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

Third Semester							
				L	T	P	Credit
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

Fourth Semester							
				L	T	P	Credit
1	PCC	CME106	Theory of Machines	3	1	2	5
2	PCC	CME107	Applied Thermodynamics-II	3	1	2	5
3	PCC	CME108	Fluid Mechanics	3	1	2	5
4	BSS	BSME101	Maths III	3	1	0	4
5	PEC	EME10X	Elective- I (NCER/M. Sc./CM)*	4	0	0	4
6	HSS	HSMC103	Business Essentials for Engineers	2	0	0	2
7	HSS	HSMC104	Universal Human Values & Professional Ethics	2	0	0	2
8	MNC	MC101	Indian Constitution	2	0	0	0
9	MPD	MPD102	MPD	0	0	1	1
Total (33 hrs)							28

*NCER: Non-Conventional Energy Resources (EME101)
M Sc : Machining Science (EME102)
CM: Computational Methods (EME103)

Fifth Semester							
				L	T	P	Credit
1	PCC	CME109	Design of Machine Elements	3	0	2	4
2	PCC	CME110	Heat Transfer	3	1	2	5
3	PCC	CME111	Mechanical Measurement and Control	3	0	2	4
4	PCC	CME112	Industrial Automation and Robotics	3	0	2	4
5	PEC	EME10X	Elective- II	4	0	0	4
6	ESC	ESME102	Design Thinking	0	0	2	1
7	MNC	MC102	Essence of Indian Knowledge	2	0	0	0
8	MPD	MPD103	MPD	0	0	1	0
9	PW&S	TRME102	Training -II (after 2nd year)				1
Total (30 hrs)							23

Sixth Semester							
				L	T	P	Credit
1	PCC	CME113	Refrigeration and Air Conditioning	3	0	2	4
2	PCC	CME114	Operations Research	3	1	0	4
3	PCC	CME115	Industrial Engineering	3	0	2	4
4	PEC	EME10X	Elective- III (FMC/M.M P../CAD)*	4	0	0	4
5	ESC	ESME101	Program Specific Course (MV)	3	0	2	4
6	ESC	ESC106	Entrepreneurship and Startups	3	0	0	3
7	MNC	MOC101	Organizational Behavior	2	0	0	0
8	PW&S	PRME101	Project -I	0	0	2	1
9	PW&S	FSME101	Preparation for Placement	2	0	0	2
10	MPD	MPD103		0	0	1	1
Total (33 hrs)							27

*****F MC: Fluid Machinery
MMP Modern Manufacturing Processes

CAD: Computer Aided Design

Seventh Semester							
				L	T	P	Credit
1	PEC	MOOCS	Elective –IV	4	0	0	3
2	OEC	MOOCS	OE –I	3	0	0	3
3	OEC	MOOCS	OE –II	3	0	0	3
4	OEC	MOOCS	OE –III	3	0	0	3
5	PW&S	PRME102	Project –II	0	0	6	3
6	MPD	MPD104		0	0	1	0
Total							15

Eighth Semester							
				L	T	P	Credit
1	PW&S	TRME103	Industrial Training (Trg-III)				12
2	MPD	MPD104		0	0	1	1
Total							13

Guru Nanak Dev Engineering College, Ludhiana
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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	https://bsa-

	conditions.	iiith.vlabs.ac.in/exp/column-analysis/objective.html

Guru Nanak Dev Engineering College, Ludhiana
An Autonomous College under UGC Act 1956
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
An Autonomous College under UGC Act 1956
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
An Autonomous College under UGC Act 1956
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.

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

Course Code: BSME101
Course Title: Mathematics-III

Programme: B.Tech.	**L : 3 T : 1 P : 0**	**Credits:4**
Semester: 4th	**Theory/Practical:** Theory	**TeachingHours:**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 inESE:90%		
Duration of End Semester Examination(ESE):3 hours		
Course Type: Core Course		

Prerequisites (if any): BSC102, BSC104.

Additional Material Allowed in ESE: Use of (non-programmable) scientific calculator is allowed

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

CO#	Course Outcomes
1	Analyze the properties of Laplace Transform and apply Laplace transforms to solve ordinary differential equations with initial conditions.
2	Demonstrate the representation of periodic functions using the Fourier series.
3	Solve second-order linear differential equations using power series (Frobenius methods) and define special functions.
4	*Solve* first and second order PDE'S using different methods.
5	*Apply* the Cauchy-Riemann equations to *verify* the analyticity of complex functions and *analyze* their behaviour in the complex plane.
6	*Apply* Cauchy's Integral theorem, Cauchy's Integral formula and residue theorem to evaluate real and complex integrals.

Contents

Part-A

Unit-1LaplaceTransforms **8 hrs**

Definition and existence of Laplace Transforms, Laplace transforms of various standard functions, properties of Laplace transforms, inverse Laplace transforms, transform of derivatives and integrals, Transform of multiplication and division by t, convolution theorem, Laplace transform of unit step function. Applications to solution of ordinary linear differential equations with constant coefficients.

