Autonomous Program Structure of Second Year B. Tech. Third Semester (Mechanical Engineering)
Academic Year: 2021-2022 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Total Marks	Credit
		Lecture	Tutorial	Practical	In Sem.	End Sem.	Practical	Oral		
20BSME301	Calculus and Statistics (C&S)	3	1	0	50	50	0	0	100	4
20ME301	Engineering Metallurgy (EM)	3	0	0	50	50	0	0	100	3
20ME302	Engineering Thermodynamics (ET)	2	1	0	50	50	0	0	100	3
20ME303	Machining and Machine Tool Operations (MMTO)	3	0	0	50	50	0	0	100	3
20ME304	Strength of Materials (SOM)	3	1	0	50	50	0	0	100	4
20HS 301	Universal Human Values-II	2	1	0	50	50	0	0	100	3
20ME305L	Computer Aided Machine Drawing lab (CAMD Lab)	0	0	4	25	0	25	0	50	2
20ME301L	Engineering Metallurgy Lab (EM Lab)	0	0	2	25	0	0	25	50	1
20ME303L	Machining and Machine Tool Operations Lab (MMTO Lab)	0	0	2	25	0	25	0	50	1
20AC301	Audit Course (AC)	0	0	2	0	0	0	0	0	-
	Total	**16**	**4**	**10**	**375**	**300**	**50**	**25**		
	Grand Total	**30**			**675**		**75**		**750**	**24**

S. Y. B. Tech. – Semester-I

Course Code	Calculus & Statistics	L	T	P
20BSME301		3	-	-
Pre-requisite	First order linear ordinary differential equations, Basics of Vector Algebra, Integration – basic properties, standard results, Beta & Gamma Functions, Basics of probability.	Syllabus Version		
		V:1.1		

Course Objectives:

To make students

1. To provide sound knowledge of engineering mathematics
2. Strengthen thinking power to analyze
3. Solve engineering problems in their respective areas.

Course Outcomes:

Students will be able to

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

1 Solve the higher order linear differential equation and apply it to the mass-spring system.
2 Compute the transforms of simple discrete and continuous functions and solve partial differential equation.
3 Apply the concepts of vector calculus to find vector differentiation and vector integration.
4 Apply the concepts of probability distributions and statistics to interpret the data.

Unit/Module: 1	Higher Order Linear Differential equation and application	9 hours	CO: 1

Higher order Linear differential Equation with constant coefficients, Applications in solving Engineering problems. Mass Spring system, Damping effects, Resonance.

Unit/Module: 2	Transforms	9 hours	CO: 2

Fourier Transforms: Finite Fourier Sine transform, Finite Fourier Cosine transforms, Inversion formula for Sine transform, Inversion formula for Cosine transform. Finite Fourier Sine and Cosine Transforms of derivatives. Discrete Time Fourier Transforms (DTFT) of standard sequences, Existence of DTFT, Properties of DTFT, Inverse DTFT.

Laplace Transform: Definition of Laplace transform , Inverse Laplace transform , Laplace and InverseLaplace Transform of standard functions and problems.

Unit/Module: 3	**Partial Differential Equations**	**7 hours**	**CO: 3**
Basic Concepts, Types of P.D.E. (Hyperbolic, Elliptic, Parabolic). Use of Finite Fourier Transforms for solving of P.D.E			
Unit/Module: 4	**Vector Differentiation**	**5 hours**	**CO: 4**
Physical interpretation of vector differentiation, vector differential operator, Gradient, Divergence, Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, vector identities.			
Unit/Module: 5	**Vector Integration**	**6 hours**	
Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem.			
Unit/Module: 6	**Statistics and Probability Distribution**	**6 hours**	
Measure of Central tendency, Measure of Dispersion, Probability, Random variables, Distributions – Binomial , Poisson, Normal , Weibull.			
	Total Lab hours:	**42 hours**	

Text Books:

1.	B. S. Grewal, „Higher Engineering Mathematics “, Khanna Publications.
2.	B. V. Ramana, „Higher Engineering Mathematics “, Tata McGraw Hill Publications (2007)
3.	Peter V. O'neil,'Advanced Engineering Mathematics' ,Thomson Brooks / Cole, Singapore (5th edition) (2007).

