundings, Control (fixed) mass and Control Volume concept, Thermodynamic State, Thermodynamic Property, Condition for any quantity to be a property, Thermodynamic equilibrium, Thermodynamic path and process, Concept of reversible process, Quasi-static process, Irreversible process, Cyclic process, Energy and its forms; Physical insight to internal energy, Energy transfer across system boundary i.e. transient energies, Heat and work transfer-their comparison and sign conventions, Displacement work and other modes of work, Zeroth law of Thermodynamics.

Unit-2. First law of Thermodynamics **06 Hrs**

First law of Thermodynamics and its applications to closed and open system, Analysis of non- flow processes for a control mass undergoing constant volume, constant pressure, constant temperature, adiabatic and poly-tropic processes. Steady and unsteady flow processes and its applications in various engineering devices.

Unit-3.Second law of Thermodynamics **08 Hrs**

Limitations of first law of Thermodynamics, Heat reservoir, source and sink, Heat engine, Refrigerator, Heat

pump, Kelvin-Plank and Clausius Statements of second law and their corollaries, Carnot and reversed Carnot cycle, Concept of entropy, T-S diagram, Principle of increase in entropy, Applications of second law, High grade and low grade energy, Available and non-available energy, Enthalpy and entropy as a function of independent variables, Third law of Thermodynamics.

Part-B

Unit-4.Gas power cycles and IC Engines **08 Hrs**

Air standard cycle and air standard efficiency. Otto cycle (constant volume heat addition cycle), Diesel cycle (constant pressure heat addition cycle), Dual cycle (mixed, composite and limited pressure heat addition cycle) and Brayton cycle; comparison of otto, diesel and dual cycle under some defined similar parametric conditions. Introduction to heat engines Classification and constructional features of I.C. engines.

Unit-5. Properties of pure substances and Gas Mixtures **06Hrs**

Formation of steam and its Thermodynamic properties, p-V, T-S and an h-s diagram for a pure substance, Use of the steam table and Mollier chart, Determination of dryness fraction, Equation of State of a Gas, Ideal Gas, Internal energy, Enthalpy and Entropy of Gas Mixtures.

Unit-6.Vapor power Cycles **08Hrs**

Steam power cycles, Rankine Cycles, Comparison of Rankine and Carnot Cycles, Reheat Cycle, Regenerative Cycles, Reheat – Regenerative Cycle, Binary Vapor Cycles, Thermodynamics of combined cycles.

Tutorial hours will be used for practice sessions for design/numerical problems/programming/case-studies etc. (as the case may be).

Text Books

1. P.K. Nag, “Engineering Thermodynamics”, McGraw Hill Education (India), Chennai, 6th Edition 2017.
2. V. Ganeshan, “Thermal Engineering”, McGraw Hill Education (India), Chennai
3. Y.A.Cengel, M.A.Boles, “Thermodynamics–An Engineering Approach”, McGraw Hill Education, 8th Edition 2017.
4. R. E. Sonntag, C. Borgnakke, &G. J. V. Wylen, “Fundamentals of Thermodynamics”, Wiley, 7th Edition 2009.
5. M.J. Moran, H.N. Shapiro, D.D. Boettner & M. Bailey,“Fundamentals of Engineering Thermodynamics”, John Wiley & Sons, 7th Edition, 2010.

Reference Books

1. J.B. Jones, & R.E. Dugan, “Engineering Thermodynamics”, Prentice Hall, 1st Edition 1995.
2. D.B. Spalding, E.H. Cole, “Engineering Thermodynamics”, Edwar Arnold, London, 1982.
3. V.G. Erokhim, M.G. Makhan, “Fundamentals of Thermodynamics and Heat Engines”, Mir Publishers, Moscow, 1986.
4. Shvets, V. Tolubinsky, “Heat Engineering”, Med Tech Science and Technology Series, 2nd Edition 1975.