Unit-2FourierSeries **8 hrs**

Introduction, even and odd functions, periodic functions, Dirichlet's conditions for Fourier series, Euler's formulae for Fourier series expansion, change of interval, half range series expansions ,Fourier series of different waveforms.

Unit-3 Special Functions **6 hrs**

Frobenius method for power series solution of differential equations. Bessel's equation; Bessel functions of the first and second kind, recurrence relations, Legendre's equation; Legendre polynomials, generating function.

Part-B

Unit-4 Partial Differential Equations **12 hrs**

Formation of partial differential equations; Equations solvable by direct integration; Linear partial differential equations;solution of Lagrange's Linear equations, homogeneous partial differential equations with constant coefficients. Solution by method of separation of variables. Applications: Wave equation and Heat conduction equation in one dimension.

Unit-5 Complex Variables **11 hrs**

Definition of Limit; continuity; derivative of complex functions and analytic function. Necessary and sufficient conditions for analytic function (without proof); Cauchy-Riemann equation (Cartesian and polar co-ordinates); harmonic functions; orthogonal system; determination of conjugate functions. Millne's Thomson method; Applications to fluid flow problems. complex integration: Line integrals in the complex plane; Cauchy's integral theorem (without proof); Cauchy's integral formula (without proof)for analytic function and its derivatives. Taylor's and Laurent's expansions; singular points; poles; residue; Cauchy's Residue theorem; evaluation of real integrals by contour integration involving a function of sine and cosine functions

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics" ,44th Edition Khanna Publishers
2. Erwin Kreyzig, " Advanced Engineering Mathematics", 9th Edition Wiley India Pvt Ltd
3. Bali N. P, "Textbook of Engg. Mathematics", Laxmi Publishers, 9th Edition, 2011.

References:

1. Iyengar, T.K.V., B.Krishna Gandhi and S. Ranganatham& M.V.S.S.N. Prasad, "LaplaceTransforms, Numerical Methods & Complex Variables", S. Chand Publishing, 2018.
2. Sreenadh, S, "Fourier Series and Integral Transforms",. New Delhi,India: S Chand. 2014.
3. Dennis G. Zill, Michael R. Cullen, "Advanced Engineering Mathematics", CBS Publishers
4. R.K. Jain and S.R.K.Iyenger, "Advanced Engineering Mathematics", Narosa Publications, New
5. Delhi, 2008.
6. B.V. Ramana, "Higher Engineering Mathematics", 11th Reprint, Tata McGraw-Hill, New Delhi, 2010.
7. Sharma J. N. and Gupta R.K., "Differential Equations", Krishna Prakashan Media, 47th Edition, 2009.

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

Course Code: CME106
Course Title: Theory of Machines

Programme: B.Tech.	**L: 3 T: 1 P: 2**	**Credits:** 5
Semester:4th	**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: 70%		
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	Understanding the basic concept of kinematics and kinetics of machine elements.
2	Evaluate forces and couples applied to the machine elements.
3	Understand the function and application of gears and Evaluate the velocity ratio and torque in different gear trains.
4	Creating and designing of different types of cams.
5	Applying the concept of Static and dynamic balancing of rotating and reciprocating masses.
6	Understand the function of belt drives, brakes and clutches.

Contents

Part-A

Unit-1 Basic Concept of machines: **5 hrs**

Degree of Freedom, Link, Mechanism, Kinematic Pair and Kinematic Chain, Principles of Inversion, Inversion of a Four Bar Chain, Slider-Crank- Chain and Double Slider-Crank-Chain. Grashoff's criterion, Graphical and Analytical methods for finding: Displacement, Velocity, and Acceleration of mechanisms (including Corliolis Components).

Unit-2 Force analysis: **5 hrs**

Introduction, Concept of force and couple, free body diagram, condition of equilibrium, Static equilibrium of mechanisms, methods of static force analysis of simple mechanisms.

Unit-3 Gears and Gear Trains: **8 hrs**

Toothed gears and their applications, types of toothed gears and its terminology. Conditions for correct gearing, forms of teeth, length of Path of contact, length of arc of contact, contact ratio, involutes and its

variants, interference and methods of its removal. Calculation of minimum number of teeth required on pinion and wheel for helical, spiral, bevel, worm gears and involute rack. Center distance for spiral gears and efficiency of spiral gears. Gear Trains: Types of gear trains such as simple, compound and epicyclic.

Part-B

Unit-4 Friction Devices: 6 hrs

Concepts of friction and wear related to bearing and clutches. Types of brakes function of brakes. Belt and Rope Drives : Flat and V-belts, Rope , Idle Pulley, Intermediate or Counter Shaft Pulley, Velocity Ratio, Crowning of Pulley, Loose and fast pulley, stepped or cone pulleys, ratio of tension on tight and slack side of belts, Length of belt, Power transmitted by belts including consideration of Creep and Slip.

