NARAYANA ENGINEERING COLLEGE::GUDUR

(AUTONOMOUS)

DEPARTMENT OF MECHANICAL ENGINEERING

II YEARCOURSE STRUCTURE & SYLLABI

B.Tech.–II Year ISemester

S.No.	Course code	Title	L	T	P	Credits
1	23A03301	Thermodynamics	2	0	0	2
2	23A03302	Mechanics of Solids	3	0	0	3
3	23A03303	Material Science and Metallurgy	3	0	0	3
4	23A03304	Mechanics of Solids and Materials Science Lab	0	0	3	1.5
5	23A03305	Computer-Aided Machine Drawing	0	0	3	1.5

NARAYANA ENGINEERING COLLEGE:GUDUR								
Course code	THERMODYNAMICS (23A03301)							R23
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	2	0	0		2	30	70	100
Pre-requisite:								

Course Objectives: The students completing this course are expected to

- Familiarize concepts of heat, work, energy and governing rules for conversion of one form to other.
- Explain relationships between properties of matter and basic laws of thermodynamics.
- Teach the concept of entropy for identifying the disorder and feasibility of a thermodynamic process.
- Introduce the concept of available energy for maximum work conversion.
- Provide fundamental concepts of Refrigeration and Psychrometry.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Explain the importance of thermodynamic properties related to conversion of heat energy into work. (L3)
CO 2	Apply the Zeroeth and First Law of Thermodynamics. (L3)
CO 3	Understand Second Law of Thermodynamics. (L2)
CO 4	Analyze the Mollier charts, T-S and h-s diagrams, Steam calorimetry, Phase Transformations(L4)
CO 5	Evaluate the COP of refrigerating systems and properties, processes of psychrometry and sensible and latent heat loads. (L5)

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1														
CO2														
CO3														
CO4														
CO5														
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1		**8H**
Introduction: Basic Concepts : System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi static Process, Irreversible Process, Causes of Irreversibility		
MODULE -2		**7 H**

Energy in State and in Transition, Types, Work and Heat, Point and Path function.Zeroeth Law of Thermodynamics – PMM-I, Joule's Experiment – First law of Thermodynamics and applications. Limitations of the First Law – Enthalpy, Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance.

MODULE-3		8 H

Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM-II, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

MODULE-4		8 H

Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

At the end of the Module 4, students will be able to:

MODULE-5		9 H

Introduction to Refrigeration: working of Air, Vapourcompression,VCR system Components, COP Refrigerants. Introduction to Air Conditioning: Psychrometric properties & processes – characterization of sensible and latent heat loads – load concepts of SHF. Requirements of human comfort and concept of effective temperature- comfort chart – comfort air conditioning, and load calculations.

Total hours:	48 HOURS

Online Learning Resources:

- https://www.edx.org/learn/thermodynamics.
- https://archive.nptel.ac.in/courses/112/106/112106310
- https://www.youtube.com/watch?v=7NI5P4KqrAs&t=1s
- https://kp.kiit.ac.in/pdf_files/02/Study-Material_3rdSemester_Winter_2021_Mechanical-Engg.-_Thermal-Engineering-1_AbhijitSamant.pdf
- https://www.coursera.org/learn/thermodynamics-intro

Text Book(s): 1. P.K.Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013.
2. Claus Borgnakke Richard E. Sonntag, Fundamentals of Thermodynamics, 7/e, Wiley, 2009.

Reference Books :

1. J.B. Jones, and R.E. Dugan, Engineering Thermodynamics, 1/e,Prentice Hall, 1995.
2. Y.A.Cengel&M.A.Boles ,Thermodynamics – An Engineering Approach, 7/e, McGraw Hill, 2010.
3. P.Chattopadhyay, Engineering Thermodynamics, 1/e, Oxford University Press, 2011.
4. CP Arora, Refrigeration and Air-conditioning, 4/e, McGraw Hill, 2021

NARAYANA ENGINEERING COLLEGE:GUDUR								
Course code	MECHANICS OFSOLIDS(23A03302)							R23
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	3	0	0		3	30	70	100
Pre-requisite:								

Course Objectives: The students completing this course are expected to

- Understandthebehaviourofbasicstructuralmemberssubjectedtouniaxialandbi axial loads.
- Apply the concept of stressand strain to analyse and design structural members and machine parts under axial, shear and bending loads, moment and torsional moment.
- Students will earn all the methods to analyse beams, columns, frames for normal, shear, and torsion stresses and to solve deflection problems in preparation for the design of such structural components. Students are able to analyse beams and draw correct and complete shear and bending moment diagrams for beams.
- Students attain a deeper understanding of the loads,stresses, and strains acting on a structure and the irrelations in the elastic behavior
- Design and analysis of Industrial components like pressure vessels.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Learn al l the methods to analyze beams, columns, frames for normal ,shear ,and Torsion stresses and to solve deflection problems in preparation for the design of such structural components
CO 2	Apply the Zeroeth and First Law of Thermodynamics. (L3)
CO 3	Understand Second Law of Thermodynamics. (L2)
CO 4	Analyze the Mollier charts, T-S and h-s diagrams, Steam calorimetry, Phase Transformations(L4)
CO 5	Evaluate the COP of refrigerating systems and properties, processes of psychrometry and sensible and latent heat loads. (L5)