Supplementary SWAYAM Course:

S. No.	Course Name	Instructor	Host Institute	URL
1	Concepts of thermodynamics	Prof. Suman Chakaraborty	IIT, Kharagpur	https://archive.nptel.ac.in/courses/112/105/112105266/

2	Basic thermodynamics	Prof. S.K. Som	IIT, Kharagpur	https://archive.nptel.ac.in/courses/112/105/112105123/
3	Engineering thermodynamics	Prof.V. Babu	IIT, Madras	https://archive.nptel.ac.in/courses/112/106/112106310/

Guru Nanak Dev Engineering College, Ludhiana
An Autonomous College under UGC Act 1956
B. Tech. (Mechanical Engineering)

Course Code: CME103
Course Title: Machine Drawing and Computer Aided Drafting

Programme: B. Tech.	**L:** 1 **T:** 0 **P:** 4	**Credits:** 4
Semester: 3rd	**Theory/Practical:** Theory	**Teaching Hours:** 15(L)+60(P) = 75 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 00%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Acquire the knowledge, understand and remember the elements of a Computer Aided Drafting **(**CAD) through software and its features
2	To develop the capability of modeling important machine components using CAD software through 2D modeling.
3	Use standards used in machine drawing of machine components and assemblies.
4	Analysis of acquired knowledge/understanding for visualization of mechanical mechanisms.
5	Understand the mechanical CAD part to progress in Design and entrepreneurship development.
6	Generate the sectional and orthographic views of assembled components

Contents

Introduction to Computer Aided Drafting tools/software like Pro-desktop or Pro-E or AutoCAD or G-star etc. Requirements of machine drawing; Sectional Views and rules of sectioning, Machining and Surface Finish symbols indicating tolerances in dimensioning. Various types of screw threads, nuts and bolts, screwed fasteners, welding joints, riveted joints, coupling, knuckle joint, couplings, keys and cotter.

Generation of Part and Assembly Drawings including Sectioning and Bill of Materials. First Angle Projection assembly of Various Mechanical Components: Plummer Block, Foot Step Bearing, Steam Stop Valve, spring-loaded Safety Valve, Blow-off Cock, Tail Stock, Screw Jack, Expansion Joint.

Note: First angle projection to be used. BIS codes for various applications in Machine Drawing to certain thinking to design and Entrepreneurship development CAD product. Drawings should contain bill of materials and illustrate the use of its tolerances and surface finish requirements.

Laboratory Work

The following exercises are to be done in 3D modeling using AutoCAD/CATIA or other software

Experiment No.	Experiment Title
1	Popular forms of Screw threads, bolts, and nuts
2	Riveted joints for plates
3	Flange Coupling

4	Knuckle joint
5	Spigot and socket pipe joint
6	Modeling and assembly parts of Plummer Block
7	Modeling and assembly of parts in screw jack
8.	Modeling and assembly of parts in Foot Step Bearing.
9.	Modeling and assembly of parts in Steam Stop Valve.
10.	Modeling and assembly of parts in Blow-off Cock.
11.	Modeling and assembly of parts in Tail Stock.

Software Packages: Auto CAD, CATIA V5 etc.

Text Books

1. Ajeet Singh, "Machine Drawing (including Auto CAD)", McGraw Hill, 2nd edition, 2012
2. N.D. Bhatt, "Machine Drawing", Charotar publications,50th Edition, 2014
3. P.S. Gill, "Machine Drawing", S K Kataria and Sons, 18th edition, 2017 Reprint
4. Pohit, G., Machine Drawing with AutoCAD, Pearson Education Asia (2007).
5. Dhawan, R.K., Machine Drawing, S.Chand & Company Limited (2003).

Reference Books

1. Gene R. Cogorno,"Geometric Dimensioning and Tolerancing for Mechanical Design", McGraw-Hill Professional, 2 nd Edition,2011. (E-Book Available)
2. Paul Drake, Jr., "Dimensioning and TolerancingHandbook", McGraw-Hill Professional, 1 st Edition, 1999.(E-Book Available)
3. French, T. E. and Vierck, C. J., Graphic Science and Design, McGraw Hill (2000)
4. Narayana, K.L., Kannaiah P. and Reddy, K.V., Machine Drawing, New Age International Publishers (2002).
5. SP 46: 1988, "Engineering Drawing Practice for Schools and Colleges", Bureau of Indian standards.