Unit-5 Cams: 6 hrs

Types of cams and follower, definitions of terms connected with cams. Displacement, velocity and acceleration diagrams for cam followers. Analytical and Graphical design of cam profiles with various motions (SHM, uniform velocity, uniform acceleration and retardation, cycloidal Motion).Analysis of follower motion for circular, convex and tangent cam profiles.

Unit-6 Balancing: 8 hrs

Necessity of balancing, static and dynamic balancing, balancing of single and multiple rotating masses, partial unbalanced primary force in an engine, balancing of reciprocating masses, partial balancing of locomotives, swaying couple, variation of tractive effort and hammer blow condition of balance in multi cylinder in line and V-engines, concept of direct and reverse crank, balancing of machines, rotors and reversible rotors, two plane balancing of rotor.

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 fabricate various inversions of the kinematic chains.
2	To Draw displacement, velocity & acceleration diagrams of single slider/double slider crank & four bar mechanism by using working models.
3	To determine coefficient of friction for a belt pulley material combination.
4	To Demonstrate various types of gears.
5	To Perform the balancing of rotating masses.
6	To Analyse the profile of a cam with various followers.
7	To Determine gear train value of compound gear trains & epicyclic gear trains.
8	To Draw circumferential & axial pressure profile of journal bearing.
9	To Conduct experiments on various types of governors & to co-relate equilibrium height & speed of the governor.
10	To Determine moment of inertia of a fly wheel.

Text Books:

1. S.S.Rattan, “Theory of Machines”, McGraw Hill Publications, 4th Edition, 2014.

2. Sadhu Singh, "Theory of Machines", Pearson Education, 2nd Edition, 2009.
3. Thomas Bevan, "Theory of Machines", CBS Publishers & Distributors, 3rd Edition 2005.
4. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 1st Edition
5. 2009.
6. Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East West Pvt. Ltd, New Delhi, 3rd Edition 1988.

Reference Books:

1. Joesph E. Shigley, "Theory of Machines", Tata McGraw Hill Publications, 2nd Edition, 2011
2. V.P. Singh, "Theory of Machines", Dhanpat Rai and Sons Publications, 2nd Edition, 2004.
3. W.LCleghorn. , "Mechanisms of Machines", Oxford University Press, CDR Edition, 2005.

Supplementary SWAYAM Course

Sr. No.	**Course Name**	**Instructor**	**Host Institute**	**URL**
1	Introduction to Theory of Machines	Prof. Anirvan Das Gupta	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc24_me44/preview
2	Force analysis:	Prof. C. Amarnath	IIT Bombay	https://nptel.ac.in/courses/112101096
3	Gear and Gear Trains	Prof. R.S. Rengasamy	IIT Delhi	https://nptel.ac.in/courses/116102012
4	Friction Devices ,Belt rope and clutches	Prof. R.S. Rengasamy	IIT Delhi	https://nptel.ac.in/courses/116102012
5	CAM	Prof. J. Ram Kumar	IIT Kanpur	https://www.youtube.com/watch?v=Ww7-f5MzSHU
6	Balancing	Prof. Amitabha Ghosh	IIT Kanpur	https://archive.nptel.ac.in/courses/112/104/112104114/

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

Course Code: CME107
Course Title: Applied Thermodynamics-II

Programme: B. Tech.	**L: 3 T: 1 P: 2**	**Credits: 5**
Semester: 4th	**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: 50%		
Duration of End Semester Examination (ESE): 3 hours		
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 various types of steam turbines and analyze various performance parameters.
2	Estimate the amount of cooling water required in a specific type of condenser.
3	Understand working principles and performance parameters of reciprocating and rotary compressors.
4	Understand working principles and performance parameters of centrifugal and axial flow compressors.
5	Conduct thermal analysis of various types of gas turbines and their performance investigation.
6	Understand various types of jet propulsion systems and common propellants.

Contents

Part-A

Unit-1 Steam Turbines **8 Hrs**

Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, Reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

Unit-2 Steam Condensers **5 Hrs**

Function of steam condensers, Elements of condensing unit, Types of condensers, Dalton's law of partial pressures applied to the condenser problems, Condenser and vacuum efficiencies, Cooling water calculations, Effect of air leakage, Method to check and prevent air in filtration, Description of air pump and calculation of its capacity, cooling towers: function, types and their operation.

Unit-3 Reciprocating and rotary compressors **9Hrs**

Introduction, Classification of Air Compressors; Application of compressors and use of compressed air in

industry and other places ,Single stage single acting reciprocating compressor (with and without clearance volume): construction, operation, work input and best value of index of compression, heat rejected to cooling medium, isothermal, overall thermal, isentropic, polytrophic, mechanical efficiency, Clearance Volumetric efficiency, Overall volumetric efficiency, effect of various parameters on volumetric efficiency, free air delivery; Multistage compressors: purpose and advantages, construction and operation, work input, heat rejected in intercoolers, minimum work input, optimum pressure ratio; isothermal, overall thermal, isentropic, polytropic and mechanical efficiencies Comparison of rotary positive displacement compressors with reciprocating compressors, like Roots blower and Vane type Blower.