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1														
CO2														
CO3														
CO4														
CO5														
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1		**8H**
SIMPLE STRESSES & STRAINS : Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shock loadings.		
MODULE -2		**7 H**
SHEAR FORCE AND BENDING MOMENT : Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l, uniformly varying loads and combination of these loads– Point of contra flexure– Relation between S.F., B.M and rate of loading ata section of a beam.		
MODULE-3		**8 H**
FLEXURAL STRESSES : Theory of simple bending, Derivation of bending equation, Determination of bending stresses – section modulus of rectangular, circular, I and T sections– Design of simple beam sections. **SHEAR STRESSES:** Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I and T sections.		
MODULE-4		**8 H**
DEFLECTION OF BEAMS : Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, UDL and UVL. Mohr's theorem and Moment area method – application to simple cases. **TORSION:** Introduction-Derivation- Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.		
MODULE-5		**9 H**
THIN AND THICK CYLINDERS: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in dia, and volume of thin cylinders– Thin spherical shells. Wire wound thin cylinders. Lame's equation – cylinders subjected to inside & outside pressures – compound cylinders. **COLUMNS:** BucklingandStability,ColumnswithPinnedends,ColumnswithothersupportConditions, Limitations of Euler's Formula, Rankine's Formula		

Total hours:	**48 HOURS**

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc19_ce18/preview.
- https://youtube/iY_ypychVNY?si=310htc4ksTQJ8Fv6.
- https://www.youtube.com/watch?v=WEy939Rkd_M&t=2s
- https://www.classcentral.com/course/swayam-strength-of-materials-iitm-184204
- https://www.coursera.org/learn/mechanics-1
- https://www.edx.org/learn/engineering/massachusetts-institute-of-technology-mechanical-behavior-of-materials-part-1-linear-elastic-behavior
- https://archive.nptel.ac.in/courses/112/107/112107146/

TextBooks:

1. GHRyder,Strengthofmaterials,PalgraveMacmillanpublishersIndiaLtd,1961.
2. B.C.Punmia,Strengthofmaterials,10/e,LakshmipublicationsPvt.Ltd,NewDelhi, 2018.

Reference Books :

1.Gere&Timoshenko,Mechanicsofmaterials,2/e,CBSpublications,2004.
2.U.C.Jindal,StrengthofMaterials,2/e,PearsonEducation,2017.
3.Timoshenko,StrengthofMaterialsPart–I&II,3/e,CBSPublishers,2004.
4.AndrewPytelandFerdinandL.Singer,StrengthofMaterials,4/e,Longman Pulications, 1990.
5. Popov,MechanicsofSolids,2/e,NewPearsonEducation,2015.

NARAYANA ENGINEERING COLLEGE:GUDUR								
Course code	MATERIAL SCIENCE&METALLURGY (23A03303)							R23
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	3	0	0		3	30	70	100
Pre-requisite:								

Course Objectives: The students completing this course are expected to

- Understand the crystalline structure of different metal sand study the stability of phases in different alloy systems.
- Study the behavior of ferrous and non ferrous metals and alloys and their application in different domains
- Able to understand the effect of heat treatment, addition of alloying elements on properties of ferrous metals.
- Grasp the methods of making of metal powder sand applications of powder metallurgy
- Comprehendthepropertiesandapplicationsofceramic,compositesandother advanced methods

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Understand the crystalline structure of different metals and study the stability of phases in different alloy systems.(L2)
CO 2	Study the behavior of ferrous and non-ferrous metals and alloys and their application in different domains. .(L1)
CO 3	Understand the effect of heat treatment, addition of alloying elements on properties of ferrous metals. .(L2)
CO 4	Grasp the methods of making of metal powders and applications of powder metallurgy.(L3)
CO 5	Comprehend the properties and applications of ceramic, composites and other advanced methods. .(L4)

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1														
CO2														
CO3														
CO4														
CO5														
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1		**8H**
Structure of Metals and Constitution of alloys: Crystallization of metals, Packing Factor - SC, BCC, FCC& HCP-line density, plane density. Grain and grain boundaries, effect of grain boundaries–determination of grain size. Imperfections, Slip and Twinning. Necessity of alloying, types of solid solutions, Hume Rothery's rules, intermediate alloy phases, and electron compounds **Equilibrium Diagrams**: Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of binary phase diagrams such as Cu-Ni and Fe-Fe3C.		
MODULE -2		**7 H**
Ferrous metals and alloys: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast iron. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels. Non-ferrous Metals and Alloys: Structure and properties of Copper and its alloys, Aluminium and its alloys, Titanium and its alloys, Magnesium and its alloys, Super alloys.		
MODULE-3		**8 H**
Heat treatment of Steels: Effect of alloying elements on Fe-Fe3C system, annealing, normalizing,hardening, TTT diagrams, tempering, hardenability, surface - hardening methods, age hardening treatment, Cryogenic treatment.		
MODULE-4		**8 H**
Powder Metallurgy: Basic processes- Methods of producing metal powders- milling atomization- Granulation-Reduction-Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts. Secondary operations, Applications of powder metallurgical products.		
At the end of the Module 4, students will be able to:		
MODULE-5		**9 H**
Ceramic and Advanced materials: Crystalline ceramics, glasses, cermets, abrasive materials, Classification of composites, manufacturing methods, particle reinforced composites, fiber reinforced composites, PMC, MMC, CMC and CCCs. Introduction to Nanomaterials and smart materials.		
	Total hours:	**48 HOURS**
Online Learning Resources: •https://archive.nptel.ac.in/courses/113/106/113106032/ • https://www.edx.org/learn/mechanics/massachusetts-institute-of-technologymechanical-behavior-of-materials-part-3-time-dependent-behavior. • https://www.youtube.com/watch?v=9Sf278j1GTU • https://www.coursera.org/learn/fundamentals-of-materials-science		