Online Resources:

1. https ://www.autodesk.in/campaigns/autocad-tutorials
2. https://my.solidworks.com/training

Guru Nanak Dev Engineering College, Ludhiana
An Autonomous College under UGC Act 1956
B. Tech. (Mechanical Engineering)

Course Code: CME-104
Course Title: Manufacturing Practices

Programme: B. Tech.	**L**: 3 **T**: 0 **P**: 2	**Credits:** 4
Semester: 3rd	**Theory/Practical: Theory**	**Teaching Hours**: 45(L) +30(P) = 75 Hrs.
Total Max. Marks: 150	**Continuous Assessment (CA)** Marks: 90	**End Semester Examination(ESE)** Marks:60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Nil		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: Nil

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Use the Knowledge of Fundamental principles of Castings, Welding, forming and cutting processes for their practical applications.
2	Identify and suggest equipment, tools and accessories required for performing the various manufacturing processes.
3	Know about cutting tools and their materials and related concepts like tool life, wear, and coolants/lubricants.
4	Identify various machine tools and knowledge of different parameters of the processes for analyzing their effect.
5	Suggest a suitable process for manufacturing of component.
6	Understand the latest technologies in Manufacturing Processes

Contents

Part-A

Unit No -I Introduction **03 Hrs**
Classification of manufacturing processes; Selection criteria for manufacturing processes; General trends in manufacturing.

Unit -II Casting Processes: **10 Hrs**
Introduction to metal casting; Patterns: types, materials and allowances; Moulding materials: moulding sand compositions and properties, sand testing, types of moulds, moulding machines. Cores: functions, types, core making process, core-prints, chaplets. Gating system design, Riser design. Melting furnaces, and metallurgical considerations in casting, Solidification of metals and alloys, Directional solidification, Segregation, Nucleation and Grain growth.

Unit -III Welding Processes **10 Hrs**
Introduction and classification of welding processes; Principle, Equipment and constructional details for Gas welding, Electric Arc welding, relative merits of AC & DC arc welding; Electrodes: types, selection, electrode coating ingredients and their function; Thermal effects on weldment: heat affected zone, grain size and its control; Resistance welding: principle and their types. TIG and MIG welding processes: principle, equipment and constructional details.

Part B

Unit- IV Metal Forming **08 Hrs**
Introduction and classification; Rolling process: introduction, classification, rolling mills, products of rolling,

rolling defects and remedies; Forging: open and closed die forging, forging operations, forging defects, their causes and remedies; Extrusion: classification, equipment, defects and remedies; Drawing: drawing of rods, wires and tubes, drawing defects and remedies; Introduction to sheet metal forming operations.

Unit- V Metal Cutting **07 Hrs**

Introduction to machining processes; Cutting tool geometry, Cutting tool materials: high carbon steels, alloy carbon steels, high-speed steel, cast alloys, cemented carbides, ceramics and diamonds, and CBN; Mechanics of chip formation process, concept of shear angle and cutting forces in metal cutting; Merchant theory, tool wear, tool life, machinability.

Unit -VI Machine Tools **07 Hrs**

Classification, description and operations of Lathe machine, Shaping and Planning Machine, Milling machine, Boring machine; Broaching machine.

Laboratory Work

Sr.No.	Name of Practical
1	To determine grain fineness number, clay content and moisture content of a given sample of moulding sand.
2	To Prepare a specimen of moulding sand on a standard Rammer and to carry out following tests: a) Tensile, compressive and transverse strength b) Mould Hardness c) Shatter index d)Permeability
3	To study the effect of process parameters of MIG Welding (Voltage, wire feed, gas flow) on welding of Mild steel sheet.
4	To study the effect of process parameters of TIG welding (Pulse, Gas flow, current) on welding of Stainless steel and Mild steel sheets.
5	To grind single point and multipoint cutting tools and to prepare introductory report on cutting inserts.
6	To determine cutting forces with dynamometer for turning operation.
7	To prepare a job of spur gears by the use of milling machines

Text Books

1. P. N. Rao, "Manufacturing Technology, Foundry, Forming & Welding", Tata McGraw Hill, 4th Edition, 2017
2. P. N. Rao, "Manufacturing Technology, Metal Cutting and Machine Tools", Tata McGraw Hill, 4th Edition, 2017
3. B. L. Juneja and G. S. Sekhon, "Fundamentals of Metal Cutting & Machine Tools", New Age International (P) Ltd, 2nd Edition, 2017.
4. P. C. Sharma, "A Text Book of Production Technology", S. Chand & Company Ltd., 8th Edition, 2014.
5. H. S. Shan, "Manufacturing Processes", Cambridge University Press, 2nd Edition, 2018.

