PUNE VIDYARTHI GRIHA'S

COLLEGE OF ENGINEERING AND TECHNOLOGY, PUNE-9

(AFFILIATED TO SAVITRIBAI PHULE PUNE UNIVERSIT, PUNE)

DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULUM BOOK

ACADEMIC YEAR: 2016-17

FOR THE PROGRAMME

MECHANIAL ENGINEERING (UNDER GRADUATE)

PUNE VIDYARTHI GRIHA'S

COLLEGE OF ENGINEERING AND TECHNOLOGY

VISION

TO ACHIEVE EXCELLENCE IN ENGINEERING EDUCATION

MISSION

- **To satisfy all stakeholders**
- **To develop ethical, highly motivated engineering professionals with good human values, requisite skills and competencies**
- **To adopt innovative teaching mechanisms**
- **To promote research culture**
- **To contribute to country's economic development**
- **To be responsive to changes in technology, socio-economic and environmental conditions**

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To become premier source of competent Mechanical Engineering professionals for providing service to the society.

MISSION

1. To provide state of the art facility and to offer opportunities for multifaceted development and enriching learning experience for students, faculty and staff.
2. To enhance the status as a recognized academic and research centre in collaboration with other institutions and industry.
3. To provide interactive and innovative teaching to transform students into competent engineering professionals having good ethical, social and human values.
4. To deliver ready to employ engineering graduates who are adaptable and practicing lifelong learning to meet the ever changing requirements of the employers.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1: To demonstrate the ability to design, develop products, systems and processes in multi-disciplinary engineering environment by application of principles of Science and Engineering.

PEO2: To develop experimental and computational skills necessary to formulate and solve industrial problems related to Mechanical Engineering.

PEO3: To offer sustainable solutions through research, technological competency, leadership skills and team work.

PEO4: To continue professional development through higher education and lifelong learning.

PEO5: To demonstrate socio-economic, ethical and environmental awareness while making professional decisions.

PROGRAMME OUTCOMES

Graduates of the mechanical engineering program will be able to -

1. Use basic knowledge in mathematics, science and engineering to solve problems specific to Mechanical engineering.
2. Investigate complex problems, gather data and then interpret and analyze the same leading to a meaningful solution.
3. Identify, formulate and design a mechanical system that meets desired specifications.
4. Function as a coherent member in multidisciplinary design teams, and deliver results through collaborative research.
5. Identify, formulate and solve mechanical engineering problems of complex nature.
6. Understand their professional and ethical responsibilities, and use technology for the benefit of mankind.
7. Communicate effectively in both verbal and written forms within and outside the engineering community, give and receive instructions.
8. Apply and understand impact of engineering solutions in societal and environmental contexts.
9. Self-educate and clearly understand the importance of lifelong learning.
10. Understand and apply the basic principles of project management and finance.
11. Apply modern computational tools to analyze mechanical engineering problems.
12. Design a mechanical system or, component to meet the desired needs within realistic constraints such as economic, environmental, social, health and safety.

PROGRAMME SPECIFIC OUTCOMES

1. Demonstrate competency in the areas of Thermal, Design and Manufacturing.
2. Ability to use skills and tools to work in interdisciplinary areas of engineering

INDEX

Third Year

Curriculum Book

Syllabus Structure of Savitribai Phule Pune University, Pune

T. E. (Mechanical) Semester – I

(w.e.f. Academic year 2014-15)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
302041	Design of Machine Elements – I	4	--	2	30#	70@	25**	--	--	**125**
302042	Heat Transfer	4	--	2	30	70	--	50*	--	**150**
302043	Theory of Machines-II	4	--	2	30	70	--	--	50$	**150**
302044	Metrology and Quality Control	3	--	2	30	70	--	--	50	**150**
302045	Hydraulics and Pneumatics	3	--	2	30	70	25	--	--	**125**
302046	Skill Development	--	--	2	--	--	50	--	--	**50**
Total of Semester – I		**18**	**--**	**12**	**150**	**350**	**100**	**50**	**100**	**750**

*** Evaluation should be on performance in practical examination and oral based on TW and theory**

$ Common Oral will be based on both TOM-I and TOM-II term work at end of First Semester of T.E.

T. E. (Mechanical) Semester – II

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
302047	Numerical Methods and Optimization	4	--	2	30	70	--	50	--	**150**
302048	Design of Machine Elements -II	4	--	2	30#	70@	25	--	50**	**175**
302049	Turbo Machines	4	--	2	30	70	25		--	**125**
302050	Mechatronics	3	--	2	30	70	25	--	--	**125**
302051	Manufacturing Process-II	3	--	--	30	70	--	--	--	**100**
302052	Machine Shop -II	--	--	2	--	--	25	--	--	**25**
302053	Seminar	--	--	2			--	--	50	**50**
Total of Semester – II		**18**		**12**	**150**	**350**	**100**	**50**	**100**	**750**

**** Common oral based on both DME-I and DME-II term work**

TE (Mech)

Semester I

Course Title

Course Title: Design of Machine elements I		**Course Number: 302041**	**Course Code: C301**
Year: TE		**Semester: I**	
Designation of Course		Professional Core	
Teaching Scheme: 4 Hrs/Week		**Practical: 2 hrs/week**	
Course Assessment Methods	**Direct methods**	In-semester Examination: 30 Marks	End Semester Examination: 70 Marks
		Term Work 25 marks	
	Indirect Methods	Assignments	Class test
Prerequisites	Engineering Mechanics, Strength of Materials		
Course Objectives			
1	To develop the understanding of different steps involved in designing various machine components with reference to stresses involved, material selection and manufacturing methods, type of loads- Static and/or fluctuating		
2	To identify various modes of failure of commonly used machine components and to adopt related design procedure thereafter.		
3	To apply codes and standards to machine component design.		
4	To design and analyze suitable joints, fasteners, screws, welds etc.		
Course Outcomes			
CO1	Apply the basic principles of strength of materials; formulate the design procedure in eccentric loading, knuckle joint, cotter joint, and lever.		
CO2	Analyse and design the mechanical system consisting of shaft, coupling, and screws.		
CO3	Understand the importance of fluctuating stresses and its impact onto the design of the components.		
CO4	Evaluate any real life system considering the various modes of failure in the perspective of mechanical design.		
CO5	Develop/Design the suitable 'size' of the joints so as to avoid the failure in real applications.		
CO6	Create the technical drawings of individual components and assembly drawings thereof with required tolerances.		
Course Contents			
Unit-I	**Design process and design of Simple Machine elements**		
	Machine Design, Design Process, Design considerations, Standards and codes, Use of preferred series, Factor of safety, Service factor. Design of Cotter joint, Knuckle joint, Levers - hand / foot lever, lever for safety valve, bell crank lever, curved beams of circular cross section and components subjected to eccentric loading.		
	Practical/Tutorial		

Unit-II	**Design of Shafts, Keys and Couplings**
	Shaft design on the basis of strength, torsional rigidity and lateral rigidity, A.S.M.E. code for shaft design, Design of keys and splines. Design of Flange Coupling and Flexible Bushed Pin Coupling.
	Practical/Tutorial
Unit-III	**Design for Fluctuating Load**
	Stress concentration - causes & remedies, fluctuating stresses, fatigue failures, S-N curve, endurance limit, notch sensitivity, endurance strength modifying factors, design for finite and infinite life, cumulative damage in fatigue failure, Soderberg, Gerber, Goodman, Modified Goodman diagrams, Fatigue design of components under combined stresses.
	Practical/Tutorial
Unit-IV	**Power Screws**
	Forms of threads, multiple start screws, Torque analysis and Design of power screws with square and trapezoidal threads, Self locking screw, Collar friction torque, Stresses in power screws, design of a C-Clamp. Design of screw jack, Differential and Compound Screw and Re-circulating Ball Screw (Theoretical treatment only).
	Practical/Tutorial
Unit- V	**Threaded joints and Welded joints**
	Basic types of screw fasteners, Bolts of uniform strength, I.S.O. Metric screw threads, Bolts under tension, Eccentrically loaded bolted joint in shear, Eccentric load perpendicular and parallel to axis of bolt, Eccentric load on circular base. Design of Turn Buckle. Welding symbols, Stresses in butt and fillet welds, Strength of butt, parallel and transverse fillet welds, Axially loaded unsymmetrical welded joints, Eccentric load in plane of welds, Welded joints subjected to bending and torsional moments.
	Practical/Tutorial
Unit-VI	**Mechanical Springs**
	Types, applications and materials for springs, Stress and deflection equations for helical compression Springs, Style of ends, Design of helical compression

	and tension springs, Springs in series and parallel, Concentric helical springs. Helical torsion Spring, Surge in springs. Multi-leaf springs (Theoretical treatment only).
	Practical/Tutorial/TW
	Term work shall consist of 1. Two design projects on Assemblies covering above syllabus. The design project shall consist of two full imperial (A1) size sheet involving assembly-drawing with a part list and overall dimensions and drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary for selection of standard components. Drawings of design project should be done manually. 2. Assignments The assignment shall be internally presented in the form of power point presentation, by a group of three to five students. A report of assignment (Max 8 to 10 pages) along with print out of ppt is to be submitted. Each student shall complete any two of the following assignments, with Assignment (i) compulsory. a. Selection of manufacturing methods for machine elements designed in any one of the above design projects. b. Selection of materials for mechanical elements. c. Theories of failures and their applications. d. Use of dimensional tolerances, Geometrical tolerances and surface finish symbols in machine component drawings.