- https://www.coursera.org/learn/material-behavior

Text Book(s): 1. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 1997.
2. Donald R.Askeland, Essentials of Materials science and Engineering, 4/e, CL Engineering publications, 2018.

Reference Books :

1. Dr.V.D.kodgire, Material Science and Metallurgy, 39/e, Everest Publishing House, 2017.
2. V.Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004.
3. William D. Callister Jr, Materials Science and Engineering: An Introduction, 8/e, John Wiley and Sons, 2009.
4. George E.Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2013.
5. Yip-Wah Chung, Introduction to Material Science and Engineering, 2/e, CRC Press, 2022.
6. A V K Suryanarayana, Material Science and Metallurgy, B S Publications, 2014.
7. U. C. Jindal, Material Science and Metallurgy, 1/e, Pearson Publications, 2011.

NARAYANA ENGINEERING COLLEGE:GUDUR								
Lab code	LAB title: **MECHANICS OF SOLIDS & MATERIAL SCIENCE LAB (23A03304)**							R23
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II	0	0	3	32	1.5	30	70	100

Pre-requisite:

Course Objectives: The students completing this course are expected to

- Evaluate the values of yield stress, ultimate stress and bending stress of the given specimen under tension test and bending test
- Conduct the torsion test to determine the modulus of rigidity of given specimen.
- Justify the Rockwell hardness test over with Brinell hardness and measure the hardness of the given specimen.
- Examine the stiffness of the open coil and closed coil spring and grade them.
- Analyze the microstructure and characteristics of ferrous and non ferrous alloy specimens.

Course Outcomes: After successful completion of the course, the student will be able to:

CO1	Understand the stress strain behavior of different materials(L2)
CO2	Evaluate the hardness of different materials(L4)
CO3	Explain the relation between elastic constants and hardness of materials. (L1)
CO4	Identify various microstructures of steels and cast irons. (L3)
CO5	Evaluate hardness of treated and untreated steels. (L4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1														
CO2														
CO3														
CO4														
CO5														

1-Low, 2-Medium, 3- High

COURSE CONTENT	CO
NOTE: Any 6 experiments from each section A and B. **A) MECHANICSOFSOLIDSLAB**: **Task 1 .** Tensile test **Task 2** Bending test on a) Simply supported beam b) Cantilever beam **Task 3.** Torsion test	

Task 4. . Hardness test a) Brinell's hardness test b) Rockwell hardness test c) Vickers hardness test **Task 5.** Test on springs **Task 6.** Impact test a) Charpy test b) Izod test **Task 7.** Punch shear test **Task 8.** Liquid penetration test **B) MATERIAL SCIENCELAB:** **Task 1.** Preparation and study of the Microstructure of pure metals. **Task 2.** Preparation and study of the Microstructure of Mild steel, medium carbon steels, and High carbon steels **Task 3.** Study of the Microstructures of Cast Irons. **Task 4.** Study of the Microstructures of Non-Ferrous alloys. **Task 5**. Study of the Microstructures of Heat treated steels. **Task 6.** Hardenability of steels by Jominy End Quench Test.	

Virtual Labs:

1.To investigate the principal stresses σa and σb at any given point of a structural element or machine component when it is in a state of plane stress. (https://virtuallabs.github.io/exp-rockwell-hardness-experiment-iiith/objective.html)

2. To find the impact resistance of mild steel and cast iron.(https://smnitk.vlabs.ac.in/exp/izod-impact-test).

3. To find the impact resistance of mild steel.(https://sm-nitk.vlabs.ac.in/exp/charpyimpact-test/index.html)

4. To find the Rockwell hardness number of mild steel, cast iron, brass, aluminum and spring steel etc. (https://sm-nitk.vlabs.ac.in/exp/rockwell-hardness-test)

5. To determine the indentation hardness of mild steel, brass, aluminum etc. using Vickers hardness testing machine. (https://sm-nitk.vlabs.ac.in/exp/vickers-hardnesstest

NARAYANA ENGINEERING COLLEGE:GUDUR								
Lab code	LAB title: **COMPUTER-AIDED MACHINE DRAWING (23A03305)**							R23
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II	0	0	3	32	1.5	30	70	100

Pre-requisite:

Course Objectives: The students completing this course are expected to

- Introduce conventional representations of material and machine components.
- Train to use software for 2D and 3D modeling
- Familiarize with thread profiles, riveted, welded and key joints.
- Teach solid modeling of machine parts and their sections
- Explain creation of 2D and 3D assembly drawings and Familiarize with limits, fits and tolerances inmating components

Course Outcomes: After successful completion of the course, the student will be able to:

CO1	Demonstrate the conventional representations of materials and machine components. (L3)
CO2	Model riveted, welded and key joints using CAD system. (L6)
CO3	Create solid models and sectional views of machine components. (L6)
CO4	Generate solid models of machine parts and assemble them. (L5)
CO5	Translate 3D assemblies into 2D drawings. (L6)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1														
CO2														
CO3														
CO4														
CO5														

1-Low, 2-Medium, 3- High

COURSE CONTENT	CO
The following are to be done by any 2D software package **Conventional representation of materials and components:** **Task 1 .** Detachable joints: Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint with washer and locknut, stud joint, screw joint and foundation bolts. **Task 2** Riveted joints: Drawing of rivet, lap joint, butt joint with single strap, single riveted, double riveted double strap joints.	

