NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
B.Tech. in Mechanical Engineering
Proposed Teaching & Examination Scheme
Semester III

w.e.f. Academic Year 2023-24

Course Code	Course Name	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
2ME301	Thermodynamics	2	1	0	3	3	0.6	-	0.4
2ME101	Material Science and Engineering	2	0	2	3	3	0.3	0.3	0.4
2ME601	Solid Mechanics and Geometric Modelling	2	0	2	3	3	0.3	0.3	0.4
2ME801	Mathematics for Mechanical Engineering	2	1	0	3	3	0.6	-	0.4
2ME102	Metrology and Quality Control	2	0	2	3	3	0.3	0.3	0.4
2HS401	Organisational Behaviour	2	1	0	3	3	0.6	-	0.4
2FT901	Internship - Community services	0	0	0	3	-	1	-	-
	Total Credits				**21**	-	-	-	-

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	2ME301
Course Title:	Thermodynamics
Course Type:	Core
Year of introduction:	2023-24

L	**T**	**Practical component**				**C**
		LPW	**PW**	**W**	**S**	
2	**1**	**-**	**-**	**-**	**-**	**3**

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1	infer the basic concepts and laws related to thermodynamics,	(BL2)
2	determine properties of substances used in various systems,	(BL5)
3	apply the laws of thermodynamics for various processes,	(BL3)
4	analyse various thermodynamic cycles for related applications.	(BL4)

Syllabus: **Total Teaching Hours: 30**

Unit	**Syllabus**	**Teaching Hours**
Unit I	**Fundamental Concept and First Law of Thermodynamics** Basic Fundamentals, Thermodynamic system, properties, processes and cycles, Concept of continuum, Zeroth law and temperature measurement, Work interactions and Heat interactions, First law for a closed system undergoing a cycle and change of state, Steady flow energy equation and its applications.	**06**
Unit II	**Properties of Gas and Pure Substance** Revision of ideal gas concept and overview of non-flow processes such as constant pressure, constant volume, isothermal, isentropic and polytropic, Real gases and real gas mixtures, Various equation of state, compressibility charts, Properties of pure substance, P-V-T surface, Use of property tables and Mollier's chart to determine properties of steam.	**06**

Unit III **Second Law of Thermodynamics and Entropy** **08**

Kelvin-Plank and Clausius' statements, Causes of irreversibility and entropy concept, Carnot's theorem and its corollary, Thermodynamic temperature scale, Statement of third law of thermodynamics, Clausius theorem, inequality of Clausius, Entropy changes for reversible and irreversible processes, principle of increase of entropy, Entropy generation in closed and open system, Second law efficiency.

Unit IV **Thermodynamic Relations and Cycles** **10**

Maxwell's relations, Clausius-Claperayon equation, General equations for change in internal energy, enthalpy, entropy, difference and ratio of heat capacities, Joule Kelvin effect. Analysis of Carnot cycles, Rankine cycle, Otto, Diesel, Dual cycle, Brayton cycle, Reverse Carnot cycle and VCR cycle based on first and second law of thermodynamics. Methods for the improvement of cycle performance.

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings/References:

1. Boles M.A., Cengel Y.A., Thermodynamics: An Engineering Approach, McGraw Hill Education
2. Moran M. J., Shapiro H.N., Fundamentals of Engineering Thermodynamics, John Wiley & Sons
3. Sonntag R. E., Borgnakke C., Introduction to Engineering Thermodynamics, John Wiley & Sons
4. Nag P. K., Engineering Thermodynamics, McGraw Hill Education

Suggested List of Tutorials:

1. First law of thermodynamics applied to close and open systems
2. Properties of ideal and real gas
3. Properties of pure substance
4. Second law of thermodynamics applied to various systems
5. Application of entropy principle to close and open systems.
6. Analysis of various thermodynamics cycles
7. Applications of performance improvement methods for thermodynamic cycles
8. Application of software tools for problem solving

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	2ME101
Course Title:	Material Science and Engineering
Course Type:	Core
Year of introduction:	2023-24