Text Books	**Author**	**Title of Book**	**Publication**
T1	Shigley J.E. and Mischke C.R.	Mechanical Engineering Design	McGraw Hill Publication Co. Ltd.
T2	Spotts M.F. and Shoup T.E.	Design of Machine Elements	Prentice Hall International.
T3	Bhandari V.B.	Design of Machine Elements,	Tata McGraw Hill Publication Co. Ltd.
T4	Juvinal R.C.	Fundamentals of Machine Components Design	John Wiley and Sons
Reference Books			
R1	Black P.H. and O. Eugene Adams	Machine Design	McGraw Hill
R2	Willium C. Orthwein	Machine Components Design	West Publishing Co. and Jaico Publications
R3	Hall A.S.	Theory and Problems of Machine Design,	Schaum's Outline Series.

R4	C.S.Sharma and Kamlesh Purohit	Design of Machine Elements	PHI Learing Pvt. Ltd
R5	P.S.G. College of Technology, Coimbatore.	Design data book	P.S.G. College of Technology, Coimbatore.
Self-Learning Facilities, Web Resources, Research papers for reference	NPTEL Video Lectures		
Contents beyond Syllabus	Stress Analysis using Ansys		
Additional Experiments	NIL		
Bridging Courses	NIL		
Tutorials	NIL		
Presentations	NPTEL Videos		

Course Title

Course Title: Heat Transfer		**Course Number: 302042**	**Course Code: C302**
Year: TE Mechanical		**Semester: I**	
Designation of Course		Professional Core	
Teaching Scheme: 4 Hrs/Week		**Practical:** --2 Hrs/Week	
Course Assessment Methods	**Direct methods**	On-line/In-semester Examination: 30 Marks	End Semester Examination: 70 Marks
		Practical Examination: 50 Marks	
	Indirect Methods	Assignments	End of topic Oral Exam
Prerequisites	Engineering Mathematics, Engineering Physics, Basics of Thermodynamics, Fluid Mechanics		
Course Objectives			
1	To understand basic modes, laws and different terms associated with heat transfer and to derive heat conduction equation in different forms. To introduce students to steady state heat conduction with different standard geometries		
2	To introduce students to steady state heat conduction with heat generation and to understand transient heat conduction with and without variation of temperature with space		
3	To understand different boundary and initial conditions used in heat transfer analysis and to introduce the concept of fins and the analysis of heat transfer using fins		
4	To understand principles of heat convection and to analyze the convective heat transfer problems.		
5	To understand thermal radiation and terms, laws and problems associated with it.		
6	To understand the concept of heat exchanging and to analyze the heat exchangers also to understand the concept of convection with phase change associated with it		
Course Outcomes			
CO1	Students will be able to identify the heat transfer problem and apply the laws, also will be able to solve 1D heat conduction problems involving different aspects of steady state.		
CO2	Students will be able to solve the problems of heat transfer involving heat generation and will be able to analyse the problems involving unsteady heat transfer		
CO3	Students will be able to identify, differentiate and apply between boundary & initial conditions also will be able to identify the fins and will be able to determine the rates of HT using fins		
CO4	Students will be able to apply the empirical relations and to will be able to determine the convective heat transfer coefficients in natural as well as forced convection.		

CO5	Students will be able to solve the problems involving radiation by applying the appropriate laws of radiation
CO6	To understand the concept of heat exchanging and to analyze the heat exchangers also to understand the concept of convection with phase change associated with it
Course Contents	
Unit-I **Conduction**	***Introduction and Basic Concepts***
	Application areas of heat transfer, Modes and Laws of heat transfer, Three dimensional heat conduction equation in Cartesian coordinates and its simplified equations, thermal conductivity, thermal diffusivity.
	One dimensional steady state heat conduction without heat generation
	Heat conduction in plane wall, composite slab, composite cylinder, composite sphere, electrical analogy, concept of thermal resistance and conductance, three dimensional heat conduction equations in cylindrical and spherical coordinates (no derivation) and its reduction to one dimensional form, critical radius of insulation for cylinders and spheres, economic thickness of insulation.
	Practical/Assignment
	1. Determination of Thermal Conductivity of Insulating Powder. 2. Determination of Thermal Conductivity of Composite Slab 3. Determination of Thermal Conductivity of Metal Rod
Unit-II **Heat Generation and Transient Heat conduction**	***One dimensional steady state heat conduction with heat generation***
	One dimensional steady state heat conduction with heat generation: Heat conduction with uniform heat generation in plane wall, cylinder & sphere with different boundary conditions.
	Transient heat conduction
	Validity and criteria of lumped system analysis, Biot and Fourier number, Time constant and response of thermocouple, Introduction to transient heat analysis using charts.
	Practical/Assignment
	Assignment to solve transient heat transfer problem using Heisler and Grober charts.
Unit-III **Boundary conditions and Extended Surfaces**	***Boundary Conditions***
	Temperature boundary condition, heat flux boundary condition, convection boundary condition, radiation boundary condition.
	Heat Transfer through Extended Surfaces
	Types of fins, Governing Equation for constant cross sectional area fins, solution (with derivation) for infinitely long & adequately long (with insulated end) fins and short fins (without derivation), efficiency & effectiveness of fins.
	Practical/Assignment
	Determination of temperature distribution, fin efficiency in Natural / Forced

	Convection
Unit- IV Convection	***Fundamentals of Convection***
	Mechanism of natural and forced convection, local and average heat transfer coefficient, concept of velocity & thermal boundary layers.
	Forced Convection
	Dimensionless numbers and their physical significance, empirical correlations for external & internal flow for both laminar and turbulent flows.
	Natural Convection
	Introduction, dimensionless numbers and their physical significance, empirical correlations for natural convection.
	Practical/Assignment
	1. Determination of heat transfer coefficient in Natural Convection 2. Determination of heat transfer coefficient in Forced Convection
Unit-V Radiation	***Thermal Radiation***
	Fundamental concepts of radiation, different laws of radiation, Radiation shape factor, Heat exchange by radiation between two black and diffuse gray surfaces, Radiation shields.
	Practical/Assignment
	1. Determination of Emissivity of a Test surface 2. Determination of Stefan Boltzmann Constant
Unit-VI Heat Exchangers and Phase change Phenomenon	***Heat Exchangers***
	Classification and applications, heat exchanger analysis – LMTD for parallel and counter flow heat exchanger, effectiveness– NTU method for parallel and counter flow heat exchanger, introduction to cross flow heat exchanger, LMTD correction factor, design criteria for heat exchanger, introduction to heat pipe.
	Condensation and Boiling
	Boiling heat transfer, types of boiling, pool boiling curve and forced boiling phenomenon, condensation heat transfer, film wise and drop wise condensation (No numerical treatment).
	Practical/Assignment
	1. Assignment on multipass / cross heat exchanger using effectiveness charts. 2. Study of pool boiling phenomenon and determination of critical heat flux

Text Books	Author	Title of Book	Publication
T1	F.P. Incropera, D.P. Dewitt	Fundamentals of Heat and Mass Transfer	John Wiley
T2	Y.A. Cengel and A.J. Ghajar	Heat and Mass Transfer – Fundamentals and Applications	McGraw Hill Education Private Limited.
T3	S.P. Sukhatme	A Textbook on Heat Transfer	Universities Press