Reference Books:

1.	C.R.Wylie, L.C. Barrette, „Advanced Engineering Mathematics“, McGraw Hill Publications, New Delhi.(6th edition)(2003)
2.	Erwin Kreyszig ,'Advanced Engineering Mathematics' Wiley Eastern Ltd. (8th Student Edition), (2004).
3.	S.C. Gupta, V.K. Kapoor, 'Fundamental of Mathematical Statistics', S. Chand & Sons (10th revised edition) (2002).
4	Michael D. Greenberg, 'Advanced Engineering Mathematics ', Prentice hall College Div., (1998).

Course Code	Engineering Metallurgy	L	T	P
20ME301		3	-	-
Pre-requisite	Engineering Physics, Engineering Chemistry, Engineering mathematics	Syllabus Version		
		V:1.1		

Course Objectives:

Course prepares students to

1. Understand type of materials
2. Understand properties of materials.
3. Understand Constraints in Engineering Industry
4. Correlate the constraints and materials

Course Outcomes:

Students will be able to.

1. Correlate the relationship between processing-structure-property-performance of materials to define and evaluate properties relevant to engineering
2. Define and evaluate properties relevant to mechanical engineering
3. Cite usual types of failures in materials correlate the structure and integrity of materials with common failures and write their causes
4. Read binary phase diagram, predict and quantify phase transformation using phase diagrams.
5. Specify metals and alloys used in engineering industry.
6. Select method for modification of properties.

Unit/Module: 1	Crystal Structure:	6hours	CO: 1

Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Unit/Module: 2	Mechanical Property measurement:	6hours	CO: 2

Tensile, compression and torsion tests; Young‟s modulus, relations between true and engineering stress- strain curves, generalized Hooke‟s law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.Introduction to non-destructive testing (NDT

Unit/Module: 3	Failure theories:	8 hours	CO: 3

Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue,			
Unit/Module: 4	**Phase diagrams:**	**6 hours**	**CO: 4**
Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.			
Unit/Module: 5	**Metals and alloys:**	**6 hours**	**CO: 5**
Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys			
Unit/Module: 6	**Heat treatment of Steel:**	**6 hours**	**CO: 6**
Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening			
	Total Lecture hours:	**36 hours**	

Text Books:

1.	Callister's Material Science and Engineering", W.D. Callister, D.G.Rethwisch, Wiley, 2016, Second edition.
2.	Materials engineering, science, processing and design, Michael Ashby, Hugh Shercliff, David Cebon, Butterworth-Heineman, 2008

Reference Books:

1.	"Properties of Engineering materials", R.A. Higgins, ELBS, Edward Arnold, 1988.
2.	"Material Science & Engineering." Raghavan V., Prentice Hall of India, New Delhi. 2003
3.	"Material selection in mechanical design', Michael Ashby, Butterworth-Heinemann, 3/e, 2005
4	An Introduction to properties, Applications and design, Third edition, Ashby and Jones, Butterworth Heinemann.
5.	Relevant ISO and Indian standards

Course Code	Engineering Thermodynamics	L	T	P
20ME302		2	1	-
Pre-requisite	Engineering Physics, Engineering Mathematics, Engineering Chemistry	Syllabus Version		
		V:1.1		

Course Objectives:

To make students

1. To state and illustrate laws of thermodynamics
2. To understand concept of entropy and availability.
3. To get conversant with properties of steam, vapor processes and steam trap.
4. To analyze the performance of various thermodynamics cycles.

