3.

3.1 SECOND YEAR B.Tech. Sem. III & IV

(Mechanical Engineering)

Academic Scheme And Course Content

Year 2016-17

Revised Scheme for Second Year B. Tech. in Mechanical Engineering (Semester - III)

Sr. No.	Course	Code	Course Plan per Week (Hrs)			Credits	Evaluation (Marks)						
			L	P	T		T-I	T-II	End Semester		End Semester Weightage(%)	Term Work	Total
									Marks	Time Hrs			
Theory Courses													
1	Applied Mathematics – III	BTM301	4	--	--	4	20	20	100	3	60	--	100
2	Strength of Materials	BTM302	4	--	--	4	20	20	100	3	60	--	100
3	Machine Drawing	BTM303	1	--	4	3	20	20	100	4	60	50	150
4	Material Science	BTM304	4	--	--	4	20	20	100	3	60	--	100
5	Thermodynamics	BTM305	4	--	2	5	20	20	100	3	60	50	150
6	Manufacturing Science -I	BTM306	4	--	2	5	20	20	100	3	60	50	150
Laboratory Courses													
7	Strength of Materials Laboratory	BTM352	--	2	--	1	--	--	--		--	50	50
8	Material Science Laboratory	BTM354	--	2	--	1	--	--	--		--	50	50
9	Machine –Shop Practice - I	BTM399	--	2	--	1	--	--	--		--	50	50
Total			**21**	**6**	**8**	**28**	**120**	**120**	**---**		**--**	**300**	**900**

Revised Scheme for Second YearB. Tech. in Mechanical Engineering (Semester - IV)

Sr. No.	Course	Code	Course Plan per Week (Hrs)			Credits	Evaluation (Marks)						
			L	P	T		T-I	T-II	End Semester		End Semester Weightage(%)	Term Work	Total
									Marks	Time Hrs			
Theory Courses													
1	Applied Mathematics -IV	BTM401	4	--	--	4	20	20	100	3	60	--	100
2	Theory of Machines - I	BTM402	4	--	2	5	20	20	100	4	60	50	150
3	Fluid Mechanics	BTM403	4	--	--	4	20	20	100	3	60	--	100
4	Mech. Engineering Measurement	BTM404	4	--	--	4	20	20	100	3	60	--	100
5	Manufacturing Science – II	BTM405	4	--	2	5	20	20	100	3	60	50	150
6	Presentation and Communication Technique	BTM406	2	--	2	3	10	10	50	2	60	50	100
Laboratory Courses													
7	Fluid Mechanics Laboratory	BTM453	--	2	--	1	--	--	--		--	50	50
8	Measurement Laboratory	BTM454	--	2	--	1	--	--	--		--	50	50
9	Machine –Shop Practice – II	BTM499	--	2	--	1	--	--	--		--	50	50
Value AddedCourses													
10	Introduction to Composite Material Technology	BTM491	1	1	--	--	20	20	--		--	60	100
11	Internet of Things (IOT)	BTM492	1	--	1	--	20	20	--		--	60	100
Total			**22**	**8**	**6**	**28**	**110**	**110**	**550**		**330**	**300**	**850**

SEMESTER-III	**S.Y.B.Tech. (Mechanical Engineering)**		
CODE: BTM301	**COURSE: Applied Mathematics -III**		
Period per week (each of 60 minutes)	Lecture	04	
	Practical	---	
	Tutorial	---	
Scheme of Evaluation	Credit	04	
		Hours	Marks
	In Semester	01	20x2
	End Semester*	03	100
	Practical	---	---
	Term Work	---	---
	TOTAL	---	100

* 60% Weightage for end semester

Course Objectives:

1. Introduce Laplace & Inverse Laplace transforms and its application to solve differential equations.
2. Introduction to Complex integration (Cauchy's theorem)
3. Introduce Rank of Matrix, Caley-hamilton theorem.
4. Introduce vector integration, Green's Stoke's& Gauss theorems.

Course Outcomes:

Upon successful completion of the course, students should be able to

1. Solve problems based on Laplace and inverse Laplace transform.
2. Solve integration of complex valued functions.
3. Solve problems on vector integration.

Course Contents:

Module	**Details**	**Hrs.**
01	**Laplace Transforms** Function of bounded variation (statement only) Laplace's transforms of 1, t^n, e^{at}, sin(at), cos (at), sinh (at), cosh (at) Linearity property, expressions (without proof) for $L[e^{at} f(t)]$, $L[f(at)]$, $L[t^n f(t)]$, $L[f(t)/t]$, $L\left[\int_0^t f(u)\,du\right]$, $L\left[\frac{d^n}{dt^n} f(t)\right]$ Periodic functions, Heaviside unit step function, Dirac- delta Function and their Laplace transforms (statement only)	**06**

02	**Inverse Laplace Transforms** Linearity property evaluation of inverse Laplace Transforms using theorems and by partial fraction method Convolution Theorem (without proof) and Heaviside unit step function. Application to solve initial and boundary valve problems involving ordinary differential equations with one dependent variable	
03	**Vector Integration** Vector integrals – Line, area and surface integrals Green theorem in plane Stoke's theorem Gauss's Divergence theorem Application to mechanical systems	**08**
04	**Complex Integration** Regions and Paths in the Z-plane Line integral of a function of complex variable Cauchy's integral theorem Cauchy's integral formula and deduction (without proof) Taylor's and Laurent's development (without proof) Singularities, poles, residue at isolated singularity and its evaluation Cauchy's Residue Theorem and application to evaluate real integrals.	**08**
05	**Matrices** Types of Matrices (Hermitian,skewHermitian,symmetric, skew symmetric) Orthogonal and Unitary matrices) Elementary transformations, rank of a matrix. Reduction to a normal form. System of homogeneous and non-homogeneous equations, their Consistencyand solution	**06**
06	**Eigen values, Vectors** Brief revision of vectors over real field, Inner product, Norm, Linear dependence and independence, Orthogonality of matrix Characteristic polynomial, Eigen values and vectors of square matrix Characteristic polynomial,	**06**
07	**Cayley Hamilton theorem and derogatory matrix** Cayley Hamilton Theorem (without proof) Functions of square matrix. Diagonalizable matrix. Powers of matrix using diagonal matrix. Derogatory matrix.	**08**

Reference Books:

1. Chapman, Stephen J. MATLAB programming for engineers. Nelson Education, 2015.
2. Spiegel, Murray R. *Schaum's outline of theory and problems of Laplace transforms*. McGraw-Hill, 1965.
3. Spiegel, Murray R. "Schaum's outline of theory and problems of vector analysis and an introduction to tensor analysis." (1959).
4. Brown, James Ward, Ruel Vance Churchill, and Martin Lapidus. *Complex variables and applications*. Vol. 7. New York: McGraw-Hill, 1996.
5. Grewal, B. S. *Higher engineering mathematics*. Khanna Publisher, New Delhi, 1996.

Text Books

1. Kumbhojkar, G.V., "*Applied Mathematics-III*", C.Jamanadas, 2011.

SEMESTER – III	**CLASS: S.Y.B.Tech.(Mechanical Engineering)**		
CODE : BTM302	**COURSE: Strength of Materials**		
Periods per week (each of 60 minutes)	Lecture	04	
	Practical	--	
	Tutorial	--	
Scheme of Evaluation	Credit	4	
		Hours	Marks
	In Semester	01	20 X 02
	End Semester*	03	100
	Practical	--	--
	Term Work	--	--
	TOTAL		**100**

*60% Weightage for end semester

Course Objectives:

1. To determine the internal forces developed in structural members.
2. To determine the stresses and strains produced in the structural members and machine components and their deformationsunder various types of loads.
3. To understandanalytical methods for determining the strength, stiffness and stability of various load carrying structural members and machine components
4. To study the failure theories

Course Outcomes:

Upon successful completion of the course, students should be able

1. To apply principles of engineering mechanics, science and mathematics to derive equations governing the internal resistance forces in machine components subjected to different types of loading.
2. To identify, formulate and solve for stresses and strains produced in basic components of mechanical engineering systems.
3. To analyze and interpret data obtained from the experiments related to strength of materials.
4. To examine effect of complex loading in mechanical components using energy methods, principal stress computations and theories of failure.