T4	A.F. Mills	Basic Heat and Mass Transfer	Pearson
Reference Books			
R1	J P Holman	Fundamentals of Heat and Mass Transfer	McGraw Hill Publication
R2	P K Nag	Heat and Mass Transfer	McGraw Hill Publication
R3	M. Thirumaleshwar	Fundamentals of Heat and Mass Transfer	Pearson Education
Self-Learning Facilities, Web Resources, Research papers for reference	None		
Contents beyond Syllabus	Heat pipe		
Additional Experiments	None		
Bridging Courses	None		
Tutorials	None		
Presentations	None		

Course Title

Course Title: Theory of Machines II		**Course Number: 302043**	**Course Code: C303**
Year: TE		**Semester: I**	
Designation of Course		Professional Core	
Teaching Scheme: 4 Hrs/Week		**Practical: 2 hrs/week**	
Course Assessment Methods	**Direct methods**	In-semester Examination: 30 Marks	End Semester Examination: 70 Marks
		Oral: 50 Marks	
	Indirect Methods	Assignments	Class Test
Prerequisites	Engg Mathematics, Physics, Theory of Machines I		
Course Objectives			
1	To develop competency in understanding of theory of all types of gears.		
2	To understand the analysis of gear train.		
3	To understand step-less regulations and mechanisms for system control – Gyroscope.		
4	To make the student conversant with synthesis of the mechanism.		
5	To develop competency in drawing the cam profile and understand the follower motion.		
Course Outcomes			
CO1	Ability to understand kinematics of gears, which will be the prerequisite for gear design.		
CO2	Ability to understand torque transmitting capacity in gear trains which will be the prerequisite for gear box design.		
CO3	Ability to be conversant with working principle of step-less regulations.		
CO4	Ability to apply concepts of gyroscopic action and to calculate effect of gyroscopic couple		
CO5	Ability to conversant with synthesis of the mechanism.		
CO6	Ability to understand design of mechanism and cam profile.		
Course Contents			
Unit-I	**Spur Gears**		
	Classification, Spur gear: definition, terminology, fundamental law of toothed gearing, involute and cycloidal profile, path of contact, arc of contact, conjugate action, contact ratio, minimum number of teeth, interference and under cutting, Force analysis and Friction in gears. **(8 hrs)**		
	Practical/Tutorial		

	1. To generate involute gear tooth profile and to study the effect of undercutting and rack shift using model. **2.** To draw conjugate profile for any general type of gear tooth.
Unit-II	**Helical, Bevel, Worm and Worm Wheel**
	Helical gears: nomenclature, center distance, virtual number of teeth. Spiral Gear terminology and Efficiency Bevel Gear & Worm and worm wheel: terminology, geometrical relationships, tooth forces, torque transmitted. **(08 hrs)**
	Practical/Tutorial
Unit-III	**Gear Trains**
	Types of Gear Trains, analysis of epicyclic gear trains, Holding torque – Simple, compound and epicyclic gear trains, torque on sun and planetary gear train, compound epicyclic gear train, Bevel epicyclic Gear train. Types of gearboxes. **(08 hrs)**
	Practical/Tutorial
	3. To measure holding torque of the epicyclic gear train. 4. To study various types of gearboxes- constant mesh, sliding mesh, synchromesh gear box, Industrial gearbox, differential gearbox
Unit-IV	**Step-less regulation and gyroscope**
	Continuous Variable Transmissions - Geometry, Velocity and torque analysis of Faceplate variators, Conical variators, Spheroidal and cone variators, Variators with axially displaceable cones, PIV drives. **(04 hrs)** Gyroscopes, Gyroscopic forces and Couples, Gyroscopic stabilisation for ship and Aeroplane, Stability of four wheel drive vehicle moving on curved path, Stability of a two wheel vehicle. **(06 hrs)**
	Practical/Tutorial
	5. To verify the gyroscopic principles.
Unit- V	**Synthesis of Mechanism**
	Steps in synthesis process: Type, number and dimensional synthesis. Tasks of Kinematic synthesis: Path, function and motion generation (Body guidance). Precision Positions, Chebychev spacing, Mechanical and structural errors. Graphical synthesis: Two and three position synthesis using relative pole method and inversion method for single slider crank and four bar mechanism. Freudenstein's equation for four bar Mechanism, Three position function generation using the equation. **(08 hrs)**
	Practical/Tutorial

	6. To draw the cam profiles and study the effect of a. Different follower motions. b. Different follower (roller) dimensions
Unit-VI	**Cam and Follower**
	Types of cams and followers, analysis of standard motions to the follower, Determination of cam profiles for different follower motions, analysis of circular arc cam with flat face follower. Methods of control: pressure angle, radius of curvature and undercutting. Jump phenomenon of Eccentric cam, Introduction to advanced cam curves (3-4-5 Polynomial cam only) **(08 hrs)**
	Practical/Tutorial
	7. To draw the cam profiles and study the effect of a. Different follower motions. b. Different follower (roller) dimensions. 8. To study cam jump phenomena.

Text Books	**Author**	**Title of Book**	**Publication**
T1	S. S. Rattan	Theory of Machines	McGraw Hill Education
T2	Thomas Bevan	v	Longman
T3	A.G. Ambekar	Mechanism and Machine Theory	PHI
T4	N. K. Mehta	Machine Tool Design	Tata McGraw Hill
T5	J.J.Uicker, G.R.Pennock, J.E.Shigley	Theory of Machines and Mechanisms	OXFORD
Reference Books			
R1	Ghosh Malik	Theory of Mechanism and Machines	East West
R2	Hannah and Stephans	Mechanics of Machines	Edward Arnolde Publication
R3	R L Norton	Kinematics and Dynamics of Machinery	McGraw Hill Education
R4	David H. Myszka	Machines and Mechanism	PHI
R5	Sadhu Singh	Theory of Machines	Pearson
Self-Learning Facilities, Web Resources, Research papers for reference	Nil		

Contents beyond Syllabus	Governers, belt drives
Additional Experiments	None
Bridging Courses	None
Tutorials	None
Presentations	None

Course Title

Course Title: METROLOGY & QUALITY CONTROL		**Course Number: 302044**	**Course Code: C304**
Year: THIRD YEAR(T.E.)		**Semester: I**	
Designation of Course		Professional Core	
Teaching Scheme: 03 Hrs./Week (Theory),02Hrs\Week (Practical)		**Tutorial:** NIL	
Course Assessment Methods	**Direct methods**	In-semester Examination: 30 Marks	End Semester Examination: 70 Marks
		Oral: 50 Marks	
	Indirect Methods	Assignments	Q&A session, Class Test.
Prerequisites	Knowledge of PHYSICS, BASIC MATHEMATICS.		
Course Objectives			
1	Selection of tool and techniques for determining geometry and dimensions.		
2	Design and calibration of measuring tools and equipment's.		
3	Application of Quality Control Techniques.		
4	Application of Quality Management Concept.		
Course Outcomes			
CO1	An ability to understand knowledge of various tools and techniques used to determine geometry and dimensions of components in engineering applications.		
CO2	An ability to perform experiments, as well as to analyse and interpret data.		
CO3	An ability to design gauges to meet desired needs within realistic constraints		
CO4	An understanding of Quality Control Techniques and its applications in engineering industries		
CO5	Ability to practice various methods of Quality Management.		
Course Contents			
Unit-I	**Measurement and Measuring Instruments.**		
	Principles of Engineering metrology, Measurement standards, Types and sources of errors, Accuracy and Precision, introduction to uncertainty in measurement, linear and angular measuring instruments and their applications. Calibration: Concept and procedure, traceability, Gauge R&R Comparators: Mechanical, Pneumatic, Optical, Electrical (LVDT).Checking all geometrical forms		
	Assignment		
	Assignment on types and sources of errors in measurement & concept of Precision & accuracy.		

