



**C. U. SHAH UNIVERSITY**  
**Wadhwan City**

**FACULTY OF:** - Technology and Engineering

**DEPARTMENT OF:** - Mechanical Engineering

**SEMESTER:** - IV

**CODE:** - 4TE04IEN1

**NAME** – Industrial Engineering (IEN)

**Teaching & Evaluation Scheme:-**

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Credits	Evaluation Scheme							
		Th	Tu	Pr	Total		Theory				Practical (Marks)			Total
							Sessional Exam		University Exam		Internal		University	
							Marks	Hrs	Marks	Hrs	Pr/Viva	TW	Pr	
4TE04IEN1	Industrial Engineering	4	0	0	4	4	30	1.5	70	3	--	---	---	100

**Objectives:**

- To give a global competitive edge to the students by way of honing their Managerial/Leadership Skills.
- To make them aware of the societal setting of the Industrial life.
- To train them in basic fundamentals prerequisites of Industrial Engineering.

**Prerequisites:**

- Students should have basic knowledge of history of Industrial Engineering.
- Students should have basic curiosity to take Case Studies in Industries.
- Students should be familiar with correct usage of Symbolic Language..

**Course outline:**

Sr. No.	Course Contents	No. of Hours
1	<b>Location Selection and Plant Layout:</b> Nature of Location Decision, Importance of Plant Location, Dynamic Nature of Plant Location, Choice of site for selection, State regulations on location, Government policies on decentralization. Industrial Estates, Economic Survey of Site selection, SEZ, Comparison of location <b>1.1</b> Principles of Plant layout and Types, factors affecting layout, methods, factors governing flow pattern, travel chart, analytical tools of plant layout, layout of manufacturing shop, repair shop and services sectors.	10
2	<b>Production Planning and Control:</b> <b>Introduction :</b> Types of production systems and their characteristics functions and objectives of P.P.C., product design and development including standardization and simplification. <b>2.1</b> Sales forecasting, concept, techniques, application, production planning and process planning. <b>2.2</b> Sequencing, loading and scheduling, techniques and their selection, line of balance,	10



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	assembly line balancing, dispatching, progress control.	
3	<b>Productivity and Work Study:</b> Definition of productivity, application and advantages of productivity improvement tools, reasons for increase and decreases in productivity. Areas of application of work study in industry. Reaction of management and labour to work study. <b>3.1 Method Study:</b> Objectives and procedure for methods analysis, Recording techniques, Micro motion and macro-motion study: Principles of motion economy, Normal work areas and work place design. <b>3.2 Work Measurement:</b> Objectives, Work measurement techniques – time study, work sampling, pre-determined motion time standards (PMTS) Determination of time standards. Observed time, basic time, normal time, rating factors, allowances, and standard time. introduction to ergonomics	12
4	<b>Job Evaluation and Wage Plan:</b> Objective, Methods of job evaluation, job evaluation procedure, merit rating (performance appraisal), method of merit rating, wage and wage incentive plans	06
5	<b>Industrial Legislation</b> Need for Industrial legislation, Factories act 1948, Industrial dispute act 1947, The Indian trade unions act 1926, Industrial employment act 1946, Payment of wage act 1936, Workmen compensation act 1923, Payment of bonus act 1965, Employees provident fund scheme 1952,	08
6	<b>Inspection and Statistical Quality Control:</b> Inspection – functions, types, objectives and benefits, quality control – principles, Concepts of quality circles, Total quality management, Quality assurance, Quality audit, ISO, and six sigma. <b>6.1 SQC Concept,</b> variable and attributes, normal distribution curves and its property charts for variable and attributes and their applications and interpretation (analysis) process capability. <b>6.2 Acceptance sampling,</b> sampling plans, OC curves and AOQ curves.	08
7	<b>Entrepreneurship:</b> Concept, product identification, infrastructure facilities, preparation of project report, sources of industrial finance, Resources allocation, Government incentives to entrepreneurs.	06

**Learning Outcomes:-** Learner will be able to ....

1. Understand the basic concepts/processes of .Industrial Engineering.
2. Understand the Laws and Regulations governing Industries..
3. Develop Entrepreneurship skills.

#### **Books Recommended:-**

- Industrial Engineering and Production Management – By **M. Mahajan**, Dhanpat Rai & Co.