L	**T**	**Practical component**				**C**
		LPW	**PW**	**W**	**S**	
2	**0**	**2**	**-**	**-**	**-**	**3**

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1 explain the relationship between structure of materials and mechanical properties, (BL2)

2 recommend the heat treatment process for ferrous materials using phase diagrams, (BL5)

3 analyse the microstructure of ferrous and non-ferrous materials, (BL4)

4 select the material for engineering applications. (BL3)

Syllabus: **Total Teaching Hours: 30**

Unit	**Syllabus**	**Teaching Hours**
Unit I	**Crystal structure and mechanical properties** Various crystal structures and their characteristics, imperfection in solids, plastic deformation by slip, stress-strain curve, generalized Hooke's law, yield strength, resilience, toughness and elastic recovery, impact test, hardness measurement.	**09**
Unit II	**Phase diagram and heat treatment** Phase rule, cooling curves, construction and applications of phase diagrams, lever rule, important binary phase diagrams, isomorphous system, eutectic system, peritectic system, iron-iron carbide (Fe-Fe3C) equilibrium diagram. Purpose of heat treatment, TTT diagram, study of heat treatment processes such as annealing, normalizing, hardening, tempering, carburizing, nitriding, cyaniding, martempering, austempering,	**09**

induction hardening and flame hardening, hardenability and its determination.

Unit III **Ferrous materials** **05**

Classification of steel, effect of alloying elements on the properties of steels, properties and applications of alloy steels, exposure to national & various international standards such as AISI, SAE, IS etc., classification of cast iron, properties and applications of different cast irons.

Unit IV **Non-ferrous materials** **07**

Composition, properties & uses of important aluminium alloys & copper alloys. Properties and applications of Ceramics, Composite materials and Polymers. Non-destructive testing using dye penetrant, radiography, Magnetic particle testing and ultrasonic, their applications and limitations.

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Callister W.D.,Materials Science and Engineering, Wiley India (P)Ltd.
2. Avener S.H., Physical Metallurgy, Tata Mc Graw Hill publication
3. Raghavan V.,Materials Science and Engineering- A first Course, PHI publication
4. Askeland D.R.,The Science and Engineering of Materials, Cengage Publication

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	Non-Destructive Testing using dye-penetrant test	2
2.	Detection of defects using ultrasonic flaw detector	2
3.	Study of optical and electron beam microscopes	2
4.	Preparation of specimen for microscopic examination	2
5.	Examination of microstructures of different ferrous metals	2
6.	Examination of microstructures of different non-ferrous metals	2
7.	Study of iron-iron carbide phase diagram	2
8.	Analysis of the effect of quenching media on hardness of steel	2

Sr. No.	Title	Hours
9.	Determination of hardenability of steel	2
10.	Determination of effect of section size on hardness of the metal during the hardening process	2
11.	Study of grain size and its measurement	2
12.	Microhardness measurement of a specimen	2

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	2ME601
Course Title:	Solid Mechanics and Geometric Modelling
Course Type:	Core
Year of introduction:	2023-24

Credit Scheme

L	T	Practical component				C
		LPW	PW	W	S	
2	0	2	-	-	-	3

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1	analyse the forces acting on the structural elements,	(BL4)
2	evaluate the stresses developed in structural elements,	(BL5)
3	relate properties of materials, principal stresses and theories of failure,	(BL2)
4	build part and assembly of mechanical components using solid modelling software.	(BL3)

Syllabus: **Total Teaching Hours: 30**

Unit	Syllabus	Teaching Hours
UNIT – I	**Statics and Distributed Forces** Principles of statics, Particle, Rigid body, Coplanar, Concurrent and non-concurrent parallel and non-parallel forces, Composition and resolution of force, Couples and their properties, Combination of coplanar couple and forces, Centre of gravity, Moment of inertia, Analysis of frictional forces.	**08**
UNIT-II	**Strength and Elasticity** Stresses: Axial, normal, in-plane, tensile, compressive, shear, flexural, thermal and hoop, complementary shear. Strain: Linear, shear, lateral, thermal and volumetric, Poisson's ratio, Elastic constants and relation between them and bodies subjected to loads in three directions. Mechanical Properties of Materials	**06**
UNIT-III	**Stresses in Beams and Shafts** Types of supports, Support reactions, Bending moment and shear force diagrams in statically determinate beams subjected to different types of loading, Relation between bending moment, Shear force and rate of loading,	**10**