	Assignment on Various types of Comparators.
	Practical
	1. Determination of linear and angular dimensions of given composite part using precision/non precision measuring instruments. 2. Error determination with linear / angular measuring instruments. 3. Calibration of measuring instrument. Example – Dial gauge 4. Machine tool alignment testing on any two machines.
Unit-II	**Design of gauges, Interferometers and Surface Roughness measurements**
	Design of Gauges: Tolerances, Limits and Fits, Taylor's principle, Types of gauges and gauge design (numerical). Interferometer: Principle, NPL Interferometer, Laser Interferometer and their applications. Surface Roughness Measurement: Surface texture, Parameters for measuring surface roughness, Contact & non-contact type surface roughness measuring instruments.
	Assignment
	Design of Gauges for Hole & Shaft on Taylor's Principle
	Practical
	Identification of surfaces using optical flat/interferometers and measure surface roughness using surface roughness tester.
Unit-III	**Metrology of Thread, Gears and Advance Metrology**
	Measurement of Thread form: Thread form errors, Measurement of Minor, Major and Effective diameter (Three Wire Method), Flank angle, pitch, Floating Carriage Micrometre (Numerical). **Gear Metrology**: Types of errors, Gear tooth Vernier, Constant chord, Base tangent (Numerical), Gear Rolling Tester. Profile Projector, Tool maker's microscope and their applications. **Advancements in Metrology**: Introduction & applications of: Co-ordinate Measuring Machine, Universal Measuring Machine, Laser in Metrology, Automatic inspection system, Machine vision for online-offline inspection.
	Assignment
	Numerical on Screw Thread & Gear Metrology.
	Practical
	• Measurement of thread parameters using floating carriage diameter measuring machine. • Measurement of spur gear parameters using Gear Tooth Vernier, Span

	Micro meter.
Unit-IV	**Introduction to Quality and Quality Tools**
	Quality: Dimensions, Statements, Cost of quality & value of quality, Deming's cycles & 14 Points, Juran Trilogy approach, Seven Quality Tools, Introduction to N Seven Tools, Quality Circle, Criteria for Quality Award (National & International).
	Assignment
	Assignment on concept of Quality.
Unit- V	**Statistical quality control**
	Statistical quality control: Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable (X & R Chart) & Attribute (P & C Chart), Process capability(Indices: cp, cpk, ppk), Statistical Process Control (Numerical). Production Part Approval Method (PPAP). **Acceptance Sampling**: Sampling Inspection, OC Curve and its characteristics, sampling methods, Sampling Plan: Single, Double (Numerical), Multiple, Comparison of Plan, calculation of sample size, AOQ, Probability of Acceptance (Numerical).
	Assignment
	1. Numerical on Control charts to determine the process capability. 2. Study of OC curve & its Characteristics.
	Practical
	Determination of process capability from given components and plot variable control chart/ attribute chart.
Unit-VI	**Total Quality Management**
	Quality Function Deployment, 5S, Kaizen, Poka yoke, Kanban, JIT, QMS (ISO 9000, TS16949, ISO14000), Quality Audit, FMECA, Zero defect, TPM. Six Sigma: DMAIC - Concept and Applications.
	Assignment
	Assignment on Total Quality Management

Text Books	**Author**	**Title of Book**	**Publication**
T1	Jain R.K.	Engineering Metrology	Khanna Publication
T2	Hume K.J	Engineering Metrology	Macdonald Publications
T3	Juran J. M	Quality Handbook	McGraw Hill Publications
T4	Grant S.P	Statistical Quality Control	Tata McGraw hill Publication
Reference Books			
R1	Judge A.W	Engineering Precision	Chapman and Hall

		Measurements	
R2	Gupta I.C	Engineering Metrology	Dhanpatrai Publications
R3	Harrison M. Wordsworth	Stefeen Godfrey, Modern Methods for Quality control and Improvement	Willy publication.
R4	ASTME	Handbook of Industrial Metrology,	Prentice Hall of India Ltd.
Self-Learning Facilities, Web Resources, Research papers for reference	Web sites of Metrology, Quality control & Quality Assurance.		
Contents beyond Syllabus	Geometric Dimensioning & tolerancing for CMM.		
Additional Experiments	NIL		
Bridging Courses	Basic Training Courses For GD & T, Quality Analysis by Minitab.		
Tutorials	Three Tutorials(Unit 1&2,Unit 3&4,Unit 5&6)		
Presentations	CD Presentations, PPT Presentations.		

Course Title

Course Title: HYDRAULICS&PNEUMATICS		**Course Number: 302045**	**Course Code:C305**
Year: THIRD YEAR(T.E.)		**Semester: I**	
Designation of Course		Professional Core	
Teaching Scheme: 03 Hrs/Week (Theory),02Hrs\Week (Practical)		**Tutorial:** NIL	
Course Assessment Methods	**Direct methods**	In-semester Examination: 30 Marks	End Semester Examination: 70 Marks
			Term Work
	Indirect Methods	Assignments	Q&A session, Class Test
Prerequisites	Knowledge of Fluid Mechanics,BME,DME-I,DME-II.		
Course Objectives			
1	Application of fluid mechanics and governing laws in hydraulic and pneumatic systems.		
2	Study of working principle of various components used in hydraulic and pneumatic systems.		
3	Selection of different components used in hydraulic and pneumatic systems.		
4	Drawing and design of hydraulic and pneumatic systems.		
5	Industrial applications of hydraulic and pneumatic systems.		
Course Outcomes			
CO1	Working principle of various components used for hydraulic and pneumatic systems.		
CO2	Identify various components of hydraulic and pneumatic systems.		
CO3	Ability to select appropriate components required for hydraulic and pneumatic systems.		
CO4	Ability to design hydraulic and pneumatic systems for Industrial Applications.		
CO5	Ability to understand Industrial applications of hydraulic and pneumatic systems & Troubleshooting of hydraulic &pneumatic systems.		
Course Contents			
Unit-I	Introduction to Hydraulics & Pneumatics.		
	Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations. Properties of fluids, Fluids for hydraulic systems, governing laws. Distribution of fluid power, ISO symbols, energy losses in hydraulic systems.		
	Assignment		
	ISO symbols for different components of Hydraulic & Pneumatic systems.		
Unit-II	Pumps		

	Types, classification, principle of working and constructional details of vane pumps, gear pumps, radial and axial plunger pumps, screw pumps, power and efficiency calculations, characteristics curves, selection of pumps for hydraulic Power transmission. **Power units and accessories:** Types of power units, reservoir assembly, constructional details, pressure switches, temperature switches. **Accumulators:** Types, selection/ design procedure, applications of accumulators. Types of Intensifiers, Pressure switches /sensors, Temperature switches/sensors, Level sensors.
	Practical
	1)Test on Gear \Vane\Piston pump and plotting of performance charactristics.2)Design of accumulators and pressure intensifiers in hydraulic system.
Unit-III	Hydraulic Actuators
	(i) Linear and Rotary. (ii) Hydraulic motors - Types- Vane, Gear, Piston types, radial piston. (iii) Methods of control of acceleration, deceleration. (iv) Types of cylinders and mountings. (v) Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads. (vi) Design considerations for cylinders. Cushioning of cylinders. (Numerical treatment).
	Assignment\Practical
	1)Different types of actuators used in hydraulic & pneumatic systems.(Assignment)2)Testing of Pressure Relief Valve.
Unit-IV	Industrial Circuits
	Simple reciprocating, Regenerative, Speed control (Meter in, Meter out and bleed off), Sequencing, Synchronization, transverse and feed, circuit for riveting machine, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, circuit for hydraulic press, unloading circuit (Numerical treatment), motor breaking circuit.
	Practical
	1)Demonstration of Basic 04 Circuits on Hydraulic Trainer kit.2)Drawing and design of Simple Hydraulic Systems used in practice(05 systems).
Unit- V	Pneumatics
	Principle of Pneumatics: (i) Laws of compression, types of compressors, selection of compressors. (ii) Comparison of Pneumatics with Hydraulic power transmissions. (iii) Types of filters, regulators, lubricators, mufflers, dryers. (iv) Pressure regulating valves, (v) Direction control valves, two way, three way, four way valves. Solenoid operated valves, push button, lever control valves. (vi) Speed regulating Methods used in Pneumatics. (vii)

	Pneumatic actuators-rotary, reciprocating.(viii) Air motors- radial piston, vane, axial piston (ix) Basic pneumatic circuit, selection of components, (x) Application of pneumatics in low cost automation and in industrial automation. Introduction to vacuum and vacuum measurement, Vacuum pumps, types, introduction to vacuum sensors and valves. Industrial application of vacuum.		
	Practical		
	1)Design of Air distribution system in pneumatic system.2)Demonstration of Basic 04 Circuits on Pneumatic Trainer Kit.		
Unit-VI	System Design		
	Design of hydraulic/pneumatic circuit for practical application, Selection of different components such as reservoir, various valves, actuators, filters, pumps based on design. (Students are advised to refer manufacturers catalogues)		
	Practical		
	Industrial Visit to study Automation by means of Hydraulic & Pneumatic Systems.		
Text Books	**Author**	**Title of Book**	**Publication**
T1	Anthony Esposito	Fluid Power with applications	Prentice Hall
T2	S.R.Majumdar	Oil Hydraulic Systems	Tata McGraw Hill
Reference Books			
R1	J.J.Pipenger	Industrial Hydraulics	Tata McGraw Hill
R2	Pinches	Industrial Fluid Power	Prentice Hall
R3	D.A.Pease	Basic Fluid Power	Prentice Hall
R4	B.Lall	Oil Hydraulics	I.L.A.
R5	A.A.Parr	Hydraulics & Pneumatics	Elsevier Science & Tchnology Books
Self-Learning Facilities, Web Resources, Research papers for reference	Web sites of manufactures of Hydraulic & Pneumatic Systems,System Components		
Contents beyond Syllabus	Applications of H&P Systems for Heavy Duties.		
Additional Experiments	NIL		
Bridging Courses			

Tutorials	
Presentations	CD Presentations, PPT Presentations, Animations.