Part-B

Unit-4 Centrifugal & Axial Flow Compressors **9 Hrs**

Complete thermodynamic analysis of centrifugal compressor stage; Polytrophic, isentropic and isothermal efficiencies, Pre-guide vanes and pre-whirl; Slip factor, Degree of Reaction and its derivation; Energy transfer in backward, forward and radial vanes; Pressure coefficient as a function of slip factor, Surging and choking in compressors, Different components of axial flow compressor and their arrangement; Velocity vector; Vector diagrams; Thermodynamic analysis; Work done on the compressor and power calculations, Comparison of axial flow compressor with centrifugal compressor and reaction turbine; Field of application of axial flow compressors.

Unit-5 Gas Turbines **7 Hrs**

Classification and comparison of the Open and Closed cycles; Classification on the basis of combustion (at constant volume or constant pressure); Comparison of gas turbine with a steam turbine and IC engine; Fields of application of gas turbines; Thermodynamics of constant pressure gas turbine cycle (Brayton cycle); Calculation of net output, work ratio and thermal efficiency of ideal and actual cycles; Cycle air rate, temperature ratio; Operating variables and their effects on thermal efficiency and work ratio; Thermal refinements like regeneration, inter- cooling and re- heating and their different combinations in the gas turbine cycle and their effects on gas turbine cycle, Multistage compression and expansion; Dual Turbine system; Series and parallel arrangements; Closed and Semi-closed gas turbine cycle; Requirements of a gas turbine combustion chamber; Blade materials. Gas turbine fuels.

Unit-6 Jet Propulsion **7 Hrs**

Principle of jet propulsion; Description of different types of jet propulsion systems like rockets and thermal jet engines, like (i) Athodyd (ramjet and pulsejet), (ii) Turbojet engine, and (iii) Turboprop engine. Thermodynamics of turbo jet engine components; Development of thrust and methods for its boosting/augmentation; Thrust work and thrust power; Propulsion energy, Propulsion and thermal (internal) efficiencies; Overall thermal efficiency; Specific fuel consumption; Rocket propulsion, its thrust and thrust power; Propulsion and overall thermal efficiency; Types of rocket motors (e.g. solid propellant and liquid propellant systems);Various common propellant combinations (i.e. fuels) used in rocket motors; Advantages and disadvantages of jet propulsion over other propulsion systems; Fields of application of various propulsion units.

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	Study of construction and operation of 2 stroke and 4 stroke Petrol and Diesel Engines using actual engines or models.

2	To plot actual valve timing diagram of a 4 stroke petrol and diesel engines and Study its impact on the performance of engine.
3	Study working construction of various boilers (Cochran, Lancashire, Babcock and Wilcox, Benson, Lamont, once through boiler tower type).
4	Study of working and construction of mountings and accessories of various types of boilers.
5	To perform a boiler trial to estimate equivalent evaporation and efficiency of a Fire tube/water tube boiler.
6	Determination of dryness fraction of steam and estimation of brake power, Rankine efficiency, relative efficiency, generator efficiency, and overall efficiency of an impulse steam turbine and to plot a Willian's line.
7	Determine the brake power, indicated power, friction power and mechanical efficiency of a multi cylinder petrol engine running at constant speed (Morse Test).
8	Performance testing of a diesel engine from no load to full load (at constant speed) for a single cylinder/ multi-cylinder engine in terms of brake power, indicated power, mechanical efficiency and specific fuel consumption and to measure the smoke density. Draw/obtain power consumption and exhaust emission curves. Also, make the heat balance sheet.
9	Performance testing of a petrol engine from no load to full load (at constant speed) for a single cylinder/ multi-cylinder engine in terms of brake power, indicated power, mechanical efficiency and specific fuel consumption and to measure the exhaust emissions. Also, draw/obtain power consumption and exhaust emission curves.
10	Study of construction and operation of various types of steam condensers and cooling towers.

Text Books:

1. R.Yadav, "Thermodynamics & Heat Engines", Central Publication House-Allahabad, 2011.
2. Mahesh M Rathor, "Thermal Engineering", McGraw Hill Education-New Delhi, 2010.
3. D.S. Kumar andV.P.Vasandani, "Heat Engineering", S.K.Kataria & Sons; Reprint, 2013.
4. J. S. Rajadurai, "Thermodynamics and Thermal Engineering" New Age International (P) Ltd. Publishers, 1st Edition 2003, Reprint 2015.
5. S.M.Yahya, "Turbines, Compressors and Fans", McGraw Hill Education (India), Chennai,4th Edition,2017.
6. P.L.Ballaney,"Thermal Engineering", Khanna Publishers, New Delhi, 2005.