Course Contents:

Module No.	**Details**	**Hrs.**
01	**STRESS AND STRAIN:**Definitions of stress and strain, tensile and compressive stresses, shear stress, elastic limit, Hooke's law, Poisson's ratio, modulus of elasticity, modulus of rigidity, bulk modulus, yield stress, ultimate stress, factor of safety, state of simple shear, relation between elastic constants, volumetric strain, volumetric strain for tri-axial loading,	6
02	**SIMPLE DEFORMATIONS:** Deformation of tapering members, deformation due toself weight, bars of varying sections, composite sections,	7

	THERMAL STRESSES: Temperature stresses in composite structural components **ENERGY METHODS:** strain energy, Resilience, proof Resilience, strain energy stored in the member due to gradually applied load, suddenly applied load, impact load, strain energy stored due to shear.	
03	**SHEAR FORCE AND BENDING MOMENT in beams**: Axial force, shear force and bending moment diagrams for statically determinate beams including beams with internal Hingesfor different types of loading, relationship between rate of loading, shear force and bending moment.	7
04	**STRESSES IN BEAMS:-** Theory of pure bending, assumptions, flexural formula for straight beams, moment of resistance, bending stress distribution, section moduli for different sections, beams of uniform strength. **SHEAR STRESSES IN BEAMS :** Distribution of shear stress across plane sections used commonly for structural purposes, shear connectors **TORSION**: Torsion of circular shafts – solid and hollow, stresses in shaft when transmitting power, shafts in series and parallel, strain energy due to torsion.	10
05	**PRINCIPLE STRESSES:** General equations for transformation of stress, principal planes and principal stresses, maximum shear stress, determination using Mohr's circle, maximum principal & maximum shear stress theory of failure, combined bending and torsion, equivalent bending moment and equivalent torque.	6
06	**DEFLECTION OF BEAMS**: Deflection of cantilevers, simply supported and over hanging beams using double integration and Macaulay's methods for different types of loadings.	6
07	**THIN CYLINDRICAL AND SPHERICAL SHELLS:** Stress and strain in thin cylinders and spheres due to internal pressure, cylindrical shell with hemispherical ends. **THICK SHELLS:** Introduction, Lame's theory, Lame's equation, Longitudinal stress, maximum shear stress, Volumetric strain.	6

List of Experiments to be conducted is as follows.

1. Tension test on mild steel bar (stress- strain behavior, modulus determination)
2. Tension Test on tor-steel
3. Test on cast iron (transverse, tension)
4. Shear test on mild steel, cast iron, brass
5. Torsion test on mild steel bar/cast iron bar

6. Brinell hardness test
7. Rockwell hardness test
8. Izod impact test/Charpy test
9. Flexural test on beam (central point load)*
10. Flexural test on beam (two point load)*

* For experiment no. 9 and 10, plot load deflection curve and find value of Young's modulus.

Recommended Books: 1.Strength of Materials Laboratory Manual, Dept. of Mechanical engg. SPCE.

Text Books:

1. Junnarkar, S. B., and H. J. Shah. *Mechanics of structures (Vol. I)*, *Charotar Pub. House, Anand* (1995).

Reference Books:

1. Gere, James M., and S. P. Timoshenko. "Mechanics of materials Brooks." Cole, Pacific Grove, CA (2001): 815-39.
2. Beer, Ferdinand P., R. Johnston, J. Dewolf, and D.Mazurek. "Mechanics of Materials, McGraw-Hill." (2006).

SEMESTER – III	**CLASS: S.Y.B.Tech.(Mechanical Engineering)**		
CODE : BTM303	**COURSE: Machine Drawing**		
Periods per week (each of 60 minutes)	Lecture	1	
	Practical	--	
	Tutorial	4	
Scheme of Evaluation	Credit	3	
		Hours	Marks
	In Semester	01	20 X 02
	End Semester*	04	100
	Practical	--	--
	Term Work	--	50
	TOTAL		**150**

*60% Weightage for End semester

Course Objectives:

1. It is expected to possess a thorough understanding of drawing, which includes clear spatial visualization of objects and the proficiency in reading and interpreting a wide variety of production drawings.
2. Besides it is also expected to possess certain degree of drafting skills depending upon job function, to perform day to day activities i.e. communicating and discussing ideas with supervisors and passing instructions to subordinates also knowledge of computer aided drafting is essential part hence as a part of curriculum.

Course Outcomes:

Upon successful completion of the course, students should be able

1. To interpret the assembly and details of given machine components including fits and tolerances in production drawing.
2. To sketch free hand proportionate illustrative representation of common machine components.
3. To create and compose engineering drawings for standard machine components or assemblies
4. To plan systematic organization of engineering drawings for representation of machine assembly and component details.

Course Contents:

Module No.	Details	Hrs.
01	**Solid Geometry:** Intersection of surfaces and Interpenetration of solids-Intersection of prism or cylinder with Prism, cylinder or cone (both solids in simple and offset position only), Primary auxiliary views and aux. projections of simple machine parts.	03
02	**Free Hand Sketching of Machine Elements :** Free hand sketches of machine elements such as bolts, nuts, washers, studs, components tapped holes; Conventional representation of assembly of threaded parts in normal and sectional views; **Limits fits and tolerances:** dimensioning with tolerances indicating various types of fit in details and assembly drawings.	02

03	**Details and Assembly Drawing:** Introduction to unit assembly drawing, steps involved in preparing assembly drawing from details and vice versa. Preparation of details& assembly drawings of: Clapper block, Single tool post, Lathe & Milling tail stock, Cotter, knuckle joint, : sunk, parallel, woodruff, saddle, feather etc.	03
	Coupling - simple, muff, flanged, protected flange coupling, Oldham's coupling and universal Coupling.	
04	**Preparation of Details & Assembly Drawings of Bearings-** simple, solid, bushes, pedestal, footstep, I.S. conventional representation of ball and bearings.	02
05	**Preparation of Details & Assembly Drawings of** -flat belt, V-belt, rope belts, fast and loose pulleys: flanged joints- spigot and gland and stuffing box, expansion joint, union joint.	02
06	**Preparation of details & assembly drawings of** - Air cock, Blow off cock, Steam stop valve, gates valve, globe valve, non-return Valve, piston, connecting rod, cross head and crankshaft.	01
07	**Preparation of details & assembly drawings of**: One drill jig and one milling fixture	01

Term Work:

1 Sheet on Module 1minimum 3 problems

1 Sheets on details of assembly of any two topics from Module 2
1 Sheets on details of assembly of any two topics from Module 3
1 Sheet on assembly of details of any unit topics from Module 4 1
Sheets on details of assembly of any two topics from Module 5
1 Sheet on detail & assembly of Module 6 with fits and tolerances.

Text Books:

1. Bhatt, N. D., and V. M. Panchal. *Machine Drawing*. Charotar, 1991.
2. Dhawan, R. K. *Machine Drawing*. S. Chand Limited, 1998.

Reference Books:

1. Narayana, K. L., P. Kannaiah, and K. Venkata Reddy. *Machine drawing*. New Age International, 2009.
2. John, K. C. *Textbook of Machine Drawing*. PHI Learning Pvt. Ltd., 20

SEMESTER- III	**S.Y. B.Tech. (Mechanical Engineering)**		
CODE: BTM304	**COURSE: Material Science**		
Periods per week (each of 60 minutes)	Lecture	04	
	Practical	--	
	Tutorial	---	
Scheme of evaluation	Credit	04	
		Hours	Marks
	In Semester	01	20 x 2
	End Semester *	03	100
	Practical	----	----
	Term Work	----	----
	Total		100

* 60% Weightage for end semester

Course Objective:

The objective of the course is to make students familiar with of mechanical, physical and chemical properties of common engineering materials- metals, ceramics, polymers and composites with rationale behind these properties and to develop good understanding of these.

Course Outcome:

Upon successful completion of the course, students should be able

1. To explain basic concepts of materials science and metallurgy in terms of material properties at micro as well as macro scale and to discuss economic, environmental and social issues of material usage
2. To categorize different material imperfections and fractures and apply this knowledge to explain failures
3. To discuss phase diagrams such as iron-carbon equilibrium diagram, to explain atomic arrangements, to describe heat treatment requirements and to examine properties of non-ferrous, ceramic and composite materials.
4. To describe heat treatment requirements and to examine properties of nonferrous, ceramic and composite materials.