Course Title

Course Title: Skill Development		**Course Number: 302046**	**Course Code: C306**
Year: T.E.		**Semester: I**	
Designation of Course		Professional Core	
Teaching Scheme:2Hrs/Week Practical		**Tutorial:** Nil	
Course Assessment Methods	**Direct methods**	NA	NA
	Indirect Methods	Assignments	Term Work 50 Marks
Prerequisites	Economics, Basic Thermodynamics		
Course Objectives: Following concepts to be taught to the students,			
1	To develop the skill to assemble and disassemble machines.		
2	To have knowledge of the different tools used in machine assembly shop.		
3	To use theoretical knowledge in practice.		
4	To become familiar with the practical aspect of the each component in the assembly of the machine.		
Course Outcomes: At the end of this course the students should be able to			
CO1	use various tools required for assembly and dismantling		
CO2	demonstrate hardware skills such as soldering, welding etc		
CO3	execute market survey for available components		
CO4	maintain proper documentation of experimentation.		
CO5	Solve problems using contemporary software		
Course Contents			
	Term-Work		
	1) (Any Two) Following type of set up should be made available to the students for assemble and disassemble of the machine. Dismantling and assembly of mechanical system like IC engine, Machine Tool sub system, practical mechanisms etc. **OR** (Any Two) Skills in various processes involved in Mechanical systems like RAC equipments, Piping systems, Hydraulic & Pneumatic systems, Control systems, Automation systems etc. 2) Participation in National Level Technical Competition (excluding paper presentation) **OR** Any other type of skill acquired by the students, which will be very much useful for his employment. A. The assessment has to be carried out based on close monitoring of involvement and intellectual contribution of student. B. The student should maintain the record of work in the form of diary and has to be submitted at the end of semester. C. The batch teacher should assess the concerned student.		

Self-Learning Facilities, Web Resources, Research papers for reference	None
Contents beyond Syllabus	None
Additional Experiments	None
Bridging Courses	None
Tutorials	None
Presentations	None

Course Title

Course Title: Numerical Methods and Optimization		**Course Number: 302047**	**Course Code: C307**
Year: 2015		**Semester: II**	
Designation of Course		Professional Core	
Teaching Scheme: 4 Hrs/Week		**Practical: 2 hrs/week**	
Course Assessment Methods	**Direct methods**	In-semester Examination: 30 Marks	End Semester Examination: 70 Marks
			Practical exam: 50 marks
	Indirect Methods	Assignments	Quiz, Q&A session.
Prerequisites			
Course Objectives			
1	To develop the understanding of the physical problem, defining it in to a mathematical model, find the solution of the model and again interpret the solution into physical parameters.		
2	To understand the nature of error, and reduce it so as to achieve convergence.		
3	To understand the physical problem, optimize it as per the nature of the problem.		
4	To develop different algorithms based on the type of numerical method.		
5	To develop the understanding of the physical problem, defining it in to a mathematical model, find the solution of the model and again interpret the solution into physical parameters.		
Course Outcomes			
CO1	Students would be able to classify and effectively minimize the errors by reformulating the equations, setting specific criteria and creating good balance between higher order terms and number of iterations used.		
CO2	Students would be able solve an algebraic or transcendental equations and linear set of equations using appropriate numerical method.		
CO3	Students would be able optimize the specific design variable with the given set of constraints and by appropriate method.		
CO4	Students would be able choose an approximate polynomial function from a given set of data and finding its coefficients.		
CO5	Students would be able to select appropriate method and solve Integration, Ordinary Differential Equations and Partial Differential Equations.		
CO6	Students would be able to write simple algorithms for various numerical methods.		
Course Contents			
Unit-I	***Errors and Approximations and Roots of Equation***		
	Types of Errors: Absolute, Relative, Algorithmic, Truncation, Round off Error, Error Propagation, Concept of convergence-relevance to numerical methods. Bisection Method, False position Method, Newton Raphson method and Successive		

	approximation method.
	Practical/Tutorial
	Program on Roots of Equation (Validation by suitable solver , all four compulsory) a) Bisection Method, b) False position Method, c) Newton Raphson method d. Successive approximation method
Unit-II	**Simultaneous Equations**
	Gauss Elimination Method, Partial pivoting, Gauss-Seidal method and Thomas algorithm for Tridiagonal Matrix.
	Practical/Tutorial
	a) Gauss Elimination Method, b) Thomas algorithm for tridiagonal matrix, c) Gauss - Seidal method
Unit-III	**Optimization**
	Introduction to optimization, Classification, Constrained optimization: Graphical and Simplex method. One Dimensional unconstrained optimization: Newton‟s Method. Modern Optimization Techniques: Genetic Algorithm (GA), Simulated Annealing (SA).
	Practical/Tutorial
	--
Unit-IV	**Curve Fitting & Interpolation**
	Curve Fitting Least square technique- Straight line, Power equation, Exponential equation and Quadratic equation. ***Interpolation*** Lagrange„s Interpolation, Newton„s Forward interpolation, Hermit Interpolation, inverse interpolation.
	Practical/Tutorial
	Program on Curve Fitting using Least square technique (Validation by suitable solver, all four compulsory) a) Straight line, b) Power equation c) Exponential equation d) Quadratic equation Program on Interpolation(Validation by suitable solver, all three compulsory) a) Lagrange's Interpolation, b) Newton' s Forward interpolation, c) Inverse interpolation

Unit- V	**Numerical Integration**
	Trapezoidal rule, Simpson‟s Rule (1/3rd and 3/8th), Gauss Quadrature 2 point and 3 point method. Double Integration: Trapezoidal rule, Simpson's $1/3^{rd}$ Rule.
	Practical/Tutorial
	Program on Numerical Integration (Validation by suitable solver, all four compulsory) a) Trapezoidal rule, b) Simpson's Rules ($1/3^{rd}$, $3/8^{th}$) [In one program only] c) Gauss Quadrature Method - 2 point, 3 point. [In one program only] d) Double integration: Trapezoidal rule, Simpson's $1/3^{rd}$ Rule.
Unit-VI	**Numerical Solutions of Differential Equations**
	Ordinary Differential Equations [ODE] Taylor series method, Euler Method, Modified Euler Method(Iterative), RungeKuttafourth order Method, Simultaneous equations using RungeKutta2nd order method. ***Partial Differential Equations [PDE]: Finite Difference methods*** Introduction to finite difference method, PDEs- Parabolic explicit solution, Ellipticexplicit solution.
	Practical/Tutorial
	Program on ODE(Validation by suitable solver, all three compulsory) a) Euler Method(Iterative), b) Runge - Kutta Methods - fourth order, c) Simultaneous equations.(Runge - Kutta 2nd order: One step only).