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- Industrial Engineering and Production Management **Martand Telsang** S Chand & company.
- Industrial Engineering and Production Management by **Banga and Sharma**, Khanna publishers.
- Production System, Planning, Analysis and Control – By **J.L. Riggs** 3rd ed. Wiley
- Industrial Engineering and Organization Management by **S K Sharma, Savita Sharma**, Katson Books
- Industrial Engineering and Management by **Dr. B.Kumar** Khanna Publishers



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**FACULTY OF:** - Technology and Engineering

**DEPARTMENT OF:** - Mechanical Engineering

**SEMESTER:** - IV

**CODE:** - 4TE04TOM1

**NAME** – Theory of Machines (TOM)

**Teaching & Evaluation Scheme:-**

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Credits	Evaluation Scheme							
		Th	Tu	Pr	Total		Theory				Practical (Marks)			Total
							Sessional Exam		University Exam		Internal		University	
							Marks	Hrs	Marks	Hrs	Pr/Viva	TW	Pr	
4TE04TOM1	Theory of Machines	3	0	2	5	4	30	1.5	70	3	30	20	---	150

**Objectives**

- The students will understand the basic concepts of inertia forces & couples applied to reciprocating parts of a machine.
- They will also gain knowledge of kinematic synthesis and different applications of governor and gyroscopic effect.

**Prerequisites**

- Basic knowledge of Mathematics and Basic mechanics.

**Course Outline**

Sr. No.	Course Contents	Hours
1	<b>Brakes and Dynamometers:</b> Introduction, Brakes classification, Mechanical Brakes-Shoe brake, Band brake, Band and block brake, Internal expanding shoe brake, Braking of vehicle, Dynamometer, Absorption and transmission type.	07
2	<b>Governors:</b> Introduction, Function and types of governors, Centrifugal governors, Watt governor, Porter governor, Proell governor, Hartnell governor, characteristics of governor- stability, Sensitivity, isochronism, Hunting controlling forces and stability, Effort and power of governor, Inertia governor.	09
3	<b>Gyroscope:</b> Concept of gyroscope, Angular acceleration, Gyroscopic effects in ships, Airplanes, Stability of two wheeled vehicle, Stability of automobile negotiating a curve, Gyroscopic analysis of inclined rotating discs.	08
4	<b>Flywheel:</b> Function, construction, Flywheel's rim and dimensions, Operation of flywheel in a punching machine, Turning moment diagram, Fluctuation of energy and fluctuation of speed of crank shaft, Coefficient of fluctuation of energy and speed.	07



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5	<b>Inertia forces in reciprocating parts:</b> Introduction, D –Alberts’s Principle, Effect of number of forces on a rigid, Velocity and acceleration of the piston, Forces on the reciprocating parts of an engine considering friction and inertia of moving parts- piston effort, force acting along connecting rod, Thrust on sides of cylinder walls, Crank effort, Thrust on crank shaft, Dynamically equivalent systems, Compound pendulum, Bifilar suspension, Trifilar suspension, Klein’s construction.	<b>09</b>
6	<b>Synthesis of linkages:</b> Kinematic synthesis, Function generation, Path generation, Motion generation, Graphical synthesis, Precision positions, Structural error and chebychev spacing.	<b>05</b>

**Learning Outcomes**

To impart knowledge on

- Understand different types of brakes and dynamometers.
- Understand turning moment and crank effort diagram.
- Derive the relationship between tension on tight and slack sides of belts and HP transmitted by the belt.
- Understand the functions, types and characteristics of governors.
- Apply the theory of governors to solve numerical problems.

**Books Recommended:-**

- Theory of Machines by **S.S. Rattan** , Tata McGraw Hill.
- Theory of Machines by **Dr. Sadhu Singh**, Pearson Education.
- Theory of Machines and Mechanisms by **J.Uicker , Gordon R Penstock & J.E. Shigley**, Oxford International Edition.
- Kinematics, Dynamics and Design of Machinery by **Kenneth J Waldron** , Gary L Kinzel Wiley Edition.
- Dynamics of Machinery by **Farazdak Haideri** , Nirali Publication.
- Theory of Machines by **R.S.Khurmi** S.Chand.