Course Outcomes:

Students will be able to

1. Students will be able to apply laws of Thermodynamics to various processes.
2. Students will understand the concept of entropy and availability.
3. Students will gain the knowledge about steam properties and steam trap.
4. Students will be able to do performance calculations for various thermodynamic cycles.

Unit :- 1	Laws of Thermodynamics	6 hours	CO: 1
First law of thermodynamics, second law of thermodynamics, zeroth law of thermodynamics. First law applied to closed system and open system, Second law of thermodynamics, Corollaries of Carnot theorem, Second law applied to heat engine, heat pump and refrigeration cycles.			
Unit :- 2	**Entropy**	**4 hours**	**CO: 2**
Clausius Inequality, Entropy – a system property, Evaluation of entropy change for solids, liquids and ideal gases, Principle of increase of entropy- entropy generation.			
Unit :- 3	**Properties of Steam**	**5 hours**	**CO: 3**
Formation of steam, Properties of steam, First law applied to steam processes, Steam trap.			
Unit :- 4	**Thermodynamic Vapour Cycles**	**5 hours**	**CO: 4**
Carnot cycle, Rankine cycle , Reheat and Regeneration			
Unit :- 5	**Thermodynamic Gas Cycles**	**5 hours**	**CO: 4**

Otto cycle, Diesel cycle, Dual cycle

	Total hours:	**25 hours**	

Text Books and Reference Books	
1.	Principles of Engineering Thermodynamics- Moran, Shapiro, Boettner, Baily Eighth Edition, Wiley Publication.
2.	P. K. Nag, Engineering Thermodynamics, 5th Edition, Tata McGraw Hill Publications
3.	C.P. Arora, Engineering Thermodynamics, Tata McGraw Hill
4.	S. Domkundwar, C. P. Kothandaraman, Anand Domkundwar, Thermal Engineering, Dhanpat Rai Publishers
5.	Cengel and Boles, „Thermodynamics – An Engineering Approach", 7th Edition, Tata Mc Graw Hill Publication.
6.	Rayner Joel, "Basic Engineering Thermodynamics", Addison Wesley Longman

Course Code	Machining and Machine Tool Operations (MMTO)	L	T	P
20ME303		3	-	-
Pre-requisite	--	Syllabus Version		
		V:1.1		

Course Objectives:

To make students

1. To familiarize with the basic concepts of machining science.
2. To acquaint with various single and multipoint cutting tools designing processes.
3. To make the students understand the economics of machining process

Course Outcomes:

Students will be able to

1. Identify different machining operation requirements for components considering economics of machining.
2. Select an appropriate single or multipoint cutting tool parameter to evaluate cutting force, power, tool life and surface finish for machining operation.
3. Apply features and applications of non-traditional machining processes.
4. Incorporate use of different locating and clamping devices for jigs and fixture design.
5. Understand the need of automation and its use in manufacturing.

Unit/Module: 1	Machine tools	12 hours	CO: 1
Material removing (turning, drilling and milling) & finishing processes (grinding, lapping, honing) process parameters, economics of machining			
Unit/Module: 2	**Metal Cutting Theory**	**10 hours**	**CO: 2**
Single and multipoint cutting tools (hobs and form tools), tool geometry and materials. Theory of chip formation in metal machining, force relationships and the merchant equation, power and energy relationships in machining, Tool life and tool wear.			
Unit/Module: 3	**Non-conventional machining processes**	**7 hours**	**CO: 3**
USM, WJM/WJAM, Chemical Machining, ECM, EDM, LBM, EBM, IBM process parameters and applications.			
Unit/Module: 4	**Jig & Fixture**	**6 hours**	**CO: 4**

Jig, fixtures types (basic and modular) and applications, design of jigs and fixtures.			
Unit/Module: 5	**Automation**	**7 hours**	**CO: 5**
CNC types, systems, codes, manufacturing automation (machining center, FMS).			
	Total Lecture hours:	**42 hours**	

Text Books:	
1.	Fundamentals of modern manufacturing, Fifth Edition, Mikell P. Groover, Wiley Publication.
2.	Manufacturing, Engineering and Technology SI, Serope Kalpakjian, Steven R. Schmid, Prentice Hall.
Reference Books:	
1.	Fundamentals of Metal Machining and Machine Tools, Third Edition by Winston A. Knight, Geoffrey Boothroyd, CRC press Taylor and Francis group.
2.	Jigs and Fixture, P.H. Joshi, Tata McGraw-Hill
3.	Metal Cutting Principles (2nd Edition), by Milton Clayton Shaw, Oxford University Press.