Text Books	**Author**	**Title of Book**	**Publication**
T1	Steven C. Chapra, Raymond P. Canale	Numerical Methods for Engineers	Tata McGraw Hill
T2	Dr. B. S. Garewal	Numerical Methods in Engineering and Science	Khanna
T3	Rao V. Dukkipati	Applied Numerical Methods using Matlab	New Age International
Reference Books			
R1	Gerald and Wheatley	Applied Numerical Analysis	Pearson Education Asia
R2	E. Balagurusamy	Numerical Methods	Tata McGraw Hill
R3	P. Thangaraj	Computer Oriented Numerical Methods	PHI
R4	S. S. Sastry	Introductory Methods of Numerical Analysis	PHI

Self-Learning Facilities, Web Resources, Research papers for reference	Nil
Contents beyond Syllabus	Modified Newton Raphson method
Additional Experiments	None
Bridging Courses	None
Tutorials	None
Presentations	None

Course Title

Course Title: Design of machine elements II		**Course Number: 302048**	**Course Code: C308**
Year: T		**Semester: I**	
Designation of Course		Professional Core	
Teaching Scheme: 4 Hrs/Week		**Practical: 2 hrs/week**	
Course Assessment Methods	**Direct methods**	In-semester Examination:30 Marks	End Semester Examination: 70 Marks
		Oral: 50 marks	Term Work: 25 marks
	Indirect Methods	Assignments	Class test
Prerequisites			
Course Objectives: Design of machine elements I, Strength of materials, Engg. Mechanics			
1	To develop an ability to design a system, component to meet desired needs within realistic constraints.		
2	To apply codes and standards to design machine component.		
3	To develop an ability to select various machine components from manufacturer's catalogues with some preliminary investigation.		
4	To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.		
Course Outcomes			
CO1	Students will be able to design spur gears based on standard criteria like beam strength, wear strength and dynamic load		
CO2	Students will be able to design helical and bevel gears based on standard criteria like beam strength, wear strength and dynamic load		
CO3	Students will be able to select suitable rolling contact bearings from manufacturer's catalogue based on load and bearing life.		
CO4	Students will be able to design worm gears based on standard criteria like beam strength, wear strength and thermal consideration.		
CO5	Students will be able to apply theory of hydrodynamic lubrication and evaluate relevant parameters leading to bearing design and selection.		
CO6	Students will be able to select V-belt drive from manufacturer's catalogue based on power and speed requirement and describe usage of rope and chain drives.		
Course Contents			
Unit-I	**Spur gears**		
	Gear Drives: Classification of gears, Selection of types of gears, Selection of materials for gears, Standard systems of gear tooth, Basic modes of gear tooth failures, Gear Lubrication Methods. Spur Gears: Number of teeth and face width, Types of gear tooth failure, Desirable properties and selection of gear material, Constructional details of gear wheel, Force analysis (Theoretical Treatment only), Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor,		

	Effective load on gear, Wear strength (Buckingham's) equation, Estimation of module based on beam and wear strength, Estimation of dynamic tooth load by velocity factor and Buckingham's equation.
	Practical/Tutorial
Unit-II	**Helical and Bevel gears**
	Helical Gears: Transverse and normal module, Virtual no of teeth, Force analysis (Theoretical Treatment only), Beam and wear strengths, Effective load on gear tooth, Estimation of dynamic load by velocity factor and Buckingham's equation, Design of helical gears. Bevel Gears: Straight tooth bevel gear terminology and geometric relationship, Formative number of teeth, Force analysis (Theoretical Treatment only), Design criteria of bevel gears, Beam and wear strengths, Dynamic tooth load by Velocity factor and Buckingham's equation, Effective load, Design of straight tooth bevel gears.
	Practical/Tutorial
Unit-III	**Rolling Contact bearings**
	Types of rolling contact Bearings, Static and dynamic load carrying capacities, Stribeck's Equation, Equivalent bearing load, Load-life relationship, Selection of bearing life Selection of rolling contact bearings from manufacturer's catalogue, Design for cyclic loads and speed, bearing with probability of survival other than 90%. Lubrication and mounting of bearings, Preloading of rolling contact bearings, Types of failure in rolling contact bearings – causes and remedies.
	Practical/Tutorial
Unit-IV	**Worm and work wheel**
	Worm and worm gear terminology and geometrical relationship, Types of worm and worm gears, Standard dimensions, Force analysis of worm gear drives, Friction in Worm gears and its efficiency, Worm and worm-wheel material, Strength and wear ratings of worm gears, Thermal consideration in worm gear drive, Types of failures in worm gearing, Methods of lubrication.
	Practical/Tutorial
Unit- V	**Belt, rope and chain drives**
	Belt drive: Materials and construction of flat and V belts, geometric relationships for length of belt, power rating of belts, concept of slip & creep, initial tension, effect of centrifugal force, maximum power condition, selection of flat and V belts from manufacturer's catalogue, belt tensioning

	methods, relative advantages and limitations of flat and V belts, construction and applications of timing belts. Wire Ropes (Theoretical Treatment Only): Construction of wire ropes, lay of wire ropes, stresses in wire rope, selection of wire ropes, rope drum construction and design. Chain Drives (Theoretical Treatment Only): Types of power transmission chains, Geometry of Chain, Polygon effect of chain, Modes of failure for chain, Lubrication of chains
	Practical/Tutorial
Unit-VI	**Sliding contact bearings**
	Lubricating oils: Properties, additives, selection of lubricating oils, Properties & selection of bearing materials. Hydrodynamic Lubrication: Theory of Hydrodynamic Lubrication, Pressure Development in oil film, 2D Basic Reynolds Equation, Somerfield number, Raimondi and Boyd method, Temperature Rise, Parameters of bearing design, Length to Diameter ratio, Unit bearing Pressure, Radial Clearance, minimum oil film thickness.
	Practical/Tutorial
	Term work shall consist of 1. One design project based on either Design of a Two Stage Gear Box (the two stages having different types of gear pair) or single stage worm gear box. The design project shall consist of two full imperial (A1) size sheets involving assembly drawing with a part list and overall dimensions and drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary to achieve selection of standard components.

Text Books	**Author**	**Title of Book**	**Publication**
T1	Shigley J.E. and Mischke C.R	Mechanical Engineering Design	McGraw Hill
T2	Spotts M.F. and Shoup T.E.	Design of Machine Elements	Prentice Hall International
T3	Bhandari V.B	Design of Machine Elements	Tata McGraw Hill
T4	Juvinal R.C	Fundamentals of Machine Components Design	John Wiley and Sons
Reference Books			

R1	Black P.H. and O. Eugene Adams	Machine Design	McGraw Hill Book Co. Inc
R2	Willium C. Orthwein	Machine Components Design	West Publishing Co
R3	PSG Tech Coimbatore	Design Data book	
R4	P. C. Gope	Machine Design: Fundamentals and Applications	PHI Learing Pvt. Ltd
R5	K. Mahadevan, K. Balveera Reddy	Design Data book	CBS
Self-Learning Facilities, Web Resources, Research papers for reference	Nil		
Contents beyond Syllabus	Design of gear box casing		
Additional Experiments	None		
Bridging Courses	None		
Tutorials	None		
Presentations	None		

Course Title

Course Title: Turbo Machines		**Course Number: 302049**	**Course Code: C309**
Year: TE		**Semester: I**	
Designation of Course		Professional Core	
Teaching Scheme: 4 Hrs/Week		**Tutorial:** --	
Course Assessment Methods	**Direct methods**	On-line/In-semester Examination: 30 Marks	End Semester Examination: 70 Marks
			Term Work: 25 marks
	Indirect Methods	Assignments	End of topic Oral Exam
Prerequisites	Concepts of compressible and incompressible fluid flow, Basics of applied thermodynamics, Fluid Mechanics, concept of mass and energy conservation, velocity, acceleration, force and energy, Integral calculus and Differential equations. Newton's laws of motion.		
Course Objectives			
1	Provide students with opportunities to apply basic flow equations like mass conservation, energy conservation equations.		
2	Train the students to acquire the knowledge and skill of analyzing different turbo machines.		
3	How to compare and chose machines for various operations		
Course Outcomes			
CO1	Ability to apply basic conservation of mass and momentum equations, Impulse-momentum principle		
CO2	Design and calculate different parameters for turbo machines		
CO3	Ability to choose the turbo machine as per requirements		
CO4	Ability to understand thermodynamics and kinematics behind turbo machines		
Course Contents			
Unit-I	***Introduction to Turbo Machinery***		
	Impulse momentum principle and its applications, Force excreted on fixed plate, moving flat plate and curved vanes, series of plates, velocity triangles and their analysis, work done equations , efficiency.		
	Impulse Water Turbines		
	Pelton wheel- construction, principle of working, velocity diagrams and analysis, design aspects,governing and performance characteristics, specific speed, selection of turbines, multi-jet.		
	Practical/Tutorial		
	4. Verification of impulse momentum principle 5. Study and trial on pelton wheel and plotting of main / operating characteristics		
Unit-II	***Reaction Water Turbines***		
	Classifications, Francis, Propeller, Kaplan Turbines, construction features,		