Task 3. Welded joints: Lap joint and T joint with fillet, butt joint with conventions.

Task 4. Keys: Taper key, sunk taper key, round key, saddle key, feather key, woodruff key. **Task 5.** Couplings: rigid – Muff, flange; flexible – bushed pin-type flange coupling, universal coupling, Oldham's' coupling.

The following exercises are to be done by any 3D software package:

Task 1. Sectional views: Creating solid models of complex machine parts and sectional views

Task 2. Assembly drawings:(Any four of the following using solid model software) Lathe tool post, tool head of shaping machine, tail-stock, machine vice, gate valve, carburetor, piston, connecting rod, eccentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva cam, universal coupling

Task 3. Production drawing: Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.

Textbooks:

1 Machine Drawing byK.L.Narayana, P.Kannaiah and K.Venkat Reddy, New Age International Publishers, 3/e, 2014
2 Machine drawing by N.Sideshwar, P. Kannaiah, V.V.S.Sastry, TMH Publishers. 2014.

Reference Books:

1. Cecil Jensen, Jay Helsel and Donald D.Voisinet, Computer Aided Engineering Drawing, Tata McGraw-Hill, NY, 2000.
2. James Barclay, Brain Griffiths, Engineering Drawing for Manufacture, Kogan Page Science, 2003.
3. N.D.Bhatt, Machine Drawing, Charotar Publishers, 50/e, 2014.

Online Learning Resources:

- https://eeedocs.wordpress.com/wp-content/uploads/2014/02/machinedrawing.pdf
- https://archive.nptel.ac.in/courses/112/105/112105294/
- https://www.edx.org/learn/engineering/dassault-systemes-solidworks-solidworks-cadfundamentals?index=product&queryID=c90b35a82a6ef58b0d6f89679c63f6a1&position=2&linked_from=autocomplete&c=autocomplete
- https://www.youtube.com/watch?v=0bQkS3_3Fq4

NARAYANA ENGINEERING COLLEGE::GUDUR

(AUTONOMOUS)

DEPARTMENT OF MECHANICAL ENGINEERING

II YEARCOURSE STRUCTURE & SYLLABI

B.Tech.II Year II Semester

S.No.	Coursecode	Title	L	T	P	Credits
1	23A52402d	Industrial Management	2	0	0	2
2	23A03401T	Manufacturing processes	3	0	0	3
3	23A03402T	Fluid Mechanics & Hydraulic Machines	3	0	0	3
4	23A03403	Theory of Machines	3	0	0	3
5	23A03402P	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	1.5
6	23A03401P	Manufacturing processes Lab	0	0	3	1.5
7	23A99401	Design Thinking &Innovation	1	0	2	2

NARAYANA ENGINEERING COLLEGE:GUDUR								
Course code	INDUSTRIAL MANAGEMENT (23A52402d)							R23
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	2	0	0		2	30	70	100
Pre-requisite:								

Course Objectives: The students completing this course are expected to

- Introduce the scope and role of industrial engineering and the techniques for optimal design of layouts
- Illustrate how work study is used to improve productivity
- Explain TQM and quality control techniques
- Introduce financial management aspects and
- Discuss human resource management and value analysis.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Learn about how to design the optimal layout. (L1)
CO 2	Demonstrate work study methods. (L3)
CO 3	Explain Quality Control techniques. (L2)
CO 4	Discuss the financial management aspects (L3)
CO 5	Understand the human resource management methods.. (L2)

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1														
CO2														
CO3														
CO4														
CO5														
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1		**8H**

INTRODUCTION: Definition of industrial engineering (I.E), development, applications, role of an industrial engineer, quantitative tools of IE and productivity measurement. Concept of management, importance, functions of management, scientific management, Taylor's principles, Fayol's principles of management.

PLANTLAYOUT: Factors governing plant location, types of production layouts, advantages and disadvantages of process layout and product layout, applications, quantitative techniques for optimal design of layouts.

MODULE -2		**7 H**

WORK STUDY: Importance, types of production, applications, work study, method study and time study, work sampling, PMTS, micromotion study, rating techniques, MTM, work

factor system, principles of Ergonomics, flow process charts, string diagram sand Therbligs

MODULE-3		8 H

STATISTICAL QUALITY CONTROL: Quality control, Queuing assurance and its importance, SQC, attribute sampling inspection with single and double sampling, Control charts – X and R –charts X and S charts and their applications, simple numerical examples.