Reference Books:

1. Jack D.Mattingly, "Elements of Gas Turbine Propulsion", McGraw Hill Education (India), Chennai, 6th Edition, 2013.
2. H.Cohen,G.F.C.Rogers and M.Sarvan,"Gas Turbine Theory",Pearson Education Canada; 5th Edition, 2008.
3. Heinz P.Bloch,"Steam Turbines:Design,Applications,and Re-rating",McGraw-Hill Professional, 2nd Edition,2009. (E-Book available)

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL

1	Steam and Gas Power System	Prof.Ravi Kumar	IIT, Roorkee	https://archive.nptel.ac.in/courses/112/107/112107216/
2	Steam Power Engineering	Prof.Vinayak N.Kulkarni	IIT, Guwahati	https://nptel.ac.in/courses/112103277
3	Aerodynamic Design of Axial Flow Compressors And Fans	Prof.Chetan Kumar Sureshbhai Mistry	IIT, Kharagpur	https://archive.nptel.ac.in/courses/101/105/101105089/
4	Introduction to Aerospace Propulsion	Prof.Bhaskar Roy Prof.A.M. Pardeep	IIT, Bombay	https://archive.nptel.ac.in/courses/101/101/101101001/#

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

Course Code: CME108
Course Title: Fluid Mechanics

Programme: B.Tech.	**L: 3 T: 1P: 2**	**Credits:** 5
Semester: 4th	**Theory/Practical:** Theory	**Teaching Hours: 45(L)+15(L) +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: 70%		
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	Acquaint with the properties of fluids, stresses in fluids, and the applications of fluid mechanics.
2	Understand the pressure, hydrostatic forces and buoyancy concept.
3	Analyze problems related to velocity field, acceleration and forces in fluid and body interactions.
4	Use and apply dimensional analysis techniques to various physical fluid phenomena.
5	Evaluate the head loss for different viscous flows in pipe network and determination of drag.
6	Analyze the compressible flow through nozzle/ducts.

Contents

PART-A

Unit-I Fluid and Fluid properties **6 Hrs**

History and importance of fluid mechanics in real life and mechanical engineering, the concept of a Fluid, the Fluid as a continuum, Newton's law of viscosity, thermodynamic properties of a fluid, surface tension and capillarity, vapour pressure and cavitations.

Unit-II Fluid Statics **8 Hrs**

Pressure and pressure gradient, Pascal's law, Equilibrium of fluid element, hydrostatic pressure distribution, Hydrostatic forces on plane and curved surfaces, Buoyancy and floatation stability, pressure distribution in rigid-body motion, Manometry; pressure measurement.

Unit-III Integral and Differential flow analysis **12 Hrs**

Lagrangian and Eulerian description of fluid flow, Acceleration and substantial derivative, Streamlines, Streaklines, Pathlines, compressible and incompressible flow. Reynolds transport theorem, conservation of mass, linear and angular momentum for inertial control volumes, conservation of energy, and Bernoulli's equation. Deformation of fluid element under stresses, differential equations of mass conservation (Cartesian and cylindrical coordinates), differential equations of linear momentum (Euler's and Navier-Stokes equation), the stream function and velocity potential function, vorticity and circulation, free and forced vortex flow, inviscid and irrotational flow; Potential flow.

PART B

Unit- IV Dimensional analysis and similitude **4 Hrs**

Principle of dimensional homogeneity, The Rayleigh and Buckingham-Pi theorem, Dimensionless groups, scaling laws, Model versus Prototype analysis.

Unit-V Viscous flows **10 Hrs**

Reynolds Number Regimes, Laminar and turbulent flow, Hagen-Poiseuille equation, Darcy equation, Effect of rough walls; Moody's chart, hydraulic diameter, Major and minor losses in pipe systems, estimation of head loss for flow through pipes and pipe networks, Orifice and venturi flow meters, notches, hydraulic coefficients. Qualitative description of boundary-layers, Flow separation, Streamlined and bluff bodies, Lift, and drag.

Unit-VI Compressible flow **5 Hrs**

Speed of sound, the Mach cone, stagnation properties, critical conditions, isentropic flows and converging-diverging nozzles, formation of shocks and its types.

Laboratory Work

Sr. No.	Name of Practical
1	To determine the meta-centric height of a floating vessel under loaded and unloaded conditions.
2	To study the flow through a variable area duct and verify Bernoulli's energy equation.
3	To determine the discharge coefficient for a venturi meter.
4	To determine the head loss in a pipe line due to sudden expansion/ sudden contraction/ bend.
5	To determine the discharge coefficient for a V- notch or rectangular notch.
6	To determine the friction coefficients for pipes of different diameters.
7	To determine velocity of flow using Pitot tube apparatus
8	To determine hydraulic coefficients for flow through Orifice.
9	To analyze free and forced vortex flow.