Course Contents:

Module	Details	Hrs.
01	**Introduction:** Historical perspective and Materials Science, Important Mechanical properties of materials, Classification of materials, Advanced materials, Future materials and Modern materials.	**06**
02	**Phase diagrams:** Equilibrium phase diagrams, Particle strengthening by precipitation and precipitation reactions, Kinetics of nucleation and growth, The iron-carbon system, phase transformations, Transformation rate effects and TTT diagrams, Microstructure and property changes in iron-carbon system. **Iron-carbon equilibrium diagram**: Study of Different Types of Steel and their mechanical properties, Types of Different types of cast iron and their mechanical properties, application of lever rules	**09**

03	**Atomic Arrangements:** Lattice, Unit cells, Crystal structures, lattice parameters and atomic radius, packing factor, FCC and BCC cell, density of FCC and BCC cell. Imperfections in the atomic and ionic arrangements like point and line defects, dislocations, ASTM grain size.	**07**
04	**Heat Treatment of Steel and cast irons**, different types of heat treatment like annealing, normalizing, tempering, austempering, stress relieving etc. Study of microstructures and correlations of mechanical properties. **Failure:** Fracture, ductile and brittle fracture, Fracture mechanics, Impact fracture, ductile brittle transition, Fatigue, crack initiation and propagation, crack propagation rate, Creep, generalized creep behavior, stress and temperature effects.	**07**
05	**Nonferrous Alloys:** Aluminum, Magnesium, Copper, Nickel and chromium alloys, effects of alloying elements	**06**
06	**Ceramic and composites:** Solidification of metals, nucleation, growth mechanism, and solidification time Ceramic materials, application of ceramics, properties of ceramics, synthesis and processing of ceramic powders, inorganic glasses. Polymers, classification of polymers, thermoplastics and mechanical properties, Elastomers, Thermosetting polymers Composites- types, characteristics, applications	**07**
07	**Economic, environmental and social issues of material usage:** Economic considerations, Environmental and societal considerations, Recycling issues, Life Cycle analysis and its use in design. Materials used in constructions	**06**

Text Books:

1. Callister, William D., and David G. Rethwisch. *Materials science and engineering: an introduction*. Vol. 7. New York: Wiley, 2007.
2. Kodgire, V. D., and S. V. Kodgire. "Material science andmetallurgy." *Everest Publication*, 2009.
3. Balasubramaniam, R. *Callister'S Materials Science And Engineering: Indian Adaptation (W/Cd)*. John Wiley & Sons, 2009.

Reference Books :

1. Lawrence, H., and Van Vlack. "Elements of materials science and engineering." (1989).
2. Raghavan, V. "Materials Science and Engineering: A First Course, PHI Learning Pvt." (2004).
3. Guy, Albert G. *Physical metallurgy for engineers*. Addison-Wesley Pub. Co., 1962.

SEMESTER- III	**S.Y. B.Tech. (Mechanical Engineering)**		
CODE: BTM354	**COURSE: Material Science Laboratory**		
Periods per week (each of 60 minutes)	Lecture	---	
	Practical	02	
	Tutorial	---	
Scheme of evaluation	Credit	01	
		Hours	Marks
	In Semester	----	----
	End Semester	----	----
	Practical	----	----
	Term Work	----	50
	Total		50

* 60% Weightage for end semester

Course Objective:

The objective of the course is to make students familiar with of mechanical, physical and chemical properties of common engineering materials- metals, ceramics, polymers and composites with rationale behind these properties and to develop good understanding of these.

Course Outcome:

Upon successful completion of the course, students should be able

1. To explain basic concepts of materials science and metallurgy in terms of material properties at micro as well as macro scale and to discuss economic, environmental and social issues of material usage.
2. To categorize different material imperfections and fractures and apply this knowledge to explain failures.
3. To discuss phase diagrams such as iron-carbon equilibrium diagram, to explain atomic arrangements, to describe heat treatment requirements and to examine properties of non-ferrous, ceramic and composite materials.
4. To describe heat treatment requirements and to examine properties of nonferrous, ceramic and composite materials.

List of Experiments:

The laboratory work shall consist of a journal based on the below mentioned laboratory experiments/study

1. Study of Metallurgical Microscope.
2. Preparation of Specimen for microscopic examination.
3. Study of microstructure of plain carbon steels of various compositions.
4. Study of microstructure of various types of C.I.
5. Study of microstructure of various types of alloy steels.
6. Study of microstructure of non – ferrous metals and their alloys.
7. Surface hardening and study of microstructure
8. Study of I.S. codes of steels and selection procedure.

SEMESTER-III	**S.Y. B.Tech. (Mechanical Engineering)**		
CODE: BTM305	**COURSE: Thermodynamics**		
Periods per week (Each Period of 60 min.)	Lecture	04	
	Practical	--	
	Tutorial	02	
	Credit	05	
		Hours	Marks
Scheme of Evaluation	In Semester	01	20 x 2
	End Semester *	03	100
	Practical	--	--
	Term Work	--	50
	TOTAL	**--**	**150**

*60% Weightage for end semester

Course Objective:

The objective of the course is to prepare students with sound knowledge thermodynamics principles and good understanding about its applied aspects. Course aims to make students capable to understand, analyze and use knowledge of the course to solve real life thermal problems.

The pre-requisite for the course is good knowledge higher secondary level mathematics.

Course Outcome:

After successful completion of the course students will

1. To have knowledge of the fundamental principles of thermodynamics, power cycles and basics of combustion
2. To have understanding of calculating different thermodynamic quantities,
3. be able to apply thermodynamic principals to solve a thermal problem.
4. be able to analyze an existing system from thermodynamic point of view and recommend solution for it.

Course Contents:

Module	**Details**	**Hrs.**
01	**Fundamentals Concepts:** Systems and surrounding, universe, state, path, processes, cycle, reversible and irreversible processes, standard thermodynamic processes, thermodynamic work, thermodynamic equilibrium, Zeroth law of thermodynamics, temperature, IPTS, heat and work transfer **First Law of Thermodynamics**: General energy equation, Statement of first law of thermodynamics applied to a closed system for cyclic and non-cyclic process, concepts of energy, internal energy, enthalpy, specific heats. First law of thermodynamics applied to an open system, flow work, steady flow energy equation Application of SFEE to common thermal devices such as boilers, nozzles and diffusers, turbines, compressors and pumps, throttling device, condensers, heat exchangers etc.	08

02	**Second Law of Thermodynamics** Limitations of the first law of thermodynamics, thermal reservoir, heat engine, refrigerator and heat pump. Statements of second law of thermodynamics and their equivalence, Carnot cycle and its significance, Carnot's theorem, Thermodynamic temperature scale, Perpetual motion machine.	06
03	**Entropy and Energy** Irreversibility if its cause, Clausius' Inequality and concept of entropy as property, Principle of increase of Entropy, Calculation of entropy for solid, liquid and gaseous medium. Entropy a measure of disorder, Entropy change of a closed and open system. Concepts of available and unavailable part of energy, dead state, definition of energy, irreversibility and energy destruction, expression for energy for closed and open system. Calculation of energy change of systems.	07
04	**Pure Substances and Gases** Properties of pure substances and property diagrams, p-v-T surface, T-s and h-s diagrams, dryness fraction, steam tables, Mollier chart and their use to calculate thermodynamic property under different standard processes. Fundamentals of gas and gas mixture, Estimation of thermodynamic properties for ideal gas and gas mixtures.	07
05	**Vapor Power Cycles** Carnot vapor cycle, Ideal Rankine cycle and methods to improve cycle output and thermal efficiency, Ideal reheat and regenerative cycle, Ideal reheat-regenerative cycle.	06
06	**Gas Power Cycles** Assumptions of Air standard cycle, Operation of reciprocating internal combustion. Engine, Otto cycle, Diesel cycle, Dual cycle and derivation for their thermal efficiency and a comparison among them, Ideal Brayton cycle, actual Brayton cycle, Brayton cycle with inter-cooling, reheating and regeneration, their effect on cycle output and efficiency.	08
07	**Combustion of Reactive Mixtures** Combustion fundamentals, stoichiometric and actual air-fuel ratio, enthalpy of formation, enthalpy of reactants and products, enthalpy of combustion, First law applied to closed and open reactive systems, Flame Temperature.	06

Term Work:

It consists of **at least one** tutorial and/or assignments from each module of the syllabus mentioned for the course. Use of MATLAB / EXCEL to solve simple problem of thermodynamics is desirable.

Text Books:

1.Nag, P. K. *Engineering thermodynamics*. Tata McGraw-Hill Education, 2013.
1. Cengel, Yunus A., and Michael A. Boles. "Thermodynamics: an engineering approach." *Sea* 1000 (1994): 8862.
2. Sonntag, Richard Edwin, Claus Borgnakke, Gordon John Van Wylen, and Steve Van

Wyk. *Fundamentals of thermodynamics*. Vol. 6. New York: Wiley, 1998.

3. Holman, J. P. "Thermodynamics McGraw-Hill." *New York* (1974).
4. Saad, Michel A. "Thermodynamics for engineers." (1966).
5. Rogers, Gordon FC, and Yon Richard Mayhew. *Engineering Thermodynamics Work & Heat Transfer*. Longman Group Limited, 1980.
6. Eastop, T. D., and A. McConkey. "Applied thermodynamics for engineering technologists, 1996."
7. Mishra, D. P. *Experimental combustion: an introduction*. CRC Press, 2014.
8. Rajput, R. K. *Thermal engineering*. Laxmi Publications, 2010.
9. Moran, Michael J., Howard N. Shapiro, Daisie D. Boettner, and Margaret B. Bailey. *Fundamentals of engineering thermodynamics*. John Wiley & Sons, 2010.

