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 secondorder 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

TextBooks:

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
   Delhi, 2008.
5. B.V. Ramana, "Higher Engineering Mathematics", 11th Reprint, Tata McGraw-Hill, New Delhi, 2010.
6. Sharma J. N. and Gupta R.K., "Differential Equations", Krishna Prakashan Media, 47th Edition, 2009.

Guru Nanak Dev Engineering College, Ludhiana

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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	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	Demonstrate various types of gears.
5	Perform the balancing of rotating masses.
6	To Analyse the profile of a cam with various followers.
7	Determine gear train value of compound gear trains & epicyclic gear trains.
8	Draw circumferential & axial pressure profile of journal bearing.
9	Conduct experiments on various types of governors & to co-relate equilibrium height & speed of the governor.
10	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 2009.
5. 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/

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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	**TeachingHours:**45(L)+15(T)+30(P)= 90 hrs
TotalMax.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):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 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 **08 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 **05 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 **09Hrs**

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 **09 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 **07 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 **07 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

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B. Tech. (Mechanical Engineering)

Course Code: CME108

Course Title: **Fluid Mechanics**

Programme: B.Tech.	**L**: 3 **T**: 1**P**: 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 **06 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 **08 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.

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B. Tech. (Mechanical Engineering)

PART B

Unit- IV Dimensional analysis and similitude **04 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 **05 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

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

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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: **6 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.

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B. Tech. (Mechanical Engineering)

Online Learning Materials

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

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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 **08 hrs**

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 **12 hrs**

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 **08 hrs**

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 **12 hrs**

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 **10 hrs**

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 **10 hrs**

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

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B. Tech. (Mechanical Engineering)

Course Code: EME103

Course Title: Computational Methods

Programme: B.Tech.	**L: T: P: 4: 0:0**	**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 **6 hrs**

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 **10 hrs**

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.

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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.