Course Code	Strength of Materials	L	T	P
20ME304		3	1	--
Pre-requisites	Engineering Mechanics	Syllabus Version		
		V:1.1		

Course Objectives:

1. Define stresses, strains and elastic constants and evaluate the principal stresses and principal planes
2. Explain basic concepts of shear force and bending-moment.
3. Determine the maximum Bending and shear stress in a given beam.
4. Develop slope and Deflection equations for beams subjected to various loads.
5. Evaluate the buckling strength of columns and torsional strength of circular members

Course Outcomes:

Students will be able to

1. Evaluate principal stress and principal strain.
2. Draw SF and BM diagrams for various beams under different loading conditions.
3. Formulate the bending and shear stresses equations and be able to draw bending and shear stress diagrams.
4. Formulate slope and deflection equations for beams subjected to various loads.
5. Determine torsional strength and buckling strength.

Unit :1	Simple and Compound Stress and Strain	10 hours	CO: 1

Stress, strain, Hooke‟s law, Poisson‟s ratio, Modulus of Elasticity, Modulus of Rigidity, and Bulk Modulus. Interrelation between elastic constants, Stress-strain diagram, factor of safety. Stresses and strains in determinate and indeterminate, homogeneous and composite bars under concentrated loads and self-weight. Temperature stresses in simple members, Normal and shear stresses on any oblique plane. Concept of principal planes, derivation of expression for principal stresses and maximum shear stress, position of principal planes and planes of maximum shear. Graphical solution using Mohr‟s circle of stresses. Principal stresses in shaft subjected to torsion, Bending moment and axial thrust Concept of equivalent torsion and bending moments

Theories of Elastic Failure :-Maximum Principal Stress Theory, Maximum shear stress theory, Maximum distortion Theory, Maximum Strain theory

Unit : 2	Shear Force and Bending Moment Diagrams	6 hours	CO: 2

Shear force and bending moment diagrams for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load and couple, Relationship between rate of loading,

shear force and bending moment. Maximum bending moment and position of points of contra flexure.

Unit : 3	Bending and Shear Stresses in Beams	8 hours	CO: 3

Bending stresses : Theory of simple bending, assumptions, derivation of flexural formula, second moment of area of common cross sections (rectangular, I,T,C) with respect to centroidal and parallel axes, bending stress distribution diagrams, moment of resistance and section modulus.

Shear stresses: Concept, derivation of shear stress distribution formula, shear stress distribution diagrams for common symmetrical sections, maximum and average shears stresses, shear connection between flange and web.

Unit : 4	Slope and Deflection of Beams.	6 hours	CO: 4

Relation between bending moment and slope, slope and deflection of determinate beams, double integration method (Macaulay‟s method), derivation of formula for slope and deflection for standard cases.