Theory of simple bending, Bending stresses and their distribution, Moment of resistance, Modulus of section, Composite beam sections, Distribution of shear stress in different sections, Torsion of solid and hollow circular shafts, Shear stress due to torsion, Angle of twist, Torsional moment of resistance.

UNIT-IV **Principal Stresses and Theories of Failure** **06**

Compound stresses, Analysis of principal planes and principal stresses, Mohr circle, Maximum principal stress theory, Maximum shear stress theory, and Distortion energy theory.

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Meriam J.L., Kraige L.G., Engineering Mechanics: Static, Wiley-India
2. Hibbeler R.C., Mechanics of Materials. Pearson
3. Beer F. P., Johnston E. R., & Dewolf J.T., Mechanics of Materials, Tata McGraw-Hill Education
4. Rattan S. S., Theory of machines, Tata McGraw Hill Education.
5. Timoshenko S. P. & Young D.H., Elements of Strength of Materials, East-West Press Private Limited.

Suggested list of experiments: (not restricted to the following)

Sr. No	Title	Hours
1.	Study of sketch module of solid modelling software	2
2.	Creating solid model of components using extrude command	2
3.	Creating solid model of components using revolve command	2
4.	Use of hole, helical profile, Rib, etc. for constructions of geometry.	2
5.	Use of pattern, mirror, trim, etc. for constructions of geometry.	2
6.	Use of dimensions, planes, axes, etc. for constructions of geometry.	2
7.	Creating solid model of components using sweep and blend command	2
8.	Creating solid model of components using loft and swept blend command	2
9.	Creating an assembly from the solid models of components.	2
10.	Creating sections views and exploded views.	2
11.	Introduction to the Machine Drawing.	2
12.	Creating assembly drawing and Bill of Material (BOM).	2
13.	Creating detail drawing of components as per drawing standards.	2

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech (Mechanical Engineering)
Course Code:	2ME801
Course Title:	Mathematics for Mechanical Engineering
Course Type:	Core
Year of introduction:	2023-24

L	**T**	**Practical component**				**C**
		LPW	**PW**	**W**	**S**	
2	**1**	**0**	**-**	**-**	**-**	**3**

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1 infer concepts related to Fourier series, vector calculus and its applications, (BL2)

2 solve engineering problems of higher order linear differential equations, (BL3)

3 apply the concepts of Laplace transforms for mechanical engineering problems, (BL3)

4 make use of various numerical methods for engineering applications. (BL3)

Syllabus: **Total Teaching Hours: 30**

Unit	**Syllabus**	**Teaching Hours**
Unit I	**Vector Calculus and Fourier Series** Differentiation of scalars and vectors, Gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems, Fourier series and its applications.	**10**
Unit II	**Differential Equations** Higher order linear differential equations with constant coefficients; method of separation of variables, similarity solutions, Euler-Cauchy equation; initial and boundary value problems; Laplace transforms of elementary functions; application of Laplace transforms in solving differential equations, solutions of heat, wave and Laplace's equations.	**10**
Unit III	**Numerical Methods** Numerical solutions of linear and non-linear algebraic equations	**10**

(bracketing and open methods), solution of the system of linear algebraic equations, integration by trapezoidal and Simpson's rules; single and multi-step methods for ordinary differential equations (Euler's and Runge-Kutta higher order methods). Finite difference methods to solve partial differential equations. Use of software tools for solving mathematical problems pertaining to mechanical engineering.