SEMESTER-III	**S.Y. B.Tech. (Mechanical Engineering)**		
CODE: BTM306	**COURSE: Manufacturing Science -I**		
Periods per week (Each Period of 60 min.)	Lecture	04	
	Practical	--	
	Tutorial	02	
	Credit	05	
		Hours	Marks
Scheme of Evaluation	In Semester	01	20 x 2
	End Semester *	03	100
	Practical	--	--
	Term Work	--	50
	TOTAL	--	**150**

* 60% Weightage for end semester

Course Objectives:

1. To impart understanding and appreciation of breadth and depth of the field of manufacturing.
2. To impart knowledge of manufacturing processes like, Pattern making, Casting, plastic moulding and metal surface treatment.
3. To impart knowledge of construction and working of various machines like, Lathe, Milling, Drilling, Surface Grinding & Shaper, and the tools used in these machines.
4. To learn and apply the basic terminology associated with this field.
5. To make the students aware of the basic welding processes & non-conventional manufacturing processes.

Course Outcomes:

Upon successful completion of the course, students should be able

1. To select manufacturing processes for various components.
2. To explain working principles of machines like Lathe, Milling, drilling etc. & their application.
3. To explain some of the basic welding, molding and metal surface treatment processes.
4. To explain the non-traditional machining processes.

Course Contents:

Module	Details	Hrs.
01	**Pattern making and Foundry**: Materials used for pattern making, Types of pattern, allowance Pattern, core box, core prints and cores. **Plastic molding:** Compression molding, Injection molding, Blow molding, Transfer molding, shell molding, carbon dioxide molding **Casting:** Gravity die or permanent mold casting, pressure die casting, cold chamber die casting, centrifugal casting, , investment mold casting, Plaster mold casting, continuous casting **Metal surface treatment:** Electroplating, galvanizing, anodizing, metal spraying.	06

02	**Lathes**: type of lathes, their construction and working, operation of lathes, attachments and accessories used on lathe, type of tools, cutting speed, feed, depth of cut and machining time. Capstan and turret lathes, tooling for simple jobs. NC, CNC and DNC machines, machining centers and types.	08
03	**Milling Machines**: types of machines, horizontal, universal, vertical, Cutters and their applications, Operation on milling machines, Use of dividing head and circular table. Direct, simple, compound, differential and angular indexing Table feed in milling. Work holding devices.	06
04	**Drilling Machines**: Types of machines, Types of drillings, operations such as drilling, boring, reaming, spot facing, counter boring, counter sinking and tapping. Drill speeds and feeds.	06
05	**Planner machines, shaping machines and slotting machine:** Various types, construction and working of machine, operations and tools, field of application, quick return mechanism and feed mechanisms of these machines.	06
06	**Grinding:** Grinding machines such as pedestal, cylindrical surface, centre less and tool and cutter grinder. Operations on the above mentioned machines. Grinding wheel, selection and specifications. Dressing and trimming of grinding wheels. Finishing operations such as lapping and honing.	06
07	**Welding:** Riveting, soldering and brazing, fusion welding, gas and arc welding, submerged arc welding-inert gas welding, electro slag welding, thermit welding, welding equipments, Pressure welding – Solid phase welding, resistance and friction welding- other miscellaneous welding processes, weld joint types, weldability. **Non Conventional Machining Processes:** Abrasive jet machining, Electric discharge machining, Electron beam machining, Plasma arc machining, Ultrasonic machining etc.	10

Term work: Term work will evaluate from performance in tutorial (assignments) activities.

- One industrial visit with report
- Demonstration of conventional machines and machine parts
- Demonstration of CNC lathe and Vertical Milling Center.

Text Books:

1. Choudhury, Hajra. "*Elements of Workshop Technology, Vol. I & II." Media Promotors Pvt Ltd* (2009).
2. Sharma, P. C. *A Textbook of Production Technology: Manufacturing Processes*. S. Chand, 2007.

Reference Books:

1. Chapman, W. A. J. *Workshop Technology Part 1-3*, 1998.
2. Doyle, Lawrence E., and Carl Keyser. "Manufacturing processes and materials for engineers." *Prentice-Hall Inc.,* 1985.
3. Lal, M., and O. P. Khanna. *A Textbook of Foundry Technology*. Dhanpat Rai, 197

SEMESTER - III	**S.Y.B.Tech. (Mechanical Engineering)**		
CODE : BTM399	**COURSE: Machine Shop Practice-I**		
Periods per week (each of 60 minutes)	Lecture	--	
	Practical	2	
	Tutorial	--	
Scheme of Evaluation	Credit	1	
		Hours	Marks
	In Semester	--	--
	End Semester	--	--
	Practical	--	--
	Term Work	--	50
	TOTAL		**50**

Course Objectives:

The objective of this course is to provide students the hands on experience about basic manufacturing processes which are nerve centre of any manufacturing industry.

Course Outcome:

Upon successful completion of the course, students should be able

1. To explain the various parts and working of lathe and shaper machines
2. To explain the different tools used in various manufacturing operations such as machining on lathe, shaper, forging and welding.
3. To apply the knowledge of various operations such as Plain turning, taper turning, precision turning on lathe machine Thread cutting on lathe machine Machining plain, horizontal and inclined surfaces on shaper machine Preparation of composite welding joint Operations in forging for manufacturing

Course Contents

Job No.	**Details**	**Hrs.**
01	One job on lathe machine involving plain turning, precision turning, taper turning and screw cutting operation.	07
02	One job on shaper involving machining of horizontal and inclined surfaces.	06
03	One job on forging of cutting tools used on lathes such as boring tool.	05
04	One job on forging of parting tool	05
05	One job on welding exercise to make a composite joint such as T-Joint.	05

S. Y. B. Tech. in Mechanical Engineering
Sem. IV
Academic Scheme and Syllabus
Year 2016-17

SEMESTER-IV	**S.Y.B.Tech. (Mechanical Engineering)**		
CODE: BTM401	**COURSE: Applied Mathematics -IV**		
Period per week (each of 60 minutes)	Lecture	04	
	Practical	---	
	Tutorial	---	
Scheme of Evaluation	Credit	4	
		Hours	Marks
	In Semester	01	20·2
	End Semester*	03	100
	Practical	---	---
	Term Work	---	---
	TOTAL	**---**	**100**

* 60% Weightage for end semester

CourseObjectives:

1. Introduce Statistical methods, probability distribution and testing of hypothesis.
2. Introduce fourier series orthogonal orthonormal functions
3. Introduce PDE and how to use PDE to solve wave equation and heat equation.

CourseOutcomes:

Upon successful completion of course students will be able to

1. Solve problem in basic statistics, probability, probability distribution, testing of hypothesis.
2. Solve the problem based on fourier series expansion.
3. Solve PDE problems based on heat and wave equation.

Course Contents:

Module No.	Details	Hrs.
01	**Statistics:** Correlation. Co-variance, Karl Pearson Coefficient and Spearman's Rank Co-relation Coefficient (non-repeated and repeated ranks, without proof) Regression Coefficient and lines of regression.	06
02	**Random Variables** Introduction to probability and conditional probability, Baye's theorem Discrete and continuous random variables, probability mass function and density function. Probability distribution for random variables. Expected value, Variance.	06
03	**Probability Distributions** Binomial, Poisson and Normal Distributions.	04

04	**Sampling Theory** Sampling distribution. Test of Hypothesis. Level of significance, critical region. One tailed and two tailed tests. Interval Estimation of population parameters. Large and small samples. Test of significance for Large samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples. Student's t-distribution and its properties. Test of significance of small samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples, Chi-square distribution and its properties, Test of the Goodness of fit.	05
05	**Fourier Series** Orthogonal and orthonormal functions, Dirichlets conditions Fourier Series of periodic functions with period 2π and 2L, Even and odd functions Half range sine and cosine series Parseval's identities (only statement) and examples based on Parseval's identities Complex form of Fourier series Fourier integrals.	07
06	**Partial Differential Equations** Classification of PDE and their characteristic. Method of separation of variables to solve PDE, Partial differential equation governing transverse vibrations of an elastic string, its formulation and solution using Fourier series.	04
07	**Partial Differential Equation (Heat Equations)** Heat equation, steady- state configuration for heat flow. Two & Three dimensional Laplace equation.	04

Reference Books:

1. Shahnaz Bathul. *A Textbook of Probability and Statistics*, Cengage Learning (2009)
2. Gupta, S. C. "Fundamental of Statistics, S." *Chand & Co., Delhi* (2007).
3. Spiegel, Murray R. *Theory and Problems*. Schaum Publishing, 1961.
4. Grewal, B. S. *Higher engineering mathematics*. Khanna Publisher, New Delhi, 1996.
5. Jain, Rajinder Kumar, and Satteluri RK Iyengar. *Advanced Engineering Mathematics*. Alpha Science Int'l Ltd., 2004.