Unit : 5	Torsion and Buckling.	6 hours	CO: 5

Torsion of circular member: Stresses, strain and deformations in determinate shafts of solid and hollow, homogeneous and composite circular cross section subjected to twisting moment, derivation of torsion equation, stresses due to combined torsion, bending and axial force on shafts.
Buckling of columns: Concept of buckling of columns, derivation of Euler‟s formula for buckling load for column with hinged ends, concept of equivalent length for various end conditions, safe load on columns

	Total Theory Lecture hours:	36 hours	

Tutorial Assignments

1.	Solving numerical on simple stress and strains
2.	Analytical and Graphical Solution (Mohr‟s Circle) for compound stresses.
3.	Drawing SFD and BMD for standard beam and loading conditions.
4.	Determine bending stresses and shear stresses in the beam.
5.	Finding slope and deflection at various locations for standard beam and loading conditions.
6.	Determination and Graphical representation using Python. **(Any One)** *a)* Determine Principal Stresses, Maximum shear stresses and their locations by plotting Mohr's Circle using Python. *b)* Plot SFD and BMD for a given beam using Python. *c)* Find Bending/Shear Stresses and plot Bending/Shear Stress distribution using Python.

Text Books:	
1.	Strength of Materials S. Ramamrutham, Dhanpat Rai Pvt. Ltd.
2.	Elements of Strength of Materials, Timoshenko and Young Affiliated East West Press.
3.	Mechanics of Materials S. S. Rattan, TMH Pvt. Ltd.
4.	Mechanics of Structures S. B. Junnarkar, Charotar Publication
5.	S.S Bhavikatti,"Strength of Materials", Third Edition Vikas Publishing house Pvt Ltd, New Delhi.
Reference Books:	
1.	Mechanics of Materials, by Russell C. Hibbeler
2.	Introduction to Mechanics of Solids - by E.P. Popov, Prentice Hall Publication.
3.	Singer and Pytel - Strength of materials - Harper and row Publication.
4.	B.K. Sarkar - Strength of Material - Tata McGraw Hill New Delhi.
5.	Beer and Johnston - Strength of materials - CBS Publication.

Course Code	Universal Human Values-II	L	T	P
20HS301		2	1	--
Pre-requisites	Nil	Syllabus Version		
		V:1.1		

Course Objectives:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes:

CO1 : Understand human values which is only the solution of most of the present-day problems and a sustained solution could emerge only through understanding of value-based living
CO2: Compare desires of „I" and „Body" distinctly. If any desire appears related to both, students are able to see that the feeling is related to I while the physical facility is related to the body
CO3: Develop Natural acceptance (intention) which is always for living in harmony which leads to fulfillment in relationships.
CO4:Understand the whole existence to see the interconnectedness in the Nature
CO5:Make use of sustainable solutions to the problems in the society and the Nature

Module 1	Introduction to Value Education	6 hours	

Understanding Value Education: Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Right Understanding, Relationship and Physical Facility : Happiness and Prosperity – Current Scenario : Method to Fulfill the Basic Human Aspirations.

Module 2	Harmony in the Human Being	6 hours	

Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - The Body as an Instrument of the Self - Understanding Harmony in the Self - Harmony of the Self with the Body - Programme to ensure self-regulation and Health.

Module 3	Harmony in the Family and Society	6 hours	

Harmony in the Family – the Basic Unit of Human Interaction: Values in Human-to-Human Relationship - 'Trust' the Foundational Value in Relationship, -„Respect‟ as the Right Evaluation - Understanding Harmony in the Society - Vision for the Universal Human Order.			
Module 4	**Harmony in the Nature/Existence**	**4 hours**	
Understanding Harmony in the Nature - Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature - Realizing Existence as Coexistence at All Levels - The Holistic Perception of Harmony in Existence.			
Module 5	**Implications of the Holistic Understanding – a Look at Professional Ethics**	**6 hours**	
Natural Acceptance of Human Values - Definitiveness of (Ethical) Human Conduct - A Basis for Humanistic Education, Humanistic Constitution and Universal Human order - Competence in Professional Ethics - Holistic Technologies, Production Systems and Management Models-Typical Case Studies - Strategies for Transition towards Value-based Life and Profession.			
	Total Theory Lecture hours:	**28 hours**	

Text Books:

1.	R. R. Gaur, R. Asthana, G. P. Bagaria, "The Textbook A Foundation Course in Human Values and Professional Ethics", *Excel Books*, *New Delhi,* (2nd Revised Edition), (2019).
2.	R. R. Gaur, R. Asthana, G. P. Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", *Excel Books*, *New Delhi,* (2nd Revised Edition), (2019).