Text Books:

1. D.S.Kumar, "Fluid Mechanics and Fluid Power Engineering", S K Kataria and Sons, 2016.
2. R.K.Bansal, "Fluid Mechanics and Hydraulic Machines", Laxmi Publication, 9th Edition 2010
3. S.K.Som, and G. Biswas, "Introduction to Fluid Mechanics and Fluid Machines", McGraw-Hill, 3rd Edition, 2004
4. F.M.White,"Fluid Mechanics", McGraw-Hill, 9th Edition, New Delhi, 2022.
5. Y.A. Cengel and J.M. Cimbala, "Fluid Mechanics - Fundamentals and Applications", McGraw Hill Publications, 4th Edition, 2019
6. P. K. Kundu, I. M. Cohen, D. R. Dowling, "Fluid Mechanics" Academic Press, 7th Edition, 2024
7. V.L. Streeter, and E.B.Wylie, "Fluid Mechanics", McGraw-Hill, 1983.
8. R.W. Fox, A.T. McDonald, and P.J.Pritchard, "Introduction to Fluid Mechanics", Wiley, 8th Edition, 2011

Reference Books:

1. I.G. Curie, "Fundamentals of Fluid Mechanics", CRC Press; 4th Edition, 2016.

2. G.K.Batchelor, "An Introduction to Fluid Dynamics", Cambridge University Press, 1st Edition, 1973
3. James A.Fay, "Introduction to Fluid Mechanics", Prentice-Hall of India Pvt.Ltd,

Online Material

1. Series of 39 videos on Fluid Mechanics by National Committee for Fluid Mechanics Films (NCFMF). http://web.mit.edu/hml/ncfmf.html

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

Course Code: EME101
Course Title: Non-Conventional Energy Resources

Programme: B.Tech.	**L: 4 T:0 P: 0**	**Credits:**4
Semester: 4th	**Theory/Practical:** Theory	**Teaching Hours: (L)=** 60 hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical / Design / Programming Problems in ESE: 20%		
Duration of End Semester Examination (ESE): 3 hours		
Course Type: Professional Elective 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	Know various types of energy resources
2	Design various types of solar collectors and use solar energy applications for different Systems
3	Understand principles of wind energy generation and estimate the power output
4	Know various types of direct energy conversion systems
5	Know types of bio gas generators and their functioning
6	Understand applications of Geothermal, Tidal and wave energy

Contents

Part-A

Unit-1 Introduction: **06 Hrs**

Renewable and non-renewable energy sources; advantages and disadvantages, their availability and growth in India; energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements.

Unit-2 Solar Energy: **12 Hrs**

Solar radiation - beam and diffuse radiation; earth sun angles; attenuation and measurement of solar radiation; Optical properties of materials and selective surfaces; Principles; general description and design procedures of flat Plate and concentrating collectors; Solar energy storage systems - their types; characteristics and capacity; solar ponds. Applications of solar energy in water; space and process heating; solar refrigeration and air conditioning; water desalination and water pumping; solar thermal power generation; solar photovoltaic system; economic analysis of solar systems.

Unit-3 Wind Energy: **12 Hrs**

Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components; various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations.

Part-B

Unit-4 Direct Energy Conversion Systems: 10 Hrs

Magnetic Hydrodynamic (MHD) Generator: gas conductivity and MHD equations; operating principle; types and working of different MHD systems – their relative merits; MHD materials and production of magnetic fields. Thermo-electric generators: Thermo-electric effects and materials; thermo-electric devices and types of thermo-electric generators; thermo-electric refrigeration. Thermionic generators: thermo- ionic emission and materials; working principle of thermionic convertors. Fuel Cells: thermodynamic aspects; types; components and working of fuel cells. Performance; applications and economic aspects of above mentioned direct energy conversions systems.

Unit-5 Bio-mass: 10 Hrs

Concept of bio-mass conversion; photo-synthesis and bio-gasification; Bio gas generators and plants - their types constructional features and functioning; digesters and their design; Fuel properties of bio gas and community bio gas plants.

Unit-6 Miscellaneous Non-Conventional Energy Systems: 10 Hrs

Geothermal: Sources of geothermal energy-types; constructional features and associated prime movers. Tidal and wave energy: Basic principles and components of tidal and wave energy plants; single basin and double basin tidal power plants; conversion devices. Advantages/disadvantages and applications of above mentioned energy systems.

Text Books

1. H.P.Garg and Jai Prakash, “Solar Energy: Fundamentals and Applications”, Tata McGraw - Hill, 2000.
2. S.P.Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill, 3rd Edition 2008.
3. S. N. Singh, “Non Conventional Energy Sources”, Pearson Education India, 2015.
4. Chang and S.L. Sheldon, “Energy Conversion”, Prentice Hall, 1963, Reprinted in 2015.
5. J.OM. Bockris and S. Srinivasan, “Fuel Cells: Their Electrochemistry”, McGraw Hill, 1969.