	velocity diagrams andn analysis, DOR, draft tubes- types and analysis, cavitations causes and remedies, specific speed,performance characteristics and governing of reaction turbines, selection of turbines.
	Practical/Tutorial
	Study and trial on any one reaction turbine and plotting of main/operating characteristics
Unit-III	***Steam Turbines***
	Steam nozzles: types and applications, Equation for velocity and mass flow rate [No numerical treatment].Steam Turbines: Classifications (Axial and Radial), construction details, compounding of steam turbines,velocity diagrams and analysis of Impulse and reaction turbines (single & multi stage), governing,performance characteristics.
	Practical/Tutorial
	Study of different types of nozzles Study of multi-staging of steam turbines Visit to hydro/steam turbine power plant
Unit- IV	***Centrifugal Pumps***
	Classification of rotodynamic pumps, components of centrifugal pump, types of heads, velocity triangles and their analysis, effect of outlet blade angle, cavitation, NPSH, Thoma"s cavitation factor, priming of pumps, installation, specific speed, performance characteristics of centrifugal pump, series and parallel operation of pumps, system resistance curve, selection of pumps.
	Practical/Tutorial
	Study and trial on centrifugal pump and plotting of operating characteristics
Unit-V	***Centrifugal Compressor***
	Classification of rotodynamic compressors, blowers, fans. Centrifugal compressor: Construction, flow process on T-S Diagram, velocity diagram and Euler's work, slip factor and its effect on work input,actual work input, dimension parameters, pre-whirl losses, surging, choking, stalling characteristics.
Unit-VI	***Axial Compressor***
	Construction, stage velocity triangles and its analysis, enthalpy entropy diagram, dimensionless parameters, flow through the blade rows, pressure rise across the stage, stage losses and efficiencies,performance characteristics.
	Practical/Tutorial
	Study of axial flow compressors/ centrifugal air blower

Text Books	**Author**	**Title of Book**	**Publication**
T1	Dr. R.K. Bansal	Fluid Mechanics and Hydraulic Machines	
T2	S.M. Yahya	Turbines, Compressors & Fans,	Tata-McGraw Hill

Reference Books			
R1	V.P. Vasandani	Theory of Hydraulic Machinary	Khanna Publishers, Delhi
R2	Modi P N & Seth S N	Hydraulics, Fluid Mechanics and Machinery	Standard Book House ,New Delhi.
R3	Karassik	Hand Book of Pumps	Tata McGraw Hills Ltd., New Delhi
Self-Learning Facilities, Web Resources, Research papers for reference	None		
Contents beyond Syllabus	None		
Additional Experiments	None		
Bridging Courses	None		
Tutorials	None		
Presentations	None		

Course Title

Course Title: Mechatronics		**Course Number: 302050**	**Course Code: C310**
Year: THIRD YEAR(T.E.)		**Semester: I**	
Designation of Course		Professional Core	
Teaching Scheme: 03 Hrs./Week (Theory),02Hrs\Week (Practical)		**Tutorial:** NIL	
Course Assessment Methods	**Direct methods**	In-semester Examination: 30 Marks	End Semester Examination: 70 Marks
			Term Work
	Indirect Methods	Assignments, Presentations	Seminars, Q&A session, Class Test, Group Discussion.
Prerequisites	Knowledge of PHYSICS, BASIC MATHEMATICS.		
Course Objectives			
1	Understand key elements of Mechatronics system, representation into block diagram.		
2	Understand concept of transfer function, reduction and analysis		
3	Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller		
4	Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application		
5	Understand control actions such as Proportional, derivative and integral and study its significance in industrial applications		
Course Outcomes			
CO1	Identification of key elements of mechatronics system and its representation in terms of block diagram.		
CO2	Effectively apply principles of signal processing and interfacing systems such as ADC, DAC, digital I/O.		
CO3	Interfacing of Sensors, Actuators using appropriate DAQ micro-controller		
CO4	PID control implementation on real time systems		
CO5	Development of PLC ladder programming and implementation of real life system.		
Course Contents			
Unit-I	**Introduction to Sensors & Actuators**.		
	• Introduction to Mechatronics, Measurement characteristics: - Static and Dynamic. • **Sensors:** Position Sensors: - Potentiometer, LVDT, Encoders; Proximity sensors:- Optical, Inductive, Capacitive; Motion Sensors:- Variable Reluctance; Temperature Sensor: RTD, Thermocouples; Force / • **Actuators:** Stepper motor, Servo motor, Solenoids Comparators: Mechanical, Pneumatic, Optical, Electrical (LVDT).Checking all geometrical		

	forms
	Assignment
	• Assignment on measurement system.
	Practical
	1. Measurement of Load / Force using Load Cell*(Estimation of unknown weight using above voltage characteristics). 2. Measurement of Temperature: Thermocouple, Thermistor & RTD and comparative analysis (estimation of sensitivity). 3. Measurement of displacement using LVDT characteristics
Unit-II	**Block Diagram Representation**
	• Open and Closed loop control system, identification of key elements of mechatronics systems and represent into block diagram (Electro-Mechanical Systems). • Concept of transfer function, Block diagram reduction principles, Applications of mechatronics systems:- Household, Automotive, Shop floor (industrial).
	Assignment
	Assignment on Block diagram reduction principle
Unit-III	**Data Acquisition & Microcontroller System**
	Interfacing of Sensors / Actuators to DAQ system, Bit width, Sampling theorem, Aliasing, Sample and hold circuit, Sampling frequency, ADC (Successive Approximation), DAC (R-2R), Current and Voltage Amplifier.
	Assignment
	Assignment on sampling theorem.
Unit-IV	**PLC Programming**
	Introduction, Architecture, Ladder Logic programming for different types of logic gates, Latching, Timers, Counter, Practical Examples of Ladder Programming, Introduction to SCADA system
	Assignment
	Assignment on Logic gates and Ladder diagram
	Practical
	• PLC control system: - ladder logic implementation on real time system. • Ladder Diagram development for different types of Logic Gates using suitable Software
Unit- V	**Modelling and Analysis of Mechatronics System**
	• System modeling (Mechanical, Thermal and Fluid), Stability Analysis via identification of poles and zeros. • Time Domain Analysis of System and estimation of Transient characteristics: % Overshoot, damping factor, damping frequency,

	Rise time. • Frequency Domain Analysis of System and Estimation of frequency domain parameters such as Natural Frequency, Damping Frequency and Damping Factor.		
	Assignment		
	Assignment on Time domain and Frequency domain analysis.		
Unit-VI	**Control System**		
	P, I and D control actions, P, PI, PD and PID control systems, Transient response:- Percentage overshoot, Rise time, Delay time, Steady state error, PID tuning (manual).		
	Assignment		
	Assignment on PID Control system.		
	Practical		
	• Real Time Temperature / Flow Control using PID Control system. • PID Control Implementation on DC Motor Speed Control System		
Text Books	**Author**	**Title of Book**	**Publication**
T1	K.P. Ramchandran.	Mechatronics: Integrated Mechanical Electronic Systems	Willey Publication
T2	Bolton	Mechatronics - A multidisciplinary approach	Prentice Hall
Reference Books			
R1	Alciatore &Histand	Introduction to Mechatronics and Measurement system	Mc- Graw Hill publication
R2	Bishop	Mechatronics – An Introduction	CRC Press
R3	Mahalik	Mechatronics – Principles, concepts and applications	Tata Mc-Graw Hill publication.
Self-Learning Facilities, Web Resources, Research papers for reference	Web sites of Mechatronics, PLC, PID.		
Contents beyond Syllabus	NIL		
Additional Experiments	NIL		
Bridging Courses	NIL		
Tutorials	NIL		
Presentations	CD Presentations, PPT Presentations.		