Reference Books:

1.	A. Nagaraj,"Jeevan Vidya: EkParichaya", *Jeevan Vidya Prakashan, Amarkantak,* (1999).
2.	A.N. Tripathi, "Human Values", *New Age Intl. Publishers, New Delhi*, (2004).
3.	Mohandas Karamchand Gandhi, "The Story of My Experiments with Truth", *Prakash books Publishers*, *Daryaganj, New Delhi.*
4.	E. F. Schumacher, "Small is Beautiful", *Harper Collins Publishers, Noida, Uttar Pradesh*, (2010).
5.	Cecile Andrews, "Slow is Beautiful", *New Society Publishers, Canada.*
6	J. C. Kumarappa, "Economy of Permanence", *Sarva Seva Sangh Prakashan, Wardha, Sevagram*, (2017).
7	Pandit Sunderlal, "Bharat Mein Angreji Raj", *Prabhat Prakashan, New Delhi* (2018).
8	Dharampal, "Rediscovering India", Society for Integrated Development of Himalayas, (2003).
9	Mohandas Karamchand Gandhi, "Hind Swaraj or Indian Home Rule", *Navajivan Publication House, Ahemadabad.*
10	Maulana Abdul Kalam Azad, "India Wins Freedom", *Orient BlackSwan,*(1989).
11	Romain Rolland,"Swami Vivekananda", *Advaita Ashrama Publication*, *Ramkrishna Math,* (2nd Edition), (2010).
12	Romain Rolland, "Gandhi", *Srishti Publishers & Distributor,* (2002).

Course Code	Engineering Metallurgy Lab (EM-L)	L	T	P
20ME301L		**-**	**-**	**2**
Pre-requisite	Engineering Physics, Engineering Chemistry, Engineering mathematics	**Syllabus Version**		
				V:1.1

The assessment will consist of two components:

1. Evaluation for performing practical and attending demonstrations in predefined closed system of lab instructions (Demonstration and exercise type of lab activity: **5 marks**)
2. Task based performance (Structured enquiry type and open ended enquiry type of lab activity: **20 marks**)

Course Objectives:

Course prepares students to

1. To provide first-hand experience of facilities for materials property testing and treating.
2. To provide an understanding of structures in material and their relation to properties

Course Outcomes:

Students will be able to.

1. Implement safety measures required in the laboratory
2. Measure mechanical properties and propose testing method for mechanical properties considered in design, quality assurance and servicing of engineering components
3. Inspect components for materials integrity using equipments in the laboratory.
4. Identify the phases in metals and alloys and measure grain size using metallography techniques to provide interpretation of microstructures and prepare a laboratory report.
5. Specify metals and alloys and find equivalents using standards.
6. Modify properties of steel by modifying microstructure using different heat treatments

Unit/Module: 1	**Laboratory safety:**	2 **hours**	**CO: 1**
Introduction to laboratory and safety			
Unit/Module: 2	**Mechanical Property measurement:**	6**hours**	**CO: 2**
Tension, hardness and Impact tests.			
Unit/Module: 3	**Inspection of Components:**	**2 hours**	**CO: 3**

Non destructive test			
Unit/Module: 4	**Metallography:**	**6 hours**	**CO: 4**
Study of microstructures of ferrous and non ferrous metals and alloys			

Unit/Module: 5	**Metals and alloys specification:**	**2 hours**	**CO: 5**
Study and use standards for specification of metals and alloys.			
Unit/Module: 6	**Modification of material properties:**	**6 hours**	**CO: 6**
Heat treatment of metals and alloys			
	Total Lecture hours:	**24 hours**	

Text Books:

3.	Callister's Material Science and Engineering", W.D. Callister, D.G.Rethwisch, Wiley, 2016, Second edition.
4.	Materials engineering, science, processing and design, Michael Ashby, Hugh Shercliff, David Cebon, Butterworth-Heineman, 2008

Reference Books:

1.	"Properties of Engineering materials", R.A. Higgins, ELBS, Edward Arnold, 1988.
2.	"Material Science & Engineering." Raghavan V., Prentice Hall of India, New Delhi. 2003
3.	"Material selection in mechanical design', Michael Ashby, Butterworth-Heinemann, 3/e, 2005
4	An Introduction to properties, Applications and design, Third edition, Ashby and Jones, Butterworth Heinemann.
5.	Relevant ISO and Indian standards

Course Code	Machining and Machine Tool Operations Lab (MMTO-L)	L	T	P
20ME303L		-	-	2
Pre-requisite	None	Syllabus Version		
		V:1.1		

Course Objectives:

To make students

1. To familiarize with the basic concepts of machining science.
2. To acquaint with various single and multipoint cutting tools designing processes.
3. To make the students understand the economics of machining process

Course Outcomes:

Students will be able to

1. Identify different machining operation requirements for components considering economics of machining.
2. Select an appropriate single or multipoint cutting tool parameter to evaluate cutting force, power, tool life and surface finish for machining operation.
3. Apply features and applications of non-traditional machining processes.
4. Understand the need of automation and its use in manufacturing.

Lab Work

1.	Demonstration of physical hazards, safety and precautions.
2.	Experimental studies on the cutting tool angle measurement.
3.	Machining of mechanical components using CNC machine (Lathe/Mill/HMC/VMC). Manufacturing drawing with appropriate geometrical and dimensional tolerances, detailed process planning to be included.
4.	Composite job machining involving minimum four operations, employing operations on lathe/CNC, precision turning, screw cutting, boring etc.
5.	Cutting Force in Turning Process-an Experimental Approach by using dynamometers.

	Total Lab hours:	**22 hours**	

Text Books:

3.	Fundamentals of modern manufacturing, Fifth Edition, Mikell P. Groover, Wiley Publication.
4.	Manufacturing, Engineering and Technology SI, Serope Kalpakjian, Steven R. Schmid, Prentice Hall.

Reference Books:	
1.	Fundamentals of Metal Machining and Machine Tools, Third Edition by Winston A. Knight, Geoffrey Boothroyd, CRC press Taylor and Francis group.
2.	Jigs and Fixture, P.H. Joshi, Tata McGraw-Hill
3.	Metal Cutting Principles (2nd Edition), by Milton Clayton Shaw, Oxford University Press.

Course Code	Computer Aided Machine Drawing Lab (CAMD-L)	L	T	P
20ME305L		-	-	4
Pre-requisite	Engineering Graphics	Syllabus Version		
		V:1.1		

Course Objectives:

To make students

1. Conversant with conventional representation of common features and standards
2. Understand the basics of projections and dimensioning techniques
3. Aware of drawing the threaded fasteners and riveted joints
4. Understand the use of dimensional and geometrical tolerances
5. Accustomed to the use of 3-D modeling software
6. Aware of 3-D printing technology

Course Outcomes:

Students will be able to

1. Interpret machine components and represent it through IS conventions
2. Understand the conventional methods of representing threaded fasteners and riveted joints
3. Apply tolerances of size, forms & positions
4. Create 3-D part and assembly model of mechanical system
5. Create manufacturing drawing with all the details
6. Create components using 3-D printing machine

Unit/Module: 1	Conventional Representation	2 hours	CO: 1

Need of graphical language, importance of machine drawing, drafting equipment (from instrument to current software). Principles of drawings: BIS conventions, ISO standards, IS conventions of springs, gear, shaft, pipe, bar, washer, knurling, array of holes, ratchet and pawl angle etc.

Unit/Module: 2	Basics of Projections and dimensioning	2 hours	CO: 5

Projections– dimensioning, relative position of views.