TOTALQUALITYMANAGEMENT: Elements of TQM – Continuous Improvement – zerodefectconcept,qualitycircles,implementation,applications,ISOqualitysystems.SixSigma– definition, basic concepts

MODULE-4		8 H

FINANCIAL MANAGEMENT: Scope and nature of financial management, Sources of finance, Management of working capital, estimation of working capital requirements, budget and budgetary control, Capital budgeting – Nature of Investment Decisions– InvestmentEvaluationcriteria-NPV,IRR,PI,PaybackPeriod,andARR,numericalproblems.

MODULE-5		9 H

HUMANRESOURCEMANAGEMENT: Concept of human resource management, per sonnel management and industrial relations, functions of personnel management, Jobevaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, and types.

VALUE ANALYSIS: Value engineering, implementation procedure, enterprise resource planning and supply chain management.

Total hours:	48 HOURS

Online Learning Resources:

- https://www.edx.org/learn/thermodynamics.
- https://archive.nptel.ac.in/courses/112/106/112106310
- https://www.youtube.com/watch?v=7NI5P4KqrAs&t=1s
- https://kp.kiit.ac.in/pdf_files/02/Study-Material_3rdSemester_Winter_2021_Mechanical-Engg.-_Thermal-Engineering-1_AbhijitSamant.pdf
- https://www.coursera.org/learn/thermodynamics-intro

Text Book(s):

1. O.PKhanna,IndustrialEngineeringandManagement,DhanpatRaiPublications(P)Ltd.
2. MartandTelsang,IndustrialEngineeringandProductionManagement,S.Chand &CompanyLtd.New Delhi

Reference Books :

1. Bhattacharya DK, Industrial Management, S.Chand, publishers.
2. J.G Monks, Operations Management, 3/e, McGraw Hill Publishers.
3. T.R.Banga,S.C.Sharma,N.K.Agarwal,IndustrialEngineeringandManagementScience, KhannaPublishers.
4. Koontz O'Donnell, Principles of Management, McGraw Hill Publishers.
5. R.C.Gupta, Statistical Quality Control, Khanna Publishers.
6. NVS Raju, Industrial Engineering and Management, Cengage India Private Limited

NARAYANA ENGINEERING COLLEGE:GUDUR								
Course code	MANUFACTURING PROCESSES (23A03401T)							R23
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	3	0	0		3	30	70	100
Pre-requisite:								

Course Objectives: The students completing this course are expected to

- Know the working principle of different metal casting processes and gating system.
- Classify the welding processes, working of different types of welding processes and welding defects.
- Know the nature of plastic deformation, cold and hot working process, working of a rolling mill and types, extrusion processes.
- Understand the principles of forging, tools and dies, working of forging processes.
- Know about the Additive manufacturing

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Design the patterns and core boxes for metal casting processes. (L6)
CO 2	Understand the different welding processes. (L2)
CO 3	Demonstrate the different types of bulk forming processes. (L3)
CO 4	Understand sheet metal forming processes (L2)
CO 5	Learn about the different types of additive manufacturing processes. (L2)

CO-PO Mapping

CO	PO												PSO	
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1														
CO2														
CO3														
CO4														
CO5														

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1		**8H**

Casting: Steps involved in making a casting – Advantage of casting and its applications. Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Molding, different types of cores , Principles of Gating, Risers, casting design considerations .Methods of melting and types of furnaces, Solidification of castings and casting defects- causes and remedies. Basic principles and applications of special casting processes - Centrifugal casting, Die casting, Investment casting and shell molding.

MODULE -2		**7 H**

Welding: Classification of welding processes, types of welded joints and their characteristics,

Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, power characteristics, Manual metal arc welding, submerged arc welding, TIG & MIG welding. Electro–slag welding.

Resistance welding, Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma Arc welding, Laser welding, electron beam welding, Soldering &Brazing.

Heat affected zones in welding; pre & post heating, welding defects –causes and remedies.

MODULE-3		8 H

Bulk Forming: Plastic deformation in metals and alloys-recovery, recrystallization and grain growth. Hot working and Cold working-Strain hardening and Annealing. Bulk forming processes: Forging-Types of Forging, forging defects and remedies; Rolling – fundamentals, types of rolling mills and products, Forces in rollingand power requirements. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

MODULE-4		8 H

Sheetmetalforming-Blankingandpiercing,Forcesandpowerrequirementintheseoperations, Deep drawing, Stretch forming, Bending, Spring back and its remedies, Coining, Spinning, Types of presses and press tools.

High energy rate forming processes: Principles of explosive forming, electromagnetic forming, Electro hydraulic forming, rubber pad forming, advantages and limitations.

MODULE-5		9 H

Additive manufacturing - Steps in Additive Manufacturing (AM), Classification of AM processes, Advantages of AM, and types of materials for AM, VAT photo polymerization AM Processes, Extrusion - Based AM Processes, Powder Bed Fusion AM Processes, Direct Energy Deposition AM Processes, Post Processing of AM Parts, Applications

Total hours:	48 HOURS

Online Learning Resources:

- https://www.edx.org/learn/thermodynamics.
- https://archive.nptel.ac.in/courses/112/106/112106310
- https://www.youtube.com/watch?v=7NI5P4KqrAs&t=1s
- https://kp.kiit.ac.in/pdf_files/02/Study-Material_3rdSemester_Winter_2021_Mechanical-Engg.-_Thermal-Engineering-1_AbhijitSamant.pdf
- https://www.coursera.org/learn/thermodynamics-intro

Text Book(s): 1. Kalpakjain S and Steven R Schmid,Manufacturing Processes for Engineering Materials, 5/e, Pearson Publications, 2007.