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**FACULTY OF:-**Technology and Engineering  
**DEPARTMENT OF:-**Mechanical Engineering  
**SEMESTER:-**IV  
**CODE:-** 4TE04FME1  
**NAME:-** Fluid Mechanics (FME)

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**Teaching & Evaluation Scheme:-**

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Credits	Evaluation Scheme							
		Th	Tu	Pr	Total		Theory				Practical (Marks)			Total
							Sessional Exam		University Exam		Internal		University	
							Marks	Hrs	Marks	Hrs	Pr/Viva	TW	Pr	
4TE04FME1	Fluid Mechanics	3	0	2	5	4	30	1.5	70	3	30	20	---	150

**Objectives:-**

- Identify and obtain values of fluid properties and relationship between them.
- Understand the principles of continuity, momentum, and energy as applied to fluid motions.

**Prerequisites:-**

- Basic knowledge of Linear Algebra and Differential Equations

**Course outline:-**

Sr. No.	Course content	No. of Hours
1.	<b>Properties of fluid:</b> Introduction: Fluid, liquids and gases, Difference between solid and fluid, physical properties such as density, specific weight, viscosity, Newtonian and Non-Newtonian Fluid, causes of viscosity in gases, causes of viscosity in a liquid compressibility, surface tension, capillarity, vapor pressure, cavitations & its all effects and remedies, Thoma's cavitations factor.	06
2.	<b>Fluid Statics :</b> Hydrostatic law, Pascal's law, Pressure at a point, pressure measurement with manometers, Total Pressure, center of pressure, Pressure on a plane (Horizontal, Vertical, Inclined) & Curved surfaces, Archimedes Principle, Buoyancy and stability of floating and submerged bodies, meta center & meta centric height – analytical and experimental determination.	06
3.	<b>Fluid Kinematics:</b> Types of flow (steady vs. unsteady, uniform vs. non-uniform, laminar vs. turbulent, One, Two and Three dimensional, compressible vs. incompressible, rotational vs. Irrotational), Stream lines, path lines, streak lines, velocity	05



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	components, convective, local and total acceleration, velocity potential, stream function, continuity equation in Cartesian co-ordinates.	
4.	<b>Fluid Dynamics:</b> Introduction to Navier-Stokes' equation, Euler's equation of motion along a stream line, Bernoulli's equation, Application of Bernoulli's equation to Pitot tube, Venturi meter, Orifices, Orifice meter, Triangular Notch & Rectangular Notch	06
5.	<b>Dimensional Analysis:</b> Dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham's theorem, important dimensionless numbers, Model analysis (Reynolds, Froude and Mach)	05
6.	<b>Viscous flow :</b> Reynolds number and Reynolds experiment, flow of viscous fluid through circular pipe - Hagen – Poiseuille's equation, Flow of viscous fluid between two parallel fixed plates, power absorbed in viscous flow through - journal, Foot step and Collar bearing, Movement of piston in dash pot, Methods of Measurement of viscosity.	06
7.	<b>Compressible Fluid Flow :</b> Thermodynamic concept, speed of a sound wave, Mach number, Mach cone, Mach cone and Mach angle, flow with friction through pipes, adiabatic and isothermal flow, jet propulsion flow through variable area, flow through nozzle, Back pressure variation.	06
8.	<b>Turbulent Flow:</b> Characteristics of diff. types of flow, expression for coefficient of friction - Darcy Weisbach Equation, moody diagram resistance of smooth and rough pipes shear stress and velocity distribution in turbulent flow through pipes.	05

#### **Learning Outcomes: -**

- The student will demonstrate an ability to recognize the type of fluid flow that is occurring in a particular physical system.
- The student will demonstrate an ability to choose the appropriate fluid mechanical principles needed to analyze fluid-flow situations.

#### **Books Recommended:**

1. Fluid Mechanics and Hydraulic Machines by **R.K. Bansal**, Laxmi Prakashan.
2. Fluid Mechanics and Hydraulic Machines by **R.K. Rajput**, S.Chand & Co.
3. Fluid Mechanics and Fluid Power Engineering by **D.S. Kumar**, S.K.Kataria & Sons
4. Fluid Mechanics by **F. White**, Tata-McGraw Hill publishers
5. Fluid Mechanics by **Cengel and Cimbala**; Tata-McGraw Hill Publishers.
6. Fluid Mechanics and Hydraulic Machines by **S. Gupta**; Pearson Publishers.
7. Mechanics of Fluids by **Shames**, McGraw Hill publishers.