Reference Books

1. John A. Duffie and W.A.Beckman, “Solar Engineering of Thermal Processes”, John Wiley, 4th Edition 2013.
2. N.K.Bansal, Manfred Kleeman & Mechael Meliss, “Renewable Energy Sources and Conversion Technology” Tata McGraw Hill. 2004.
3. Freris. L.L , “Wind Energy Conversion Systems” , Prentice Hall, UK, 1st Edition, 1990 .
4. David M Mousdale, “Introduction to Biofuels”, Prentice Hall, UK, 1st Edition, 1990.

Supplementary SWAYAM Course

Sr. No.	Course Name	Instructor	Host Institute	URL
1	Non-conventional energy Resources	Prof. Prathap Haridoss	IIT Madras	https://onlinecourses.nptel.ac.in/noc24_ge24/preview
2	Renewable Energy Engineering: Solar, Wind And Biomass Energy Systems	Prof. Vaibhav Vasant Goud Prof. R. Anandalakshmi	IIT Guwahati	https://www.google.com/url?q=https://onlinecourses.nptel.ac.in/noc24_ch26/preview&sa=D&source=editors&ust=1747130069972838&usg=AOvVaw2EMYDZDs3flqhBseJZ2gUK

3	Renewable Energy Engineering: Solar, Wind And Biomass Energy Systems	Prof. Vaibhav Vasant Goud Prof. R. Anandalakshmi	IIT Guwahati	https://www.google.com/url?q=https://onlinecourses.nptel.ac.in/noc25_ch40/preview&sa=D&source=editors&ust=1747130069972769&usg=AOvVaw3bq631FMxuqam--7rDuhDU

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

Course Code: EME102
Course Title: Machining Science

Programme: B. Tech.	**L: 4 T: 0 P: 0**	**Credits: 04**
Semester: 4th	**Theory/ Practical:** Theory	**Teaching Hours: 60(L) + 0 (T) + 0(P)** = 60 Hrs
Total Max. Marks: 100	**Continuous Assessment (CA) Marks :**40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical/Design/Programming in ESE: 20%		
Duration of End Semester Examination (ESE) : 03 Hours		
Course Type: Professional Elective Course		

Pre-requisites: Nil
Additional Material Allowed in ESE: Scientific Calculator

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

CO#	Course Outcome
1	Explain the fundamentals of conventional machining processes, including classifications, applications, and tool geometries
2	Analyze the mechanics of metal cutting, including chip formation, force analysis, and apply measurement techniques using various dynamometers.
3	Evaluate tool wear mechanisms, predict tool life using Taylor's equation, and assess the influence of machining parameters on tool performance.
4	Examine thermal aspects of machining processes, assess temperature generation and its effect on machining, and recommend cutting fluids considering economic and environmental aspects.
5	Assess machinability and estimate machining time for various cutting operations, recommend chip control methods for different processes.
6	Apply principles of machining economics, Optimize machining parameters to minimize cost and maximize production efficiency;

Contents

Part - A

Unit-I Introduction to Machining Processes **08hrs**

Concept of conventional material removal; Classification and applications of machining processes; Surface generation with machining; Tool geometry of single and multi-point cutting tools; Different process parameters in various machining operations.

Unit-2 Mechanics of Metal Cutting& Measurement of Cutting Forces **12hrs**

Formation of Chip in metal cutting and different types of chips; Concept of Orthogonal & Oblique cutting, Merchant Theory for force evaluation in machining, Shear angle relationships; Specific cutting pressure; Velocity relations, Lee and Shaffer theory; need, and basic methods of measuring cutting forces; introduction to dynamometers; working principles and construction of lathe dynamometer, drilling dynamometer and milling dynamometers

Unit-3 Tool Wear and Tool Life **08hrs**

Mechanism and modes of wear, Types of wear in reference to cutting tools; Criteria of tool wear; Measurement of tool wear; Tool life: definition & factors affecting tool life; Taylor's tool life equation; Applications of tool life equation; Role of different machining parameters on tool life.

Part -B

Unit-4 Thermal Aspects of Machining **12hrs**

Causes and location of heat generation in metal cutting operations; Effect of cutting temperature on cutting tool and workpiece; Kinetic coefficient of friction; Stagnant phenomena; Analytical methods of temperature measurement in metal cutting- Average shear plane temperature, Average chip-tool interface temperature; Experimental determination of cutting temperature. Effect of various process parameters on temperature in metal cutting operations; Cutting fluids-types, their selection and method of application; Harmful ecological and health effects of metal cutting fluids; Economical use of metal working fluids.

Unit-5 Machinability **10hrs**

Concept of machinability; Assessment of machinability; Role of various factor on machinability; Estimation of machining time in turning, drilling, boring, milling and shaping operations; Major factor affecting machining time; Process capabilities of different machining processes; Control of Chip and Chip Breakers.