2. P.N. Rao,Manufacturing Technology -Vol I, 5/e, McGraw Hill Education, 2018.

Reference Books : 1.A.Ghosh&A.K.Malik, Manufacturing Science, East West Press Pvt. Ltd, 2010.

2. Lindberg and Roy, Processes and materials of manufacture, 4/e, Prentice Hall India Learning Private Limited, 1990.

3. R.K. Jain, Production Technology, Khanna Publishers, 2022.

4. Sharma P.C., A Text book of Production Technology, 8/e, S Chand Publishing, 2014.

5. H.S. Shaun, Manufacturing Processes, 1/e, Pearson Publishers, 2012.

6. WAJ Chapman , Workshop Technology, 5/e, CBS Publishers&DistributorsPvt.Ltd, 2001.

7. Hindustan Machine Tools, Production Technology, Tata McGraw Hill Publishers, 2017.

8. Ian Gibson, David W Rosen, Brent Stucker., Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2/e, Springer, 2015

NARAYANA ENGINEERING COLLEGE:GUDUR								
Course code	FLUIDMECHANICS & HYDRAULIC MACHINES (23A03402T)							R23
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	3	0	0		3	30	70	100
Pre-requisite:								

Course Objectives: The students completing this course are expected to

- Understand the properties of fluids, manometry, hydrostatic Forces acting on different surfaces
- Understand the kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations.
- Understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Understand the basic concepts of fluid properties.. (L2)
CO 2	Estimate the mechanics of fluids in static and dynamic conditions.. (L5)
CO 3	Apply the Boundary layer theory, flow separation and dimensional analysis. (L3)
CO 4	Estimate the hydrodynamic forces of jet on vanes in different positions. (L5)
CO 5	Understand the working Principles and performance evaluation of hydraulic pump and turbines. (L2)

CO-PO Mapping

CO	PO												PSO	
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1														
CO2														
CO3														
CO4														
CO5														

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1		**8H**

Fluid statics: Dimensions and units: physical properties of fluids - specific gravity, viscosity and its significance, surface tension, capillarity, vapor pressure. Atmospheric, gauge and vacuum pressure, Measurement of pressure – Manometers - Piezometer, U-tube, inverted and differential manometers. Pascal's &hydrostatic laws.

Buoyancy and floatation: Meta center, stability of floating body. Submerged bodies. Calculation of meta center height. Stability analysis and applications.

MODULE -2		**7 H**

Fluid kinematics: Introduction, flowtypes.Equation of continuity for one dimensional flow,

circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them. Condition for irrotational flow, flow net, source and sink, doublet and vortex flow.

Fluid dynamics: surface and body forces –Euler's and Bernoulli's equations for flow along a streamline, momentum equation and its applications, force on pipe bend.

Closedconduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipesinseriesandpipesinparallel-totalenergyline-hydraulicgradientline.

MODULE-3		8 H

Boundary Layer Theory: Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body, Bluff body and its applications, basic concepts of velocity profiles. **Dimensional Analysis:** Dimensions and Units, Dimensional Homogeneity, Non dimensionalization of equations, Method of repeating variables and Buckingham Pi Theorem

MODULE-4		8 H

Basics of turbo machinery: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes ,jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow Over radial vanes.

Hydraulic Turbines: classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design – draft tube-theory-functions and efficiency.

At the end of the Module 4, students will be able to:

MODULE-5		9 H

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. Hydraulic systems- hydraulic ram, hydraulic lift, hydraulic coupling. Fluidics – amplifiers, sensors and oscillators. Advantages, limitations and applications.

Centrifugal pumps: classification, working, work done – manometric head- losses and efficiencies-specific speed- pumps in series and parallel-performance characteristic curves, cavitation & NPSH.

Reciprocatingpumps: Working, Discharge, slip, indicator diagrams.

Total hours:	48 HOURS

Online Learning Resources:

- https://archive.nptel.ac.in/courses/112/105/112105206/
- https://archive.nptel.ac.in/courses/112/104/112104118/
- https://www.edx.org/learn/fluid-mechanics
- https://onlinecourses.nptel.ac.in/noc20_ce30/previewnptel.ac.in
- www.coursera.org/learn/fluid-powerera

Text Book(s): 1. Y.A.Cengel,J.M.Cimbala, Fluid Mechanics,Fundamentalsand Applications,6/e,McGraw Hill Publications, 2019.

2. Dixon,Fluid Mechanics and Thermodynamics of Turbomachinery,7/e, Elsevier Publishers, 2014.

Reference Books :

1. P N Modi and S M Seth, Hydraulics & Fluid Mechanics including Hydraulics Machines, Standard Book House, 2017.
2. RKBansal, FluidMechanicsandHydraulicMachines, 10/e,LaxmiPublications(P)Ltd, 2019.
3. Rajput, FluidMechanicsandHydraulicMachines, S Chand & Company, 2016.
4. D.S.Kumar,FluidMechanicsandFluidPowerEngineering, S K Kataria &Sons, 2013.
5. D.RamaDurgaiah,FluidMechanicsandMachinery,1/e, NewAgeInternational, 2002.