Text Books

1. Kumbhojkar, G.V., "*Applied Mathematics-III*", C.Jamanadas, 2011.

SEMESTER - IV	CLASS: S.Y.B.Tech. (Mechanical)		
CODE: BTM402	COURSE: Theory of Machines - I		
Periods per week (each of 60 minutes)	Lecture	4	
	Practical	--	
	Tutorial	2	
Scheme of Evaluation	Credit	5	
		Hours	Marks
	In Semester	01	20 x 02
	End Semester*	04	100
	Practical	--	--
	Term Work	---	50
	TOTAL		**150**

* 60% Weightage for end semester

Course Objectives

1. To give basic knowledge on kinematic and dynamic design of machinery.
2. To provide basic concept of kinematics analysis of machines and machine members.
3. To understand the relationship between geometry and motion of the part of the machine.
4. To create a basic foundation for static and dynamic force analysis and ultimately for machine design.

Course Outcome:

Upon successful completion of the course, students should be able to

1. To identify kinematic chain and its mobility, to analyze kinematic response of a mechanism
2. To use graphical and analytic methods to calculate the motion of a planar mechanism, to calculate static and dynamic forces for linkages
3. To explain various motion generation and transmission systems, to formulate design of basic components of cam, belt, chain and gear train system.
4. To explain various motion generation and transmission systems, to analyze the basicmotion of components like cam, belt, chain and gears.

Course Contents:

Module No.	Details	Hrs.
01	**1. Basic Kinematics:** **Structure, Machine, Link and its types** **Kinematics pair -**Lower pair and higher pair, Form closed pair and force closed pairs, Based on relative motion permitted such as revolute, prismatic, cam, helical, globular. **Kinematics chain and Mechanisms:** Grublers criterion for movability of chains and mechanisms, Limitations of Grubler's Criteria. **Inversion of chain:** Study of various mechanisms derived from inversions of following chains (withregard to motion of links of mechanisms,	08

	motion modification, quality of motion transmission (uniform, non-uniform, SHM, Non-SHM), limiting positions, deadpositions, quick return property, applications). -- Four bar chain (Grashoffian, and non-Grashoffian), Single slider crank chain, and Double slider crank chain.	
02	**Special Mechanisms:** **Straight line generating Mechanisms:** Exact Straight line generating Mechanisms – Peaucellier and Harts, Approximate straight line generating Mechanisms – Watts, Roberts, Evans and Chebyshev, Offset slider crank mechanisms, Pantograph, Hook joint single and DoubleSteering gear mechanisms – Ackerman, Devis **Synthesis of the mechanism:** Chebyshev method to find precision point for four bar mechanism and slider crank mechanism.	06
03	**Velocity and Acceleration Analysis of mechanisms (mechanisms upto 6 links).** Velocity analysis by instantaneous center of rotation method (Graphical approach) Velocity and acceleration analysis by relative method (Graphical approach) Velocity and acceleration analysis analytical approach--four bar mechanism only.	06
04	**Static force analysis of plane mechanisms** Static force analysis, two and three-force member, Four force member, Static force analysis with friction- in four bar chain mechanism and slider crank mechanisms.	04
05	**Cam and Follower-** classification, motion analysis and plotting of displacement-time, velocity –time, jerk-time for uniform velocity, UARM, SHM & Cycloid motion (combined motions during one stroke excluded), generation of cam profile for roller and flat face follower, Pressure angle & methods to control pressure angle.	06
06	**Flexible Connectors and Flywheel:** Belt – Types of belts, law of belting, velocity ratio, slip, length of belt. Chains – types of chains, chordal action, variation in velocity ratio, chain length. T-ϑ diagram for flywheel, energy stored calculations.	08
07	**GEARS:** Law of gearing, Conjugate profile and its graphic construction, Involute and cycloid gear tooth profile, Construction of involute profile, Path of contact, arc of contact, contact ratio for involutes and cycloid tooth Interference in involutes gears. Critical Numbers of teeth for interference free motion. Methods to control interference in involutes gears.	10

Term Work:

1.THEORY ORIENTED:

Assignment based on topics covered.

2.PROBLEM ORIENTED:

A Graphic work (on half imperial drawing sheets)

(a) Location of instant center 3P
(b) Velocity analysis by ICR 3P
(c) Velocity analysis by relative method 3P
(d) Velocity – Acceleration analysis by relative method 3P
(e) Construction of involute profiles 1P
(f) Construction of x-t, v-t, a-t, j-t curves of follower motions and cam profile 2P

B Analytical / Numerical work

1. Velocity – Acceleration analysis by analytical method 3P
2. Numerical Problems on belts / chains 2P
3. Numerical Problems on gear 4P
4. Numerical Problems on cams 3P
5. Any two problem using computer programming. (C++/MATLAB) 2P

P = Problem

C. Demonstration with physical models of mechanisms

D. Simulation of motions of mechanism using CAD package (e.g. CATIA)

Text Books:

1. Rattan, Sarjit S. *Theory of machines*. Tata McGraw-Hill, 2005.

Reference Books :

1. Uicker, John Joseph, Gordon R. Pennock, and Joseph Edward Shigley.*Theory of machines and mechanisms*. Vol. 1. New York: Oxford University Press, 2011.
2. Ghosh, Amitabha, and Asok K. Mallik. *Theory of mechanisms and machines*. Affiliated East-West Press, 1994.
3. Ballaney, P. L. *Theory of machines and mechanisms*. Khanna Publishers, 2003.

SEMESTER-IV	**S.Y. B.Tech. (Mechanical Engineering)**		
CODE: BTM403	**COURSE: Fluid Mechanics**		
Period per week (each of 60 minutes)	Lecture	04	
	Practical	--	
	Tutorial	--	
Scheme of Evaluation	Credit	04	
		Hours	Marks
	In Semester	01	20·2
	End Semester*	03	100
	Practical	---	---
	Term Work	---	--
	TOTAL	**---**	**100**

* 60% Weightage for end semester

Course Objectives:

The objective of the course is to make student familiar with the mechanics of fluid flow which includes developing knowledge of static and dynamic nature fluid and fluid flow systems, flow related measurements, techniques of fluid flow analysis, internal and external fluid flow, among students.

Course Outcome:

Upon successful completion of the course, students should be able to

1. have knowledge of fundamentals of static and dynamic behavior of incompressible and compressible fluid.
2. have understanding of performing calculation of different flow quantities and parameters.
3. be able to apply basic principles to solve single phase flow problem.
4. be able to analyze an existing flow system and recommend solution for it.

Course Contents:

Module	**Details of Course Content**	**Hrs.**
01	**Fundamental Concepts:** Continuum, fluid properties -density, pressure, viscosity, surface tension, compressibility. Classification of fluid – Newtonian and Non-Newtonian, Viscous and Inviscid, Compressible and Incompressible.	06
02	**Fluid Statics:** Definition of body forces and surface forces, static pressure, Pascal's law, Derivation of basic hydrostatic equation, Application to manometer, Forces on submerged surfaces, Fluid in rigid body motion, Buoyancy, stability and Archimedes' Principle.	08

03	**Fluid Kinematics:** Velocity and approach of description- Lagrangian and Eulerian, Acceleration, Classification of flow field – one, two and three-dimensional, steady and unsteady, uniform and non-uniform, rotational and irrotational, Laminar and turbulent. Fluid element's translation, rotation and deformation, Flow patterns: streamlines, path lines and streak lines.	06
04	**Fluid Dynamics:** Basic flow conservation equations and method of analysis- Integral and Differential approach. Reynolds Transport Equation and its application. Navier–Stokes equations (without proof) for rectangular and cylindrical co-ordinates. Cases of exact solutions of NS equations: viscous laminar flow of a fluid through a pipe, Couette flow, Euler's equations in two, three dimensions; Bernoulli's equation and its applications	10
05	**Turbulence and Boundary Layer:** Reynolds number and its significance in flow characterization. Concept of turbulence, its measurement, effect on NS equation and flow pattern. Modeling of turbulence. Boundary layer and its measurement, its development flat plate with zero pressure gradient Boundary layer equations its solution –Blasius solution (without derivation), Von-Karman momentum integral approach. Description of turbulent velocity profile in boundary layer- viscous, buffer and turbulent.	06
06	**Internal and External Flows:** Internal - Laminar flow through pipes and ducts. Deriving velocity profile using NS equation and developing expression to compute other quantities- flow rate, pressure drop, shear stress, friction factor etc. Head losses- major and minor losses, Moody's diagram, Flow through branched pipes. External – Flow over immersed bodies: Plate, Sphere, Cylinder and other objects. Concept of drag and lift, flow separation and methods to control, Streamlined and bluff bodies.	06
07	**Compressible Flow:** Characteristics of compressible flow, Concept of speed of sound, pressure, stagnation and sonic properties, Effect of area variation on flow properties in isentropic flow, Isentropic flow through converging nozzle – critical pressure ratio and chocked flow, Effect of friction and heat transfer on flow properties, High speed flow	06

Text Books:

Fox, Robert W., and Alan T. McDonald. "Introduction to Fluid Mechanics, John Wiley&Sons." *Inc., New York* (1994).