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**FACULTY OF:** - Technology and Engineering  
**DEPARTMENT OF:** - Mechanical Engineering

**SEMESTER:** - IV

**CODE:** - 4TE04MMM1

**NAME:** – Mechanical Measurement and Metrology (MMM)

**Teaching & Evaluation Scheme:-**

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Credits	Evaluation Scheme							
		Th	Tu	Pr	Total		Theory				Practical (Marks)			Total
							Sessional Exam		University Exam		Internal		University	
							Marks	Hrs	Marks	Hrs	Pr/Viva	TW	Pr	
4TE04MMM1	Mechanical Measurement and Metrology	4	0	2	6	5	30	1.5	70	3	30	20	---	150

**Objectives:-**

- The objective is to prepare the students aware of measurement instruments and systems.
- The performance of various instruments let the students to gain confidence about their knowledge gained during theory classes can be made possible.

**Prerequisites:-**

- Basic knowledge of units of measurements and general purpose instruments utilised in measurement..

**Course outline:-**

Sr. No.	Course Content	No. of Hours
<b>PART – I MECHANICAL MEASUREMENTS</b>		
1	<b>Introduction to Measurements:</b> Generalized measurement system, static & dynamic characteristics of instruments, types of measurement system , Instrumental error & its analysis, sensors and transducers.	06
2	<b>Temperature Measurement:</b> Expansion Thermometers, Change- of state thermometers parametric cones, electrical methods, pyrometry, radiation pyrometers, optical pyrometer, Calibration of temperature measuring instruments.	08
3	<b>Pressure Measurement:</b> Pressure standards and methods of pressure measurement , deadweight pressure gauge, manometers, elastic deformation gauges, electrical methods, piezoelectric pressure transducer, measurement of vacuum pressures, calibration , etc.	08





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4	<b>Measurement of force, torque &amp; power:</b> Direct methods and indirect method, force measuring instruments. Torque measuring inst. And power measuring instruments etc.	04
5	<b>Miscellaneous measurement:</b> Measurement of displacement, velocity, acceleration, speed, strain.	04
<b>PART – II METROLOGY</b>		
6	<b>Fundamentals of metrology:</b> Meaning, objectives, necessity, standards of measurement, method of measurement, precision and accuracy, sources of errors, standardizing organizations.	05
7	<b>Limits fits and Tolerance:</b> General, sizes and dimensions, types of fits etc.	02
8	<b>Linear Measurements:</b> Engineer's steel rule, Callipers, Verniers, Micrometers, gauges, Slip gauges, Dial indicators, comparators etc. their calibration, applications, advantages and limitations.	07
9	<b>Angular Measurement:</b> Working principal, construction, measurement procedure, error and elimination, limitations and calibration of different angular measuring instruments. Taper measurement.	06
10	<b>Gear Measurement:</b> Introduction, types of gear, forms of gear teeth, measurement and testing of spur gear, errors.	03
11	<b>Straightness and Parallelism and machine tool tests:</b> Measurement of straightness, parallelism, and machine tool testing: various alignment test on lathe, milling machine and drilling machine.	05
12	<b>Surface roughness measurement :</b> Different surface roughness standards of measurements , mechanical and electrical and electronic surface roughness measuring instruments.	02

#### **Learning Outcomes: -**

- Students will be able to perform the similar type of instrument in their future when exposed to the industrial environments.

#### **Books Recommended:-**

1. "Engineering Metrology", By **R. K. Jain**, Khanna Publishers.
2. "Mechanical Measurement", By **R. K. Jain**, Khanna Publishers.
3. "Mechanical Measurement and Control", By **D. S. Kumar**, Metropolitan Book Co. Pvt. Ltd., New Delhi.
4. "Mechanical Measurement and Instrumentation", By **R. K. Rajput**, Katson Book.