Reference Books:

1. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Pearson Publishers, 4th Edition, 2002.
2. J.A. Schey, "Introduction to Manufacturing Processes" ,McGraw Hill Co., 3rd Edition 2000.
3. G. Boothroyd& W.A. Knight, "Fundamentals of Machining and Machine Tools", 2nd Edition, Marcel Dekker, Inc., 1989.
4. Uday S. Dixit, "Metal Forming: Technology and Process Modeling", McGraw-Hill Professional, 2013.
5. HwaiyuGeng, "Manufacturing Engineering Handbook," McGraw-Hill Professional. 2nd Edition

6. Jonathan Beddoes, M. J.Bibby, "Principles of Metal Manufacturing Processes", Butterworth Heinemann Elsevier Publications.

Online Material

1. Modern Manufacturing Processes | Wiley Online Books
2. SO_IDCbookextract_rev9.pdf (idc-online.com)
3. E-manufacturing—fundamental, tools, and transformation - ScienceDirect
4. Advances in Manufacturing Processes and Smart Manufacturing Systems: Smart Materials and Manufacturing Systems and Sustainable Management Operations, Volume 1 | SpringerLink
5. (PDF) Good manufacturing Practice (researchgate.net)

Guru Nanak Dev Engineering College, Ludhiana
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B. Tech. (Mechanical Engineering)

Course Code: CME105
Course Title: Engineering Materials and Metallurgy

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 2	**Credits:** 4
Semester: 3rd	**Theory/Practical:** Theory	**Teaching Hours:** 45(L)+30(P) = 75 hrs
Total Max. Marks: 150	**Continuous Assessment (CA) Marks:** 90	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 10%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Core Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Analyze and differentiate between ferrous and non-ferrous metals based on their properties, composition, and applications.
2	Apply crystallographic rules to calculate coordination number, APF, and c/a ratios for various crystal structures
3	Describe and explain the fundamental theories of imperfections in solids, diffusion mechanisms, plastic deformation, and re-crystallization processes.
4	Analyze and differentiate between eutectic, eutectoid, peritectic, and peritectoid transformations in binary phase diagrams
5	Describe phase transformations in the iron-carbon equilibrium diagram and the significance of TTT curves.
6	Explain, apply, and analyze heat treatment processes, surface hardening, and steel hardenability with evaluation.

Contents

Part-A

Unit-1 Ferrous and Non Ferrous Metals **08 hrs**

Introduction, classification and composition of alloy steels, effect of alloying elements (Si, Mn, Ni, Cr, Mo, W, Al) on the structures and properties of steel. Non-Ferrous Metals & Alloys: Aluminum, Magnesium and Copper alloys: Composition, Properties and Applications.

Unit-2 Crystallography **06 hrs**

Atomic bonding in solids, crystal systems, crystal lattice of body centered cubic, face centered cubic, closed packed hexagonal; coordination number, APF, c/a ratio of HCP. crystallographic notation of atomic planes.

Unit-3 Imperfection **08 hrs**

Imperfection in solids; point defects, line defects and dislocations, interfacial defects, bulk or volume defects. Diffusion: diffusion mechanisms, steady-state and non-steady-state diffusion, factors affecting diffusion. Theories of plastic deformation; slip and twinning, recovery, re-crystallization.

Part-B

Unit-4 Phase Transformation **07 hrs**

General principles of phase transformation in alloys, Types of equilibrium diagrams: Two metals completely soluble in the liquid state and completely soluble in the solid state, Eutectic (Two metals completely soluble in the liquid state but completely insoluble in the solid state & Two metals completely soluble in the liquid state but partly soluble in the solid state), Peritectic, Eutectoid and Peritectoid system.

Unit-5 Iron carbon and TTT diagram **07 hrs**

Polymorphism and allotropy; allotropy of iron. Iron carbon equilibrium diagram and various phase transformations. Time temperature transformation curves (TTT curves): fundamentals, construction and applications.

Unit-6 Heat Treatment **09 hrs**

Principles and applications. Processes viz. annealing, normalizing, hardening, tempering. Surface hardening of steels: Principles of induction and oxyacetylene flame hardening. Procedure for carburizing, nitriding and cyaniding. Harden-ability: determination of harden-ability. Jominy end-quench test. Defects due to heat treatment and their remedies.