Reference Books :

1. White, Frank M. "Fluid mechanics.(7thedn)." (2011).
2. Streeter, V. L., E. B. Wylie, and K. W. Bedford. "Fluid mechanics. WCB McGraw-Hill." *Inc. Boston* (1998).
3. Huebsch, W., B. Munson, T. Okiishi, and D. Young. "Fundamentals of fluid mechanics." (2009).
4. Shaughnessy, Edward J., Ira M. Katz, and James P. Schaffer. *Introduction to fluid mechanics*. Vol. 8. New York: Oxford University Press, 2005.
5. Cengel, Yunus A., and John M. Cimbala. "Fluid Mechanics. Vol. 1." (2006).
6. Potter, M. C., and D. C. Wiggert. "Mechanics of Fluids . Cengage Learning." (2010).

SEMESTER-IV	**S.Y. B.Tech. (Mechanical Engineering)**		
CODE: BTM453	**Fluid Mechanics Laboratory**		
Period per week (each of 60 minutes)	Lecture	--	
	Practical	02	
Scheme of Evaluation	Credit	01	
		Hours	Marks
	In Semester	--	--
	End Semester*	--	--
	Practical	--	--
	Term Work	--	50
	TOTAL		**50**

Course Objectives:

The objective of this course is to enhance the knowledge and understanding of course BTM403 through live examples and by performing experiments which involves principles of fluid mechanics

Course Outcome:

Upon successful completion of the course, students should be able to

1. Define and explain different properties of fluid mechanic, basic principles of fluid statics and dynamics, compressible and incompressible flow,
2. Apply basic principles to solve real life problem based of fluid mechanic.
3. Examine simple fluid problem under the concept of turbulence and boundary layer,

Exp. No.	**Details of Laboratory Experiment**	**Hrs.**
1	To determine specific gravity of a given liquid	02
2	To verify Archimedes principle and to determine specific gravity of a concrete block	02
3	To determine the coefficient of discharge of a given orifice plate	02
4	To determine kinematic viscosity using Hagen-Poiseuille setup and prove that head loss is proportional to volume flow rate	02
5	To determine the coefficient of discharge of a given Venturimeter	02
6	To determine Darcy Friction factor for pipes of different diameters	02
7	To carryout experiment on a given experimental setup to verify Bernoulli's theorem	02
8	Case based numerical calculations involving fundamentals of fluid mechanics	10

Recommended Books:

1. *Fluid Mechanics Laboratory Manual*, Department of Mechanical Engineering, SPCE.

SEMESTER - IV	**S.Y.B.Tech. (Mechanical Engineering)**		
CODE : BTM404	**COURSE: Mechanical Engineering Measurements**		
Periods per week (each of 60 minutes)	Lecture	04	
	Practical	--	
	Tutorial	--	
Scheme of Evaluation	Credit	4	
		Hours	Marks
	In Semester	01	20 X 02
	End Semester*	03	100
	Practical	--	--
	Term Work	--	--
	TOTAL		**100**

* 60% Weightage for end semester

Course Objectives:

The objective of the course is to impart fundamental knowledge of mechanical measurement techniques and data analysis with its application to the measurement of several mechanical engineering quantities.

Course Outcomes:

Upon successful completion of the course, students should be able

1. To describe overall methodology of measurement and fundamental concepts of experimental data analysis.
2. To define different types or errors and to discuss uncertainty analysis.
3. To examine common techniques used for measurement of mechanical quantities such as displacement, velocity, acceleration, torque, strain, temperature, pressure, flow etc.
4. To identify and select proper measuring instrument for specific application.

Course Contents:

Module No.	**Details**	**Hrs**
01	**Introduction:** Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, Modifying and Interfering. **Static characteristics:** Static calibration, Linearity, Static Sensitivity, Accuracy, Precision, Threshold, Resolution, Reproducibility, Hysterisis, Drift, Range and Span etc. **Dynamic characteristics**: Order of instruments, dynamic behavior under standard inputs and key terminology	06
02	**Errors in measurement and data analysis:** Types of errors, factor influencing measurement, methods of elimination, Probable errors,	06

	Uncertainty and Uncertainty analysis **Statistical analysis of data:** arithmetic mean, deviation, average deviation, standard deviation, variance.	
03	**Displacement measurement:** Transducers for displacement measurement – Potentiometers, LVDT, Capacitance type, Digital transducers (Optical Encoder), Nozzle Flapper transducer. **Strain measurement:** Theory of strain gauges, gauge factor, Temperature compensation, Bridge circuit, Orientation of strain gauges for force and torque measurement, Strain gauge based load cells and torque sensors.	10
04	**Angular velocity measurement:** Tachometers, Tachogenerators, Digital tachometers, Stroboscopic methods. **Acceleration measurement:** Theory of accelerometers and vibrometers, Practical accelerometers, strain gauge based and piezoelectric accelerometers.	08
05	**Pressure measurement:** Pressure standards, Elastic pressure transducers viz. Bourdon Tubes, Diaphragms, Bellows and Piezoelectric pressure sensors, **High pressure measurement:** Bridgman gauges. Calibration of pressure sensors. **Vacuum measurement:** Vacuum gauges viz. Mcleod gauge, Pirani gauge, Ionization gauge, Thermal conductivity gauge, Knudsen gauge etc.	08
06	**Temperature measurement:** Thermodynamic Temperature Scale and IPTS, Electrical methods of temperature measurement viz. Resistance Thermometers, Thermistors, Thermocouples, Pyrometers.	06
07	**Flow measurement:**Venturimeter, Orifice meter, flow nozzles, Pitot tube, Rotameter, Hot wire Anemometrs, Turbine flow meters, Laser Doppler Anemometer etc. Miscellaneous measurement: Measurement of liquid level, humidity etc.	04

Text Books :

1. Doebelin, Ernest O., and Dhanesh N. Manik. "Measurement systems: application and design." (2007).
2. Sawhney, A. K., and PuneetSawhney. "A Course on Mechanical Measurements, Instrumentation and Control." *Dhanpath Rai and Co* (2004).

Reference Books:

1. Thomas Beckwith, N. Lewis Buck, Roy Marangoni, "*Mechanical Engineering Measurement*",Narosa Publishing House, 2005.
2. Nakra, B. C., and K. K. Chaudhry. *Instrumentation, measurement and analysis*. Tata McGraw-

Hill Education, 2003.
3. Jayal, A. K. "Instrumentation and Mechanical Measurements." (2000).
4. Doebelin, Ernest O. *Engineering experimentation: planning, execution, reporting*. McGraw-Hill College, 1995.
5. Holman, J. P. J. P. *Experimental methods for engineers*. 2001.
6. Venkateshan, S. P. *Mechanical measurements*. John Wiley & Sons, 2015.
7. Rangan, C. S., Garimella R. Sarma, and V. S. V. Mani. *Instrumentation: devices and systems*. Tata McGraw-Hill, 1983.

SEMESTER-IV	**S.Y.B.Tech. (Mechanical Engineering)**		
CODE: BTM454	**COURSE: Measurements Laboratory**		
Period per week (each of 60 minutes)	Lecture	--	
	Practical	02	
	Tutorial	---	
Scheme of Evaluation	Credit	01	
		Hours	Marks
	In Semester	--	--
	End Semester*	--	--
	Practical	---	--
	Term Work	---	50
	TOTAL	**---**	**50**

Course Objectives:

The objective of the course is to impart fundamental knowledge of mechanical measurement techniques and data analysis with its application to the measurement of several mechanical engineering quantities.

Course Outcomes:

Upon successful completion of the course, students should be able

1. To describe overall methodology of measurement and fundamental concepts of experimental data analysis
2. To define different types or errors and to discuss uncertainty analysis
3. To examine common techniques used for measurement of mechanical quantities such as displacement, velocity, acceleration, torque, strain, temperature, pressure, flow etc

List of Experiments: Any seven experiments from the following list of experiments:

1. Calibration of pressure gauge using dead weight pressure gauge tester.
2. Calibration of load cell.
3. Calibration of strain gauges.
4. Calibration of LVDT.
5. Calibration of tachometer.
6. Calibration of accelerometer/vibrometer.
7. Calibration of flow meters.
8. Calibration of temperature sensors.
9. Time constant of thermometer.
10. Study of anemometer.
11. Study of Optical Encoders

Term Work:

The term work will comprise of following

1. Journal of laboratory experiments.
2. At least one assignment on each module of the syllabus.

SEMESTER-IV	**S.Y. B.Tech. (Mechanical Engineering)**		
CODE: BTM405	**COURSE: Manufacturing Science –II**		
Periods per week (Each Period of 60 min.)	Lecture	04	
	Practical	--	
	Tutorial	02	
	Credit	05	
		Hours	Marks
Scheme of Evaluation	In Semester	01	20 x 2
	End Semester *	03	100
	Practical	--	--
	Term Work	--	50
	TOTAL	**--**	**150**

* 60% Weightage for end semester

Course Objective:

1. To impart understanding and appreciation of breadth and depth of the field of manufacturing.
2. To impart knowledge of manufacturing processes like, Pattern making, Casting, plastic moulding and metal surface treatment.
3. To impart knowledge of construction and working of various machines like, Lathe, Milling, Drilling, Surface Grinding & Shaper, and the tools used in these machines.
4. To make the students aware of the basic welding processes &non conventional manufacturing processes.