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings /References:

1. Michael D Greenberg, Advanced Engineering Mathematics, Prentice Hall, Inc.
2. William Ames et al., Mathematics for Mechanical Engineers, CRC Press
3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc.
4. Chapra and Canale, Numerical Methods for Engineers, McGraw Hill

Suggested list of Tutorials:

1. Solution of problems using Fourier series
2. Application of gradient, divergence and curl
3. Estimation of surface and volume integrals
4. Euler- Cauchy formulations
5. Solution of Initial and Boundary value problems
6. Problem solving using Laplace transforms
7. Estimation of roots of algebraic equations using numerical methods
8. Interpolation using numerical methods
9. Solution of ordinary differential equations using numerical methods
10. Application of finite difference methods in problem solving.

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	2ME102
Course Title:	Metrology and Quality Control
Course Type:	Core
Year of introduction:	2023-24

L	T	Practical component				C
		LPW	PW	W	S	
2	0	2	-	-	-	3

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1	make use of various instruments for linear and angular measurements,	(BL3)
2	interpret the importance of tolerances and gauging practice,	(BL5)
3	measure the profiles and surface finish of a given component,	(BL5)
4	identify suitable quality control tool for given application.	(BL3)

Syllabus: **Total Teaching Hours: 30**

Unit	Syllabus	Teaching Hours
Unit I	**Linear and Angular Measurements** Standards of measurement, Line standards, end standards, sources of error in measurement. Various Linear measuring instruments like Calipers, surface plates, vernier height gauge, vernier depth gauges, micrometres, slip gauges. Comparators: classification and characteristics of comparators, uses, working principal, advantages and disadvantages of various types of comparators. Angular measurements: Bevel protector, Sine bars, angle gauges, clinometers, optical instrument for angle measurements, measurement of pressure, temperature, motion, force and torque, Introduction to coordinate measuring machines.	**10**
Unit II	**Measurement of Surface Finish:** Meaning of surface texture, surface roughness, terminology as per Indian Standards, methods of measuring surface finish, direct instrument	**07**

measurement, measurement of surface coating thickness, measurement by Light wave interference: Principle and its applications. Measurement of screw threads and gears: Metrology of screw thread: screw thread terminology, effect of pitch errors, measurements of various elements of thread. Gear measurement: Sources of error in manufacturing gears, rolling tests, measurements of various elements

Unit III **Limits, fits and gauges** **07**

Tolerances, limits, fits and allowances, basis of system, hole basis and shaft basis system, types of fits and their interpretation types of gauges and gauge design.

UNIT - IV **Fundamental of Quality** **06**

Definition, need and evolution of quality, dimensions of product and service quality, basic statistical measure / terms, source of variation, chance and assignable causes of variations, process capability, quality assurance, cost of quality, quality control tools.

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Galyer J.F.W. and Shot bolt, Metrology for Engineers, Thomson Learning
2. Mahajan M., A Text Book of Engineering Metrology, Dhanpat Rai & Sons
3. Juran J.M. and Gryna Frank M, Quality planning and analysis, Tata McGraw Hill Education.
4. Mitra Amitava., Fundamentals of Quality Control and Improvement, John Wiley & Sons.
5. Grant E.L., Statistical Quality Control, McGraw-Hill Education.
6. Kaoru Ishikawa, Introduction to Quality Control, Modern Productivity and Quality Publishing Pvt. Ltd.

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	Dimension measurement using different linear measuring instruments	2
2.	Dimension measurement using indirect instruments and gauges	2

Sr. No.	Title	Hours
3.	Calibration of micrometre using slip gauges	2
4.	Calibration of dial gauge using dial gauge tester	2
5.	Angle measurement using sine bar and vernier bevel protractor	2
6.	Feature measurement using tool maker’s microscope	2
7.	Measurement of gear tooth thickness	2
8.	Calibration of tachometer using stroboscope	2
9.	Calibration of Bourdon-tube pressure gauge	2
10.	Measurement of surface roughness of given specimen	2
11.	Observation of fringe pattern using interferometer	2
12.	Measurement of flatness and roundness of given component	2
13.	Alignment test of lathe Machine	2