Laboratory Work

Experiment No.	Experiment Title
1	Preparation of models/Charts related to Atomic /Crystal Structures of Metals.
2	To prepare specimen involving cutting, mounting, polishing and etching of Mild Steel and to study microstructure of prepared specimen
3	To study the microstructure of following materials from standard specimens. 1) Hypo eutectoid and hyper eutectoid steel. 2)White and Grey Cast Iron 3) Non Ferrous Metals: Brass, Copper) Heat Treated Specimens: Annealed, Normalized, Hardened
4	To conduct Normalizing on Steel specimen and to study the effect of Normalizing on Hardness and Microstructure
5	To conduct Hardening of Steel specimen and to study the effect of Hardening on Hardness and Microstructure.
6	To determine the effect of different quenching media (Water, Oil, Brine solution) on Hardness of Steel Specimen
7	To determine Hardenability of steel by Jominy End Quench test.

Text Books

1. Sidney H Avner, “Introduction to Physical Metallurgy”, Tata McGraw-Hill. 2nd Edition, 2017
2. O.P. Khanna, “A Text book of Materials Science & Metallurgy”, Dhanpat Rai & Sons. Re-print 1984
3. U. C. Jindal, “Material Science and Metallurgy”, Pearson. Re-print 2011(E book)
4. Parashivamurthy K.I, “ Material science and metallurgy”, Pearson Re-print 2012(E book)
5. Lakhtin,Yu.M, “Engineering physical metallurgy and Heat treatment”, Mir Publishers. Re-print 1986
6. Laboratory Manuals.

Reference Books

1. V. Raghavan, “Physical Metallurgy: Principles and Practice”, PHI Learning. 3rd Edition 2015
1. B. Zakharov, “Heat Treatment of Metal”, University Press.1984

2. George S. Brady, "Materials Handbook: An Encyclopedia for Managers, Technical Professionals, Purchasing and Production Managers, Technicians, and Supervisors", McGraw-Hill Publication, 15th Edition, 2002.
3. Smallman, R.E. Ngan, A.H.W.,"Modern Physical metallurgy" Butterworth-Heinemann,8th Edition 2013.

Online Learning Materials

1. MIT Open Course Ware – Introduction to Materials Science and Engineering
2. https://ocw.mit.edu/courses/3-091sc-introduction-to-solid-state-chemistry-fall-2010/

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Phase Diagrams in Material Science& Engineering	Prof.Krishanu Biswas	(IIT Kanpur)	https://archive.nptel.ac.in/courses/113/104/113104068/
2	SWAYAM-NPTEL course titled "Materials Science and Engineering"	Prof. Vivek Pancholi	(IIT Roorkee)	https://onlinecourses.nptel.ac.in/noc21_mm04/preview
3	Introduction to Materials Science and Engineering	Prof. Rajesh Prasad	IIT Delhi	https://onlinecourses.nptel.ac.in/noc25_mm17/preview

Experiments to be performed through Virtual Labs

Sr. No.	Experiment Name	Experiment Link(s)
1	metallography experiment (engineering lab)	https://www.slideshare.net/slideshow/3metallography-expriment-engineering-lab/47424631
2	DoITPoMS Virtual Lab – University of Cambridge	https://www.doitpoms.ac.uk/tlplib/jominy/index.php
3	Rockwell Hardness Test – Virtual Lab (NITK Surathkal)	https://sm-nitk.vlabs.ac.in/exp/rockwell-hardness-test/?utm

Guru Nanak Dev Engineering College, Ludhiana
An Autonomous College under UGC Act 1956
B. Tech. (Mechanical Engineering)

Course Code: MCME101
Course Title: Environmental Science and Sustainability

Programme: B. Tech.	**L: 2T:** 0 **P:** 0	**Credits:** 0
Semester: 3rd	**Theory/Practical:** Theory	**Teaching Hours:** 30
Total Max. Marks: 50	**Continuous Assessment (CA) Marks:**50	**End Semester Examination (ESE) Marks:** NA
Minimum Percentage of Numerical / Design / Programming Problems in ESE: NA		
Duration of End Semester Examination (ESE): NA		
Course Type: Mandatory Non Credit Course		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: NA

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Propose solutions to environmental problems related to resource use and management
2	Infer threats to global biodiversity, their implications and potential solutions.
3	Interpret local, regional and global environmental issues
4	Interpret the sustainability concepts; understand the role and responsibility of engineers in sustainable development
5	Quantify sustainability, resource availability and Rationalize the Sustainability based on scientific merits.
6	Apply sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines

Contents

Part-A

Unit-1 Natural Resources **05 hrs**
Renewable and non-renewable resources: natural resources and associated problems, use and over-utilization of surface and ground water, floods, drought, dam's benefits and problems, growing energy needs, use of alternate energy sources.