NARAYANA ENGINEERING COLLEGE:GUDUR								
Course code	THEORY OF MACHINES (23A03403)							R23
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	3	0	0		3	30	70	100
Pre-requisite:								

Course Objectives: The students completing this course are expected to

- Introduce various basic mechanisms and their applications.
- Explain importance of degree of freedom.
- Familiarize velocity and acceleration in mechanisms.
- Describe the cams and follower motions.
- Explain the importance of gyroscopic couples.
- Introduce the equation of motion for single degree of freedom system.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Understand different mechanisms and their inversions. (L2)
CO 2	Calculate velocity and acceleration of different links in a mechanism. (L4)
CO 3	Apply the effects of gyroscopic couple in ships, aero planes and road vehicles. (L3)
CO 4	Evaluate unbalance mass in rotating machines. (L5)
CO 5	Analyze free and forced vibrations of single degree freedom systems. (L4)

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1														
CO2														
CO3														
CO4														
CO5														
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1		**8H**
Simple Mechanisms: Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, mobility – Grashof's law, kinematic inversions of four bar chain and slider crank chains- Limit positions – Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line mechanisms – Universal Joint – Rocker mechanisms.		
MODULE -2		**7 H**
Plane and motion analysis: Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and		

acceleration analysis using loop closure equations – kinematic analysis of simple mechanisms – slider crank mechanism dynamics – Coincident points – Coriolis component of acceleration.

MODULE-3		8 H

Gyroscope: Principle of gyroscope, gyroscopic effect in an aeroplane, ship, car and two wheeler, simple problems

Gear Profile: Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting – helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

MODULE-4		8 H

Balancing of Rotating masses: Need for balancing, balancing of single mass and several masses in different planes, using analytical and graphical methods.

Cams: Classification of cams and followers- Terminology and definitions – Displacement diagrams –Uniform velocity, parabolic, simple harmonic and cycloidal motions – derivatives of follower motions- specified contour cams- circular and tangent cams –pressure angle and undercutting.

MODULE-5		9 H

Vibrations: Introduction, degree of freedom, types of vibrations, free natural vibrations, Newton method and energy method for single degree of freedom. Damped vibrations- under damped, critically damped; and over damped systems, forced vibrations with and without damping in single degree of freedom; Vibration isolation and transmissibility.

Turning Moment Diagrams and Flywheels: Turning moment diagrams for steam engine, I.C engine and Multi Cylinder Engine. Crank effort – coefficient of fluctuation of energy, coefficient of fluctuation of speed – Fly Wheel and their design, fly wheels for punching press.

Total hours:	48 HOURS

Text Book(s): 1. S.S.Rattan, Theory of Machines, 4/e, Tata Mc-Graw Hill, 2014.
2. P.L.Ballaney, Theory of Machines & Mechanisms, 25/e, Khanna Publishers, Delhi, 2003.

Reference Books :

1.F. Haidery, Dynamics of Machines, 5/e, NiraliPrakashan, Pune, 2003.
2. J.E.Shigley, Theory of Machines and Mechanisms, 4/e, Oxford, 2014.
3. G.K.Groover, Mechanical Vibrations, 8/e, Nemchand Bros, 2009.
4. Norton, R.L., Design of Machinery – An Introduction to Synthesis and Analysis of Mechanisms and Machines, 2/e, McGraw Hill, New York, 2000.
5. William T. Thomson, Theory of vibration with applications, 4/e, Englewood Cliffs, N.J.: Prentice Hall, 1993

NARAYANA ENGINEERING COLLEGE:GUDUR								
Lab code	LAB title: **FLUID MECHANICS & HYDRAULIC MACHINERY LAB (23A03402P)**							R23
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II	0	0	3	32	1.5	30	70	100

Pre-requisite:

Course Objectives: To impart practical exposure on the performance valuation methods of various flow measuring equipment and hydraulic turbines and pumps.

Course Outcomes: After successful completion of the course, the student will be able to:

CO1	Demonstrate the devices used for measuring flow (L3)
CO2	Compute major losses in pipes. (L5)
CO3	Illustrate the operating parameters of turbines.. (L2)
CO4	Explain the working of different types of pumps. (L2)
CO5	Explain the devices used for measuring flow (L2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1														
CO2														
CO3														
CO4														
CO5														

1-Low, 2-Medium, 3- High

COURSE CONTENT	CO
Task 1 . Impact of jets on Vanes. **Task 2** Performance Test onPelton Wheel. **Task 3.** PerformanceTestonFrancis Turbine. **Task 4.** PerformanceTestonKaplan Turbine. **Task 5.** PerformanceTestonSingle Stage Centrifugal Pump. **Task 6.** PerformanceTestonMultiStageCentrifugal Pump. **Task 7.** PerformanceTestonReciprocating Pump **Task 8.** CalibrationofVenturimeter. **Task 9.** Calibration ofOrificemeter. **Task 10.** Determinationoffrictionfactorfor agivenpipeline. **Task 11.** Determinationoflossofheadduetosuddencontractionina pipeline.	

Task 12. Turbine flowmeter.	