Course Title

Course Title: MP II		**Course Number: 302051**	**Course Code: C311**
Year: 2016-17		**Semester: II**	
Designation of Course		Professional Core	
Teaching Scheme: 4 Hrs/Week		**Tutorial:**	
Course Assessment Methods	**Direct methods**	In-semester Examination: 30 Marks	End Semester Examination: 70 Marks
	Indirect Methods	Assignments	Quiz, Q&A session
Prerequisites	Basic Mechanical Engineering Mathematics		
Course Objectives			
1	To analyze and understand the metal cutting phenomenon		
2	To select process parameter and tools for obtaining desired machining characteristic		
3	To understand design of manufacturing processes.		
4	To analyze the effect of process parameter with respect to defined process characteristics.		
5	To evaluate the role of manufacturing process in industry		
Course Outcomes			
CO1	Student should be able to identify various process parameters and their effect on processes.		
CO2	Student should be able to identify various process parameters and their effect on processes.		
CO3	Student should be able to design and analyze various manufacturing processes and tooling.		
CO4	Student should be able to figure out application of modernization in machining.		
CO5	Students should get the knowledge of Jigs and Fixtures so as to utilize machine capability for variety of operations.		
Course Contents			
Unit-I	Machine tools and their applications Drilling machine: Types of drills and operations. Twist drill geometry, Types of drilling machine Tool holder. Milling machine: Types of milling machines, Cutter types and geometry and their applications. Universal dividing head, methods of Indexing: Simple, Compound Differential Numericals based on indexing. Calculation of machining time for Drilling and Milling processes (Numericals) Broaching: Introduction to broaching, Broach tool geometry, Types of broaching machines and operations. Planner and Boring Machines.(Introduction and types)		

	Practical/Tutorial
	Numericals based on indexing of milling operations Numericals based on calculation of machining time for drilling & milling operations
Unit-II	
	Grinding and Finishing processes Grinding machines : Introduction, Types and Operations of grinding machines, Sequencing of grinding operations Grinding wheel : Shapes, Designation and selection, Mounting , Balancing and Dressing of grinding wheels, Maximum chip size determination, Machining time calculation for cylindrical and plunge grinding (Numericals). Superfinishing processes : Introduction to Honing, Lapping, Buffing and Burnishing. (Construction, working and controlling parameters)
	Practical/Tutorial
	Numericals based on calculation of machining time for cylindrical & plunge grinding
Unit-III	
	Theory of Metal cutting Single point cutting tool : Tool geometry, Mechanics of shearing (orth ogonal and oblique), Shear plane angle, Shear stress, strain and Shear strain rate. Process parameters and their effect on cutting forces. Merchant's circle of forces (graphical and analytical) : Estimation of shear force, Normal shear force, Friction force Normal friction force, Material Removal Rate (MRR), Cutting power estimation, Calculation of Total power and Specific energy. Measurement of cutting forces by tool dynamometer for turning, drilling, milling and grinding operations. Machinability : Factors affecting machinability Tool life Tool wear, Types of tool wear and remedial actions, Cutting fluid and their types, Effect of process parameters on tool life, Taylor's tool life relation (Derivation along with numerical). Economics of machining: Optimum cutting speed for maximum production rate, Optimum cutting speed for minimum cost (Numerical)
	Practical/Tutorial
	Numericals based on Merchant's circle of forces for calculations of various parameters

	Numericals based on Taylor's tool life equation for evaluation of tool life. Numericals based on economics of machining for calculation of various costs associated with machining.
Unit-IV	
	Advanced Machining Processes : Introduction, classification of advanced machining processes. Principles, Working, Process Parameters, Estimation of MRR (simple numerical), Advantages, Limitations and Application for following processes: Electric Discharge Machining (EDM), LASER Beam Machining (LBM), Abrasive Jet Machining (AJM), Ultra Sonic Machining (USM) and Electro Chemical Machining (ECM)
	Practical/Tutorial
	Numericals based on estimation of material removal rate for advanced machining processes.
Unit- V	
	NC/DNC Technology : CNC Technology Introduction, Construction and working of CNC, DNC and machining center. CNC axes and drives. Automatic Tool Changer (ATC) and Automatic pallet changer (APC) CNC Tooling: New t rends in Tool Materials, Turning tool geometry (ISO 1832 Coding system), Tool inserts (coated and uncoated), Modular tooling system for Turning. Milling tooling systems, Tools presetting, Work holding. CNC Programming: Word address format (WAF) ISO Standard, G & M codes, Type of CNC Control systems, Manual part programming, Subroutine, Canned cycles .
	Practical/Tutorial
	Manual part programming for the given component on CNC machine.
Unit-VI	
	Jigs and fixtures : Concept of degree of freedom, 3 -2-1 principle of location, General guidelines to design Jigs and fixtures advantages of jig and fixtures Jigs: Definition. Elements of jig with the types, Location guidelines, Principles of clamping, Principles of guiding element, Channel jig, Template jig, Plate jig, Angle plate jig, Turn over jig, Box jig, Latch type jig. Fixtures: Definition. Elements of fixtures, Location guidelines, Principles of clamping, Principles of setting element, Turning fixture, Welding fixture, Milling fixture, Assembly and Inspection fixtures. Indexing methods, Power work holding devices with their advantages Concept, elements and advantages of modular fixture Pokayoke concept in jigs and fixtures

	.		
	Practical/Tutorial		
	Design & drawing of different types of jigs & fixtures for the given component.		
Text Books	**Author**	**Title of Book**	**Publication**
T1	P. C. Sharma	Production Engineering	S Chand Publication
T2	Mikell. P. Grover	Fundamentals of Modern Manufacturing	Pearson Publications
Reference Books			
R1	HMT	Production technology	Tata McGraw Hill publication
R2	M.C Shaw	Metal Cutting Principles	Oxford university press
R3	Gary F. Benedic	Non- traditional manufacturing processes	Marcel Dekker Inc.
R4	M. H. A Kempster	An Introduction to Jig and Tool Design	ELBS
R5	P. N. Rao	CAD/CAM Principles and Applications	McGraw Hill Education, Third Edition.
Self-Learning Facilities, Web Resources, Research papers for reference	Nil		
Contents beyond Syllabus	Advancements in current generators in wire EDM process and CNC machining		
Additional Experiments	None		
Bridging Courses	None		
Tutorials	None		
Presentations	None		

Course Title

Course Title: MACHINE SHOP II		**Course Number: 302052**	**Course Code: C312**
Year: TE		**Semester: II**	
Designation of Course		Professional Core	
Teaching Scheme: Lectures : None		**Practical: 2 hrs/week**	
Course Assessment Methods	**Direct methods**		
			Term Work: 25 Marks
	Indirect Methods		
Prerequisites	Machine Shop I		
Course Objectives			
1	To set the manufacturing set up appropriately and study the corresponding set up parameters.		
2	To select appropriate process parameter for obtaining desired characteristic on work piece.		
3	To understand the operational problems and suggest remedial solution for adopted manufacturing process.		
4	To recommend appropriate part manufacturing processes when provided a set of functional requirements.		
5	To be able to examine a product and determine how it was manufactured		
Course Outcomes			
CO1	Student will acquire knowledge about the working and programming techniques for various machines and tools		
CO2	Students will be able to deploy modern production techniques including numerical and programming capabilities of the machine tools		
Course Contents: This subject has only Practicals (2 hrs/week)			
	Two jobs (Both the following jobs should be completed individually) a. Anyone marketable assembly consisting of at least three components involving use of lathe, drilling, milling, grinding and any additional machine tool or processes as per requirement. B .Development and execution of one simple turning job on CNC (Trainer) machine.		
	Journal consisting of following assignments. a. Report based on industrial visit to gear or thread manufacturing b. Two views of at least one jig and a fixture designed, for the simple component on a half empirical sheet.(manual drafting) c. Process planning sheets for job 1.a and 1.b.		

Self-Learning Facilities, Web Resources, Research papers for reference	None
Contents beyond Syllabus	None
Additional Experiments	None
Bridging Courses	None
Tutorials	None
Presentations	None

Couse Title

Course Title: Seminar		**Course Number: 302053**	**Course Code:C313**
Year: TE		**Semester: II**	
Designation of Course		Professional Core	
Teaching Scheme: **Practical** 2 Hrs/Week		**Tutorial:** None	
Course Assessment Methods	**Direct methods**	Oral: 50 Marks	
	Indirect Methods	Mock Presentations	
Prerequisites			
Course Objectives			
1	To encourage students to identify a niche area of their interest.		
2	To inculcate habit of searching various sources of information (including internet) to get variety of information relating to that topic.		
3	To study topic related information, put together a meaningful presentation and prepare a seminar report in prescribed format.		
4	To make a presentation to examiners and answer the questions asked.		
5			
Course Outcomes			
CO1	Ability to recognize area of one's own interest and collect relevant information		
CO2	Ability to study and analyse information, eventually leading to a seminar report in standard format and meaningful presentation.		
CO3	Ability to make an effective presentation and handle the questions asked by examiners.		
Course Contents **The Seminar topic must be related to one of the following** 1. Mechanical Engineering 2. Interdisciplinary subjects 3. Recent trends in Engineering			
Self-Learning Facilities, Web Resources, Research papers for reference	Large number of research papers /standard journals are available in library. Internet facility is also available in library.		
Contents beyond Syllabus	Not Applicable		
Additional Experiments	Not Applicable		

Bridging Courses	Not Applicable
Tutorials	Not Applicable
Presentations	During mock oral the students will make their presentations.