Unit-2 Ecosystem and Biodiversity **05 hrs**
Concept of an ecosystem, producers, consumers, decomposers, ecological succession, food chains, food webs and ecological pyramids, biodiversity at global, national and local level, India as a mega diversity nation, threats to biodiversity, conservation of biodiversity.

Unit-3 Environmental Pollution and Social Issues **05 hrs**
Air pollution, water pollution, soil pollution, noise pollution, water conservation, rain water harvesting, resettlement and rehabilitation of people; its problems and concerns, environmental ethics: issues and possible solutions, climate change, global warming, acid rain.

Part-B

Unit-4 Introduction to Sustainability 04 hrs
Need and concept of sustainability, social-environmental and economic sustainability concepts, sustainable development goals.

Unit-5 Technology and Sustainability **04 hrs**

Nexus between technology and sustainable development, challenges for sustainable development, multilateral environmental agreements and protocols - Clean Development Mechanism (CDM)

Unit-6 Sustainable Design 0**7 hrs**

Basic concepts of sustainable habitat, green buildings, green materials & waste material for construction, material selection for sustainable design, green building certification- GRIHA & IGBC certification for buildings, energy efficient building design- passive solar design technique, thermal storage, cooling strategies, high performance insulation. sustainable cities, sustainable transport.

Text Books

1. G. Tyler Miller, Scott E. Spoolman, "Environmental Science", 17th Edition, Brooks/Cole, 2024.
2. D D Mishra, "Fundamental concepts in Environmental Studies", 3rd edition, S Chand & Co Ltd, 2014.
3. a. Kaushik, C. P. Kaushik, "Perspectives in Environmental Studies", 6th edition, New Age International Publishers, 2018.
4. E. Bharucha, "Textbook of Environmental studies" Kindle edition, Universities Press (India) Private Limied, 2019.
5. D. Allen, D. R. Shonnard, "Sustainability Engineering: Concepts, Design and Case Studies", 1st edition, Pearson, 2011
6. B. A. Striebig, A. A. Ogundipe, M. Papadakis, "Engineering applications in sustainable design and development", International edition, CL Engineering, 2015.
7. M. S. Sodha, N. K. Bansal, "Solar Passive Building, Science and Design", 1st edition, Pergamon Press, 1986
8. C. J. Kibert, "Sustainable Construction: Green Building Design and Delivery", 5th edition, Wiley, 2022

Reference Books

1. W. P. Cunningham, M. A. Cunningham, "Principle of Environmental Science", 9th edition, McGraw Hill, 2019 .
2. P. Meenakshi, "Elements of Environment Science & Engineering", 2nd edition, Prentice Hall India Learning Private Limted, 2012.
3. K. N. Duggal, "Elements of Environment Engineering", 3rd edition, S. Chand & Co. Ltd, 1996.
4. K. M. Mackenthun, "Basic Concepts in Environmental Management", 1st edition, CRC Press, 1999.
5. Ni bin Chang , "Systems Analysis for Sustainable Engineering: Theory and Applications", Illustrated edition, MacGraw Hill, 2010.
6. J. Twidell, T. Weir, "Renewable Energy Resources", 3rd edition, Routledge, 2015.
7. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System.

Online Learning Materials

1. https://www.youtube.com/watch?v=wNjIJaXaTkQ&t=1446s
2. https://www.youtube.com/watch?v=or-z0Q03pcY
3. https://www.youtube.com/watch?v=or-z0Q03pcY
4. https://www.youtube.com/watch?v=SHxAOoxhKTA
5. https://www.youtube.com/watch?v=B8lTtrjxn2s
6. https://www.youtube.com/watch?v=CA5gxp6rWfA
7. https://www.youtube.com/watch?v=nFBvLIfFFqI
8. https://www.youtube.com/watch?v=MWgyRNtp2Do
9. https://www.youtube.com/watch?v=80JP9SBKGv4
10. https://www.youtube.com/watch?v=kqHeD5yKtoM
11. https://www.youtube.com/watch?v=RoIpCJwX7-M

12. https://www.youtube.com/watch?v=yy3VK6OYBbU
13. https://www.youtube.com/watch?v=1b2VDJbvAtA