Virtual Labs:

1. To study different patterns of a flow through a pipe and correlate them with the Reynolds number of the flow. (https://me.iitp.ac.in/Virtual-FluidLaboratory/reynolds/introduction.html)
2. To calculate Total Energy at different points of venture meter. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/bernoulli/introduction.html).
3. To calculate the flow (or point) velocity at center of the given tube using different flow rates. (https://me.iitp.ac.in/Virtual-FluidLaboratory/pitot/introduction.html)
4. To determine the hydrostatic force on a plane surface under partial submerge and full submerge condition. (https://me.iitp.ac.in/Virtual-FluidLaboratory/cop/introduction.html).
5. To determine the discharge coefficient of a triangular notch. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/notch/introduction.html)
6. To determine the coefficient of impact of jet on vanes. (https://fmnitk.vlabs.ac.in/exp/impact-of-jet).
7. To determine friction in pipes. (https://fm-nitk.vlabs.ac.in/exp/friction-inpipes/index.html).

NARAYANA ENGINEERING COLLEGE:GUDUR								
Lab code	LAB title: **MANUFACTURING PROCESSES LAB (23A03401P)**							R23
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II	0	0	3	32	1.5	30	70	100

Pre-requisite:

Course Objectives: Acquire practical knowledge on Metal Casting, Welding, Press Working and Processing of Plastics.

Course Outcomes: After successful completion of the course, the student will be able to:

CO1	Make moulds for sand casting. (L2)
CO2	Fabricate different types of components using various manufacturing techniques. (L5)
CO3	Adapt unconventional manufacturing methods. (L3)
CO4	Develop Different Weld joints. (L6)
CO5	Explain different types of 3d Printing techniques. (L2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1														
CO2														
CO3														
CO4														
CO5														

1-Low, 2-Medium, 3- High

COURSE CONTENT	CO
Task 1 . Design and making of pattern i. Single piece pattern ii. Split pattern. **Task 2** Sand properties testing i. Sieve analysis (dry sand) ii. Clay content test iii. Moisture content test iv. Strength test(Compression test & Shear test) v. Permeability test **Task 3.** Mould preparation i. Straight pipe ii. Bent pipe iii. Dumble iv. Gear blank **Task 4.** Gas cutting and welding **Task 5.** Manual metal arc welding i. Lap joint ii. Butt joint **Task 6.** Injection Molding	

Task 7. Blow Molding **Task 8.** Simple models using sheet metal operations **Task 9.** Study of deep drawing and extrusion operations **Task 10.** To make weldments using TIG/MIG welding **Task 11.** To weld using Spot welding machine **Task 12**. To join using Brazing and Soldering **Task 13.** To make simple parts on a 3D printing machine **Task 14.** Demonstration of metal casting.	

Virtual Labs:

1. To study and observe various stages of casting through demonstration of casting process. (https://virtual-labs.github.io/exp-sand-casting-processdei/theory.html)
2. To weld and cut metals using an oxyacetylene welding setup. (https://virtuallabs.github.io/exp-gas-cutting-processes-iitkgp/index.html).
3. To simulate Fused deposition modelling process (FDM) (https://3dpdei.vlabs.ac.in/exp/simulation-modelling-process)
4. https://altair.com/inspire-mold/
5. https://virtual-labs.github.io/exp-simulation-cartesian-system-dei/theory.htm

NARAYANA ENGINEERING COLLEGE:GUDUR								
Course code	DESIGN THINKING & INNOVATION (23A99401)							R23
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	1	0	2		2	30	70	100
Pre-requisite:								

Course Objectives: The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Define the concepts related to design thinking. (L1,L2)
CO 2	Explain the fundamentals of Design Thinking and innovation (L1,L2)
CO 3	Apply the design thinking techniques for solving problems in various sectors. (L3)
CO 4	Analyse to work in a multidisciplinary environment (L4)
CO 5	Evaluate the value of creativity (L5)
CO6	Formulate specific problem statements of real time issues(L3,L6)

CO-PO Mapping

CO	PO												PSO	
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1														
CO2														
CO3														
CO4														
CO5														

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1		**8H**

Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

MODULE -2		**7 H**

Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development

MODULE-3		8 H
Innovation Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations- Creativity to Innovation- Teams for innovation- Measuring the impact and value of creativity. **Activity:** Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.		
MODULE-4		**8 H**
Product Design Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design- Case studies **Activity:** Importance of modelling, how to set specifications, Explaining their own product design.		
MODULE-5		**9 H**
Design Thinking in Business Processes Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needsDesign thinking for Startups- Defining and testing Business Models and Business CasesDeveloping & testing prototypes. **Activity:** How to market our own product, About maintenance, Reliability and plan for startup.		
Total hours:		**48 HOURS**

Online Learning Resources:

1. https://nptel.ac.in/courses/110/106/110106124/
2. https://nptel.ac.in/courses/109/104/109104109/
3. https://swayam.gov.in/nd1_noc19_mg60/preview

Text Book(s):

1. Tim Brown,Change by design, Harper Bollins (2009)
2. Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons.

Reference Books :

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shrutin N Shetty, Design the Future, Norton Press
3. William Lidwell,Universal Principles of Design- Kritinaholden, Jill Butter.
4. Chesbrough.H, The Era of Open Innovation – 2013