Course Outcome:

Upon successful completion of the course, students should be able

1. To design production devices like jigs and fixtures
2. To explain theory of metal cutting
3. To design Cutting tools , Press tools
4. To explain rolling ,forming sheet metal working operations.

Course Contents:

1	Design of Jigs and Fixtures, Introduction, need, Definitions, Principles of location, types of locators, Principles of Clamping, Types of clamping, Jig Bushes and types of Jig Bushes, Indexing devices, Fool proofing means, Types of Jigs and fixtures, Box Jig, Latch Jig, Milling fixtures, Turning Fixtures, Design principles for Jigs and fixtures, Design of Jigs and Fixtures	6
2	Metal Cutting and Tool Engineering, Mechanics of machining –geometry of cutting tools, chip formation, cutting forces and power requirements, wear and tool life, Economics of Metal Cutting parameters affecting machining cost, Tool life for minimum cost max productivity	6

3	Measurement of cutting Forces, Types of tool dynamometers, Coolants types of coolants, choice of coolants, Effects of coolants on various cutting parameters, cutting fluids, machine-ability	6
4	Design of Cutting Tools, Design of cutting Tools Types of tools, Tool geometry, Tool signature, Design of single point cutting tool, Design of Drill, Reamer, Broach, Milling Cutter	6
5	Sheet Metal Working Operations, Introduction of sheet metal working, Press, Classification of presses, Selection of presses, Difference between Hydraulic and Mechanical Press, Types of Cutting operations and non cutting operation, Different elements of die set assembly, Design of dies like simple die, progressive die, compound die, combination die, Bending die, Drawing die, Forming die	6
6	Rolling of Metals: Principles of rolling , Characteristic of rolling, Rolling mills and their types, Rolling parameters, Principles of roll pass design, Calculation of design parameters for rolls Forging, Extrusion, Rotary Swaging Processes, types, advantages, limitations and applications. Forging : Classification of forging processes, open-die forging & spread law, closed die-forging & die design, forging equipments, weight calculation of initial material in forging, forging defects Die Design for drop Forging and press Forging	9
7	Sheet Metal Forming: Introduction and Classification of Metal Forming Processes, Advantages and Limitations, Stress strain relations in elastic and plastic deformation, concept of flow stresses, deformation mechanisms, Hot and Cold Working Processes and It's Effect on Mechanical Properties. Principle, process parameters, equipments and application of the following processes: spinning, stretch forming, plate, V and edge bending, Curling, Ironing, Roll Bending, Metal Spinning. Press brake forming, explosive forming, Hydro forming, electro hydraulic forming, and magnetic pulse forming. High Velocity forming of metals and High energy Rate forming. Drawing: Introduction and Classification, Wire Drawing, Rod Drawing, Tube Drawing, Deep Drawing, Analysis of Wire Drawing Process and Load Calculations.	9

Term Work:

1. One assignment on each module of the syllabus.
2. Industrial visit report (format should be provided by teacher)
3. Seminar presentation on the topic related to any one of the topics [Desirable: inclusion of video of the manufacturing process of any product]
4. 25 MCQs on each module with answers

Text books:

1. Sharma, P. C. "Production engineering." *S. Chand publisher, New Delhi*(1999): 149-155.
2. Choudhary, SK Hajra, and AK HajraChoudhary. "Nirjhar Roy" Elements of Workshop Technology", Vol: II MACHINE TOOLS, Media Promoters & Publishers Pvt." *Ltd., Mumbai,* (2010).
3. Jain, Rajendra K., S. C. Gupta, and R. K. Jain. *Production technology*. Khanna Pub., 1986.

Reference Books:

1. Donaldson, Cyril, George H. LeCain, V. C. Goold, and JoyjeetGhose. *Tool design*. Tata McGraw-Hill Education, 2012.
2. Chapman, W. A. J. "Workshop Technology Part 1-3." (1998).
3. Juneja, B. L. *Fundamentals of metal cutting and machine tools*. New Age International, 2003.
4. Kodgire, V. D., and S. V. Kodgire. "Material science and metallurgy." *Everest Publication.* (2002).
5. Doyle, Lawrence E., and Carl Keyser. "Manufacturing processes and materials for engineers." *Prentice-Hall Inc., 1985,* (1985): 926.
6. HMT, H. M. T. *Production technology*. Tata McGraw-Hill Education, 2001.

SEMESTER – IV	CLASS: S.Y. B.Tech. Mechanical		
CODE:BTM406	COURSE: Organizational Communication & Interpersonal skills		
Period per week (each of 60 minutes)	Lecture	02	
	Laboratory	---	
	Tutorial	2**	
	Credits	3	
Scheme of Evaluation		Hours	Marks
	In Semester	01	20 X 02
	End Semester*	03	100
	TW/Practical	---	--
	TOTAL		100

*60% Weightage for end semester
** Tutorials of this courses will be held on alternate week.

COURSE OBJECTIVE:

1. To inculcate in students professional and ethical attitude, effective communication skills, team work, interpersonal Skills, and an ability to understand social responsibilities with multi-disciplinary approach.
2. To enable students to communicate in professional and social context with knowledge of business etiquettes.
3. To prepare students for successful career that meets the corporate, industrial and global requirement
4. To help students build an understanding of different organizational cultures, business practices, and social norms to communicate more effectively in domestic and cross-cultural business contexts.
5. To help student's to use a strategic communication model and critical thinking to identify objectives, analyze audiences, and choose the most effective structure and style for delivering strategically sound written and spoken messages.

COURSE OUTCOME:

Upon successful completion of this Course learners will be able to

1. Explain principles of effective group communication, so as to cultivate trust and understanding, develop open participation, and strengthen decision making in work groups and teams.
2. Analyse a company's communication processes or key messages and recommend changes that can help advance communication as an integral part of that organization's management strategy and possess entrepreneurial approach for lifelong learning
3. As a team, design and deliver a presentation that both informs and persuades, using an appropriate visual support strategy with leadership skills and adhering to a specified time limit.
4. Participate and succeed in campus placements and display corporate etiquettes
5. Have education necessary for understanding the impact of engineering solutions on society and demonstrate awareness of contemporary issues.

Course Contents:

Module No.	Details	Hrs.
01	**OrganisationalBehaviour:** Introduction, Concept of OB, Organisational culture, Status patterns in organizations, Organisational conflicts: Causes, Consequences and Management, Techniques of Organisational Development.	05
02	**Corporate Etiquettes and Manners:** Introduction, Etiquettes and rules of behavior, Professional Conduct, Etiquette in Meetings, Dining Etiquettes.	05
03	**Meetings & Documentations:** Types of meetings, Notice, Agenda, Minutes of the meetings, Strategies for conducting effective meetings.	02
04	**Report writing:** Objectives of report writing, Language and style in a report, Types of reports. **Formats of reports:** Memo, Letter, and Project report Survey based.	06
05	**Presentation Skills**: A Computer- aided presentation of the Project report. Technical Proposals: Objectives of technical proposals, Parts of proposals.	02
06	**Interpersonal Skills:** Emotional Intelligence, Leadership Skills, Goal Setting and Decision making, Stress Management, Assertiveness.	08
07	**Career Skills:** Group Discussions, Know thy Self (SWOT Analysis), Job Application letter, Writing Effective Resume', Interview Skills.	04

List of Assignments:

1. Two assignments based on case studies on OrganisationalBehaviour
2. Three assignments on report-writing (A Bound report to be submitted on topic given in partial fulfillment of the syllabus report writing, Report content will be graded and counted during presentation, a printed copy of the presentation and a soft copy in the form of CD to be attached with the report).
3. Technical Proposal (Group activity, document of the proposals)
4. Interpersonal Skills: Case Studies, Group Activity and assignments
5. Two assignments on Career Skills (Cover Letter and Resume' Mock Interviews, Practical sessions)
6. Etiquettes case study and role play.
7. Practical sessions on Group Discussion topics

Distribution of Term Work/ Practical marks shall be as follows:

1. Project report presentation :**15 marks**
2. Presentations on Interpersonal topics: **10 Marks**
3. Assignments:**10 marks**
4. Group Discussion :**10 marks**
5. Attendance**: 05 marks**

Text Books:

1. Lesikar, Raymond Vincent, Marie Elizabeth Flatley, Kathryn Rentz, and NeerjaPande. *Business communication: Making connections in a digital world*. McGraw-Hill, 2008.