Sectioning– Cutting planes and section, hatching lines, half sections, aligned sections, offset sections, sectioning revolved, removed sections, local sections.

Dimensioning– principle of dimensioning, dimensioning of common features e.g. diameter, radii, chords, arcs, angles, countersunk, counter drilled holes, counter-bore holes, chamfered and countersunk holes on curved surfaces, spot faces, chamfers, tapered features. Addition of letters and symbols, special indications.

Unit/Module: 3	**Threaded Fasteners and Riveted joints**	**2 hours**	**CO: 2**
Threaded Fasteners– Different screw threads, metric and BSW threads, Square thread and multi start threads. Nut bolts, Washers, Setscrew, Locknuts and foundation bolts. **Locking devices–** lock nut-castle nut-Studs-Tap bolt-Machine screws washers- Keys-sunk key-Gib head key. (For a given standard diameter with proportions). **Riveted joints–** Forms and proportions of river heads, Different views of different types of riveted Lap and Butt joints.			
Unit/Module: 4	**Limit, fits, tolerances and Geometrical dimensioning and tolerancing**	**4 hours**	**CO: 3**
Limits, fits and tolerances– tolerancing and limit systems, symbols for tolerances, deviation and fits, method of tolerancing, tolerance grade, fits- system of fits, classification of fits, selection of fits, methods of indicating fits on drawing. **Geometrical tolerance–** Need, geometrical characteristics of symbols, characteristics (such as straightness, flatness, circularity, cylindricity, etc) its symbols and interpretations.			
Unit/Module: 5	**Part Modelling**	**12 hours**	**CO: 4**
Parametric solid modeling - fundamentals, transform the parametric 2-D sketch into a 3D solid, feature operations, Free form feature modeling, design by features, feature recognition.			
Unit/Module: 6	**Assembly Modelling**	**14 hours**	**CO: 4**
Defining relationship between various parts of machine, creation of constraints, and generation of exploded view. Animation of the motions of assembly.			
Unit/Module: 7	**Production Drawing**	**10 hours**	**CO: 5**
Generation of manufacturing drawing from parts and assembly 3-D model with representation of appropriate dimensioning and tolerancing.			
Unit/Module: 8	**Introduction to 3-D printing**	**6 hours**	**CO: 6**
Introduction to use of 3-D printing technology for manufacturing of a component.			
	Total Lab hours:	**52 hours**	

Lab Work

1.	Assignment on drawing IS conventions, threaded fasteners and riveted joints using the basics of projections and dimensioning rules. (to be completed manually)
2.	Assignment on solid modeling of a machine component. (minimum 10 machine components)
3.	Assignment on parametric solid modeling of a machine component using various commands and features of the software. (minimum 2 machine components)
4.	Assignment on assembly modeling using proper mating conditions and generation of exploded view. (minimum 5 assemblies)
5.	Assignment on creating production drawing with the limit, fits and tolerance representation.

6.	Design and Manufacturing of an assembly (4-5 components) using 3-D printing.
Text Books:	
1.	N. D. Bhat, "Machine Drawing", Charotor publishing house, Bombay.
2.	R. K. Dhavan, "Machine Drawing", S. Chand and Company.
3.	N. D. Junnarkar, "Machine Drawing", Pearson Education.
4.	IS: SP46- Engineering drawing practice for schools and colleges, B.I.S. Publications.
5.	IS: 696- Code of practice for general engineering drawing B.I.S. Publications.
6.	IS: 2709- Guide for selection of fits, B.I.S. Publications.
7.	IS: 919- Recommendation for limits and fits for Engineering, B.I.S. Publications.
8.	IS: 8000- Part I, II, III, IV, geometrical tolerancing of technical drawing – B.I.S. Publications
Reference Books:	
1.	P. S. Gill, "A textbook of Machine Drawing", revised edition, K Kataria and Sons, New Delhi, 2008, ISBN 81-85749-79-5.