#### **Research reference:-**

1. "Mechanical Measurement and Control", By **D. S. Kumar**, Metropolitan Book Co. Pvt. Ltd., New Delhi.
2. "Measurement Systems", By **E. O. Doebelin**, McGraw Hill.
3. "Mechanical Measurements" By **T. G. Beckwith, R. D. Marangoni & J. H. Lienhard V**, Pearson (LPE).
4. "Experimental Methods for Engineers", By **J. P. Holman**, McGraw Hill.
5. "Engineering Measurement", By **Collets and Hope ELBS**.



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**FACULTY OF:-**Technology and Engineering  
**DEPARTMENT OF:-**Mechanical Engineering  
**SEMESTER:-** IV  
**CODE:-** 4TE04MPR1  
**NAME -**Manufacturing Processes-I (MPR)

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**Teaching and Evaluation Scheme:-**

Subject Code	Name of the Subject	Teaching Scheme (Hours)				Credits	Evaluation Scheme							
		Th	Tu	Pr	Total		Theory				Practical (Marks)			Total
							Sessional Exam		University Exam		Internal		University	
							Marks	Hrs	Marks	Hrs	Pr/Viva	TW	Pr	
4TE04MPR1	Manufacturing Processes-I	4	0	2	6	5	30	1.5	70	3	30	20	---	150

**Objectives:-**

- The objective is to impart the basic knowledge about machine and their operation in general as a prime element in manufacturing environment.
- It also clears the importance of engineering machine selection in various fields of manufacturing applications.
- The availability of wide range of machine makes it essential to select most suitable machine for the suitable application.

**Prerequisites:-**

- Basic knowledge of machine.
- Basic knowledge of materials.
- Basic knowledge of physics.

**Course outline:-**

Sr. No.	Course content	No. of Hours
1.	<b>Basic Machine Tools:</b> Machine tools classification, working and auxiliary motions in machine tools, Primary cutting motions in machines tools.	06
2.	<b>Lathes Machine:</b> Engine Lathes, construction all arrangement and principal unit so engine lathes, type and size range of engine lathes, Operations carried one engine lathe, attachment extending the processing capacities of engine lathes, description of other type s of lathes, Plain truing lathes, facing lathes, multiple tool lathes, simple purpose lathes, turret lathes, horizontal and vertical. Alignment tests of lathes.	10
3.	<b>Drilling Machines:</b> Purpose and field of application of drilling machines upright drill processes, radial drills, alignment tests of drilling machine.	08
4.	<b>Boring Machine:</b> Purpose and filed of application, Horizontal boring machines,	06



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	Precision boring machines.	
5.	<b>Milling Machines:</b> Purpose and types of milling machines, general purpose milling machines, different types of milling operations, milling cutters, attachments extending the processing capabilities of general purpose milling machines. Alignment tests of milling machine.	10
6.	<b>Planers, Shapers and Slotters:</b> Classification: Attachments extending the processing capacities of each.	08
7.	<b>Sawing and broaching, Machines:</b> Metal sawing classification: reciprocating sawing machines, circular sawing machines, band sawing machines. Types of broaching machines, advantage and limitations of broaching.	06
8.	<b>Grinding Machines and Abrasives:</b> Classification of grinding machines, cylindrical grinders, internal grinders, Surface grinders, tool and cutter grinders, grinding wheel surface finishing. Abrasives, manufacture or grinding wheels.	06

**Learning Outcomes: -**

- Students will be confident to select the machine in their fields of manufacturing.
- The practical performance develops the team work spirit and accuracy in work of an individual student.

**Books Recommended:-**

1. Workshop Technology Vol.II by **Hajra Choudhari S. K., Hajra Choudhari A. K. and Roy Nirjhar**; Media Promoters and Publishers Pvt. Ltd.
2. Manufacturing Processes by **O.P.Khanna**; Dhanpat Rai Publications.
3. Workshop Technology Vol.I &II &III by **Chapman**; Edward Arnold
4. Production Technology by R. K. Jain and **S.C.Gupta**; Khanna Publishers
5. Processes and Materials of Manufacture; **Lindberg Roy A.**; Prentice-Hall India.
6. Manufacturing Engineering and Technology; **Kalpakkian**; Addison Wesley Publishing Co.
7. Workshop Technology Vol.II by **B.S.Raghu Vamshi**; Dhanpat Rai & Co (p) Ltd
8. Principles of Manufacturing by **Chembel**; Tata Mcgraw-Hill Publishing Company