2. Sharma, Ram Chandra, and Krishna Mohan. *Business correspondence and Report writing*. Tata McGraw-Hill, 1979.

Reference Books:

1. Luthans, Fred. "OrganisationalBehavior . New Yolk." (2005).
2. Olsen, Leslie A. *Technical writing and professional communication*. McGraw-Hill Humanities, Social Sciences & World Languages, 1991.
3. Wallace, Harold R., and L. Ann Masters. *Personal development for life and work*. South-Western Pub, 2000.
4. Thill, John V., Courtland L. Bovée, and Ava Cross. *Excellence in business communication*. New York etc: McGraw-Hill, 1991.
5. Ghosh, B. N., ed. *Managing Soft Skill for Personality Dev*. Tata McGraw-Hill Education, 2012.
6. Bell, Arthur H., and Dayle M. Smith. *Management communication*. John Wiley & Sons, 2010.
7. Alex, K. *Soft Skills*. S. Chand Publishing, 2009.

SEMESTER-IV	**S.Y.B.Tech. (Mechanical Engineering)**		
CODE: BTM499	**COURSE: Machine Shop Practice-II**		
Period per week (each of 60 minutes)	Lecture	--	
	Practical	02	
	Tutorial	---	
Scheme of Evaluation	Credit	01	
		Hours	Marks
	In Semester	--	--
	End Semester*	--	--
	Practical	---	--
	Term Work	---	50
	TOTAL	**---**	**50**

Course Objective:

The objective of this course is to provide students the hands on experience about basic manufacturing processes which are nerve centre of any manufacturing industry.

Course Outcomes:

Upon successful completion of the course, students should be able

1. To explain the Various parts and operation of lathe, shaper, milling, drilling, grinding machines
2. To apply the knowledge of various operations such as Plain turning, taper turning, precision turning on lathe machine Thread cutting on lathe machine Machining plain, horizontal and inclined surfaces on shaper machine Preparation of composite welding joint Operations in forging for manufacturing
3. To apply the knowledge of various operations such as precision turning on lathe machine, Boring and taper boring on lathe machine, External and internal thread cutting on lathe machine.
4. To explain the defects and their elimination in various manufacturing processes

Term Work:-

Job No.	**Details**	**Hrs**
01	One composite job of assembly of minimum three components produced using lathe, shaper, milling, drilling and grinding machines and involving the operations of precision turning, taper turning, taper boring, internal and external threading, shaping plain flat surfaces, slot milling ,drilling and grinding etc.	28

SEMESTER :-IV	**CLASS: S.Y.B.Tech(Mechanical)**		
CODE:BTM 491	**VALUE ADDED COURSE - Introduction to Composite Material Technology**		
Periods per week (each of 60 minutes)	Lecture	01	
	Practical	01	
	Tutorial	---	
	Credit	---	
		Hours	Marks
Scheme of Evaluation	In Semester	01	20x2
	In Semester Evaluation	---	60
	Practical	--	--
	Term Work	--	PASS/FAIL
	TOTAL		**PASS/FAIL**

Course Evaluation Scheme:

It is an audit course which involves both Theory and Practical sessions. Following evaluation scheme will be adopted for the evaluation of the course.

Test 1: 20% (Theory paper)
Test 2: 20% (Theory paper)
In-semester evaluation: 60%

On successful completion of the course by the candidate "PASS" grade shall be awarded in the final grade-sheet whereas **no grade will be awarded** on failure of completion of the course by the candidate registered for the course.

Course Objectives:
Upon successful completion of the course, students should be able to
1. Explain types of composite materials and their applications
2. Describe manufacturing processes for composite materials
3. Discuss mechanical properties of composites

Course Outcomes:

Upon successful completion of the course, students should be able to
1. explain types of composite materials and identify its applications to mechanical engineering systems
2. discuss constituents of different types of composites
3. describe manufacturing processes for composite materials
4. define simple mechanical properties of composites

Course Content:

Module No	Details	Hrs.
Module 01	**Overview of composite materials** Historical background, Classification based on structure and matrix, Advantages and limitations, industry applications	04
Module 02	**Composite materials** Reinforcement fibers, whiskers, polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC),	06
Module 03	**Composite Science** Material and microstructure parameters of layered and phased composites, micro and macro approaches to study and prediction of structure property relations.	06
Module 04	**Introduction to micromechanics** Anisotropy of composites, anisotropic elastic constants, failure criteria under multiaxial loading, interlaminar failure mechanism	06
Module 05	**Composite manufacturing processes** Manufacturing of reinforcement fibers and whiskers, preparation of fillers, additives and pigments for PMC, manufacturing of matrix polymers, manufacture of metallic matrices, processing of ceramics, manufacture of foams, honeycombs and adhesives.	08
Module 06	**Composite post processing operation** Machining, cutting, polishing, welding of thermoplastic PMC, bonding, riveting and painting.	04
Module 07	**Composite product design** Material considerations in composite product design, material design of thermal, optical, acoustic, electrical design requirements, design exercise for design of simple structural element such as tension bar and ring.	06

Term Work:

It consists of **at least one** tutorial and/or assignments and/or hands-on excercises from each module of the curriculum mentioned for the course.

Text Books:

1. K.K. Chawla, Composite Materials – Science & Engineering, Springer-Verlag, New York, 1987.
2. Analysis and Performance of Fiber Composites, Bhagwan D. Agarwal, Lawrence J. Broutman, K. Chandrashekhara, Wiley, 2006

References:

1. Handbook of Composites, George Lubin, Van Nostrand, Reinhold Co., 1982

SEMESTER :-IV	**CLASS: S.Y.B.Tech(Mechanical)**		
CODE:BTM 492	**VALUE ADDED COURSE – Internet of Things (IOT)**		
Periods per week (each of 60 minutes)	Lecture	01	
	Practical	---	
	Tutorial	01	
	Credit	---	
		Hours	Marks
Scheme of Evaluation	In Semester	01	20x2
	In Semester Evaluation	--	60
	Practical	--	--
	Term Work	--	PASS/FAIL
	TOTAL		**PASS/FAIL**

Course Evaluation Scheme:
It is an audit course which involves both Theory and Tutorial sessions. Students shall select a Mechanical or any interdisciplinary application & apply concepts of IOT learned during theory & tutorial. Following evaluation scheme will be adopted for the evaluation of the course.

Test 1: 20% (Theory paper)
Test 2: 20% (Theory paper)
In-semester evaluation: 60%

On successful completion of the course by the candidate "PASS" grade shall be awarded in the final grade-sheet whereas **no grade will be awarded** on failure of completion of the course by the candidate registered for the course.

Course Objectives:
Upon successful completion of the course, students will be

Explored to the interconnection and integration of the physical world and the cyber space. They are also able to design & develop IOT Devices.

Course Outcomes:
Upon successful completion of the course, students should be able to

1. Able to understand the application areas of IOT
2. Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
3. Able to understand enabling technologies & platform of IOT

Course Content:

Module No	Details	Hrs.
Module 01	**Introduction** Fundamentals of Internet of Things (IOT), Components in IOT, Architecture of IOT, Security, Privacy, Advantages, Applications: Smart Vehicles, Medical, Smart city, Smart Supply Chain etc.	04
Module 02	**Enabling Technologies of IOT** Technology Roadmap, RFID, Augmented Reality, Blue Tooth, Zigbee, WiFi, RFLinks, MEMS etc	06

Module 03	**Programming the Microcontroller for IOT** Cloud computing and IOT –Arduino/Equivalent Microcontroller platform – Setting up the board - Programming for IOT – Reading from Sensors - Communication-Connecting microcontroller with mobile devices – communication through Bluetooth and USB – connection with the internet using WiFi / Ethernet	06
Module 04	**Resource Management** Understanding the Elements of IOT (Sensors, Connectivity through network, Application Layer), Overview of Sensors, Gateways, Sensors Available in Market, Selecting the Right Sensor for the Right Use case, Considerations for Mounting Sensors for Right Results	06
Module 05	**IOT PROTOCOLS** Network Overview, Various Types of Networks, Network Protocols, Selecting the Right Network for the Right Use case, Network Challenges for IOT: Connecting sensors, Integrating with Application Platform	08
Module 06	**IOT Platforms** Introduction, Necessity of IOT Platform, Industrial Grade Platform, Key IOT Platform Features, IOT Platform Architecture, Getting access to IOT platforms, Introduction to Model based development on IOT platforms	04
Module 07	**Challenges & Opportunities of IOT** New business markets in IOT, IOT Design Challenges, IOT Design Opportunities, Technological challenges faced by IOT devices	06

Term Work:
It consists of **at least one** tutorial and/or assignments and/or hands-on excercises from each module of the curriculum mentioned for the course.

TEXT BOOKS:

1. Dieter Uckelmann et.al, “Architecting the Internet of Things”, Springer, 2011

REFERENCE BOOKS:

1. CharalamposDoukas , “Building Internet of Things with the Arduino”, Create space, April 2002