Unit-6 Economics of Machining **10hrs**

Various types of Machining costs; Economy and optimization of machining; Choice of Feed and cutting speed for optimal machining economics; Determination of optimum cutting speed for minimum cost; Maximum production rate and profit rate; introduction to machinability data systems.

Text Books

1. Winston A. Knight, Geoffery Broothroyd, "Fundamentals of Metal Machining & Machine Tools", CRC Taylor & Francis, 2005
2. G.K. Lal, "Introduction to Machining Science", New Age International Ltd., 2007
3. A. B. Chattopadhyay, "Machining and Machine Tools", Wiley India Pvt. Ltd.,2011
4. B.L. Juneja, G.S.Sekhon, "Fundamentals of Metal Cutting and Machine Tools", New Age International Ltd., 2003.
5. A. Bhattacharya, "Metal Cutting Principles", CBS Publishers, 1989.

Reference Books

1. Serope Kalpankjian, Steven R. Sachimid, "Manufacturing Engineering and Technology", Pearson Education, 2001
2. Edward Trent & Paul Wright, "Metal Cutting", Butterworth Heinemann", 2000
3. Milton C. Shaw, "Metal Cutting Principles". Oxford University Press, 2005
4. David A. Stephenson, John S. Agapiou, " Metal Cutting Theory and Practice", CRC Press, 2016
5. P.C.Sharma, "A Textbook of Production Engineering", S Chand and Company, 2019

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

Course Code: EME103
Course Title: Computational Methods

Programme: B.Tech.	**L: 4 T: 0 P: 0**	**Credits:** 4
Semester : 4th	**Theory/Practical:** Theory	**Teaching Hours:** 60 Hrs
Total Max. Marks : 100	**Continuous Assessment (CA) Marks:** 40	**End Semester Examination (ESE) Marks:** 60
Minimum Percentage of Numerical/Design/Programming Problems in ESE:80%		
Duration of End Semester Examination (ESE) :3hours		
Course Type: Professional Elective Course		

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

CO#	Course Outcomes
1	Understand and quantify errors in numerical calculations, including floating-point representation.
2	Apply numerical methods such as Bisection, Newton-Raphson, and Secant to solve algebraic and transcendental equations.
3	Utilize interpolation techniques like Newton's and Lagrange's formulas for both evenly and unevenly spaced data.
4	Implement numerical differentiation and integration methods, including Newton-Cote's formulas and Simpson's rules.
5	Solve systems of linear equations using methods like Gauss elimination, LU decomposition, and iterative techniques.
6	Apply numerical methods to solve ordinary and partial differential equations, including Runge-Kutta and finite difference methods.

Contents

Part-A

Unit-1 Errors in Numerical Calculations **06hrs**

Errors and their analysis, general error formula, errors in a series approximation, floating point representation of numbers

Unit-2 Solution of Algebraic and Transcendental Equations **10hrs**

Bisection method, Fixed point iteration method, Method of false position, Newton-Raphson method, Secent method.

Unit-3 Interpolation Method **12 hrs**

Finite difference, forward, backward and central difference, Difference of a polynomial, Newton's formulae for interpolation, central difference interpolation formulae, Interpolation with unevenly spaced points, Newton's general interpolation formula, interpolation by iteration.

Part-B

Unit-4 Numerical Differentiation and Integration **10 hrs**

Numerical differentiation: formulae for derivatives, maxima and minima of a tabulated function, errors in numerical differentiation. Numerical Integration: Newton-cote's integration formula, trapezoidal rule, Simpson's one-third rule, Simpson's three eighth rule.

Unit-5 Solution of Linear Systems of Equations **10 hrs**

Gauss elimination, Gauss Jordan, LU Decomposition, Gauss Seidal, iteration method, Jacobi's method, Eigen value problems (Power method only).

Unit-6 Numerical solution of ordinary and partial differential equations 12 hrs

Initial value and Boundary value problems, Picard's method, Euler's and modified Euler's method, Solution by Taylor's series, Predictor –corrector method, Runge-Kutta method of order two and order four, finite difference method to derivatives. PDE- classification of PDE, Elliptic equation, Parabolic equations, Hyperbolic Equations, Solutions of Parabolic and Elliptic equations using iterative methods.

Text Books

1. Steven C. Chapra, "Applied Numerical Methods with MATLAB for Engineers and Scientists", McGraw Hill.Dr.
2. S. Grewal, "Numerical Methods in engineering and science", Khanna Publishers.
3. M.K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering Computation", New age International Publishers.
4. S. S. Sastry, "Introductory methods of numerical analysis", Prentice Hall of India.
5. Dukkipati, Rao V., "Numerical Methods", New Age International (P) Ltd., Publishers.

Reference Books

1. Joe D. Hoffman, "Numerical Methods for Engineers and Scientists" , CRC Pr I Llc
2. Rao, Singiresu S., "Applied Numerical Methods for Engineers and Scientists", Pearson College Div.
3. Kendall E. Atkinson , "An Introduction to Numerical Analysis", John Wiley & Sons.