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Environmental Science	Prof. Sudha Goel and Prof. Shamik Chowdhary	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc24_hs160/preview
2	Environment and Development	Prof. Ngamjho Kipgen	IIT Guwahati	https://onlinecourses.nptel.ac.in/noc23_hs133/preview
3	Introduction to Environmental Engineering and Science – Fundamental and Sustainability Concept	Prof. Brajesh Kr. Dubey	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc25_ge17/preview
4	Water, Society and Sustainability	Prof. Jenia Mukherje	IIT Kharagpur	https://elearn.nptel.ac.in/shop/nptel/water-society-and-sustainability/?v=c86ee0d9d7ed
5	Basic Environmental Engineering and Pollution Abatement	Prof. P. Mondal	IIT Roorkee	https://onlinecourses.nptel.ac.in/noc24_ch53/preview
6	Sustainable Materials and Green Buildings	Prof. B.Bhattacharjee	IIT Delhi	https://onlinecourses.nptel.ac.in/noc19_ce40/preview

Guru Nanak Dev Engineering College, Ludhiana
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B. Tech. (Mechanical Engineering)

Course Code: SMME101
Course Title: Seminar and Technical Report Writing for Engineers

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 1	**Credits:** 1
Semester: 3rd	**Theory/Practical:** Practical	**Teaching Hours:** 26(P) = 26hrs
Total Max. Marks: 50	**Continuous Assessment (CA) Marks:** 50	**End Semester Examination (ESE) Marks:** 00
Minimum Percentage of Numerical / Design / Programming Problems in ESE: Not Applicable		
Duration of End Semester Examination (ESE): NIL		
Course Type: Seminar		

Prerequisites (if any): NIL
Additional Material Allowed in ESE: *NIL*

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Define and agree the purpose of the report and needs of the readers/audience
2	Design a document structure to effectively get the message across
3	Identify the necessary content and have an appropriate layout
4	Use readily available tools to assist with report writing
5	Reference and quote correctly, and not infringe. Know about Intellectual Property Rights
6	Speak and defend technical reports publicly.

Contents

Every Student has to present a seminar on a topic of science and Technology which is relevant to the Branch of Study.

They have to conduct a Power Point Slide Presentation and a prescribed format Report should be submitted to the department.

The credit of the seminar will be distributed among the presentation report, topic content, power point slide preparation, the abstract, skill of presentation, response to the questions, answering methods and to the overall efforts of the student, that are put in towards the successful execution of the seminar.

A seminar presentation is an expert talk of a particular subject matter, which is not directly covered by the curriculum syllabus, but it is relevant to the branch of study, should emphasis to grasp the physics of the problem and underlying fundamentals along with the relevance of the topic and application of subsequent project work.

Hard core sophisticated mathematical models, theories and correlations can be avoided. It can be even a comparative study between existing or non-existing ideas, methods, technologies, or a new practice, new principles of applications, new trends, new observations, measures, or even detailed analysis of an existing practice pros and cons etc.

Suggested Text Books/References:

1. Van Emden J.,"Effective communication for Science and Technology", Palgrave 2001.
2. Van Emden J., "A Handbook of Writing for Engineers",2nd Edition, Macmillan 1998.
3. Van Emden J. and Easteal J.,"Technical Writing and Speaking, an Introduction", McGraw-Hill 1996.
4. Pfeiffer W.S., "Pocket Guide to Technical Writing", Prentice Hall 1998.
5. Eisenberg A., "Effective Technical Communication", McGraw-Hill 1992.
6. Presentation skills: Effective Presentation Delivery (Coursera).
7. Frank Mittelbach , Michel Goossens, Johannes Braams,David Carlisle, Chris Rowley, "The LaTeX

Companion (Tools and Techniques for Computer Typesetting)", 2nd Edition,Addison Wesley,2005
8. Stefan Kottwitz, "LaTeX Beginner's Guide",1st Edition PACKT, 2011.
9. Davies J.W., "Communication for Engineering Students", Longman, 1996.

E-Books and online learning material:

1. http://www.sussex.ac.uk/ei/internal/forstudents/engineeringdesign/studyguides/techreport writing.
2. "Introduction to LaTex", http://home.iitk.ac.in/~kalpant/docs/intro_latex.pdf.
3. LaTeX, Wikibook , http://en.wikibooks.org/wiki/LaTeX ,en.wikibooks.org, 2016.

Online Courses and Video Lectures:

1. "Technical Report Writing for engineers", https://www.futurelearn.com/courses/technicalreport writing-for-engineers
2. "Academic and Research Report Writing", https://swayam.gov.in/courses/4635-academic and research-report-writing