Marathwada Mitra Mandal's College of Engineering

Karvenagar, Pune- 52

An Autonomous Institute Affiliated to SPPU

Curriculum for

Third Year B. Tech Mechanical Engineering

A.Y. 2026-27

Permanently Affiliated to SPPU | Accredited with A++ grade by NAAC
Recipient of Best College award by SPPU | Accredited by NBA
Recognized under 2(f) and 12(B) of UGC Act 1956
www.mmcoe.edu.in

CONTENTS

Institute Vision

To be a globally renowned institution through excellence in engineering education for sustainable and holistic development

Institute Mission

M1: Empower students with cutting-edge technologies and global competencies

M2: Foster culture of research and entrepreneurial mindset

M3: Imbibe social and professional values

M4: Provide an inclusive environment for lifelong learning

Department Vision

To develop globally competent and socially committed mechanical engineers

Department Mission

Our Mission is to

1.Develop competent professionals through center of excellence

2.Strengthen industry-academia collaboration for ethically responding real-world problems

3.Provide an inclusive environment for entrepreneurship, research and innovation.

4. Empower students for higher education and lifelong learning

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.(WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.(WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Educational Objectives (PEO)

Graduates from our program will:

1. Apply professional skills for solving the problems in mechanical engineering & related fields.
2. Demonstrate ethics and concern for society and the environment.
3. Embrace lifelong learning through higher studies, research and innovation.

Program Specific Outcomes (PSOs)

Graduates from our program will:

PSO-I: Apply advanced technologies of mechanical and allied engineering to address the challenges faced in Industry 4.0.

PSO-II: Contribute to the project in the core and associated domain by using add-on skills like CAD, CAM and CAE.

PSO-III: Develop the ability to innovate socially relevant products and systems by effectively utilizing resources.

Abbreviations	
BSC:	Basic Science Course
UG:	Undergraduate Programme
ESC:	Engineering Science Course
PCC:	Program Core Courses
PEC:	Program Elective Courses
MDM:	Multidisciplinary Minor Courses
OEL:	Open Elective
VSE:	Vocational & Skill Enhancement Course
AEC:	Ability Enhancement Course
EEM:	Entrepreneurship/Economics/Management
IKS:	Indian Knowledge System
VEC:	Value Education Course
RMD:	Research Methodology
CEP/FPR:	Comm. Eng. Project (CEP)/Field Project (FP)
PRJ:	Project
INT/OJT:	Internship/On-Job Training
CCC:	Co-Curricular Courses
IT:	Internal Tool
ET:	External Tool
ETE:	End –Term Examination
CIE:	Continuous Internal Evaluation
TW:	Term work
OR:	Oral Examination
PR:	Practical Examination
L:	Lecture
P:	Practical
T:	Tutorial
OL:	Online Teaching
ODL:	Open Distance Learning

Assessment Tool Guidelines for Continuous Internal Evaluation (CIE)

AY: 2026-27

Distribution of CIE 40 marks for each subject is as below:

<table>
<tr><th>Sr. No.</th><th>Unit No.</th><th>Weightage</th><th>Assessment Tools</th></tr>
<tr><td>1</td><td>Unit 1</td><td>8 Marks</td><td rowspan="2">Class Test</td></tr>
<tr><td>2</td><td>Unit 2</td><td>8 Marks</td></tr>
<tr><td>3</td><td>Unit 3</td><td>8 Marks</td><td rowspan="3">1. Quizzes
2. Home Assignments
3. Case Study
4. Field work
5. Report writing
6. Presentations/Seminar Topics
7. Mini projects/Course Projects
8. Mind map
9. Poster Presentation
10. Problem Solving and Coding
11. Parametric Study
12. Any other assessment tool with permission of BoS chairperson</td></tr>
<tr><td>4</td><td>Unit 4</td><td>8 Marks</td></tr>
<tr><td>5</td><td>Unit 5</td><td>8 Marks</td></tr>
</table>

1. Above are the suggestive assessment tools for CIE.
2. The class test is a one-time assessment; no retests will be conducted
3. Module coordinators should review and verify the assessment tools implemented for each course.
4. Course coordinators are required to maintain softcopy records of the respective CIE assessment tools used for their classes.

Curriculum Structure Sem-V

Third Year B.Tech Mechanical Engineering Semester-V																	
Course Code	Course Name	Course Type	Teaching Scheme (Hrs/week)				Examination Scheme						Credits				
			L	P	T	ODL	CIE	ETE	TW	PR	OR	Total	L	P	T	ODL	Total
ME24PCC301	Numerical Methods and Optimization	PCC	3		-	-	40	60	-		-	100	3		-	-	3
ME24PCC302	Design of Machine Elements	PCC	3		-	-	40	60	-		-	100	3		-	-	3
ME24PCC312	Heat Transfer	PCC	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ME24PEC304A	1. Digital Manufacturing	PEC	3	-	-	-	40	60	-	-	-	100	3	-	-	-	3
ME24PEC304B	2. Non-Traditional Machining Process																
ME24PEC304C	3. Advance Engineering Materials																
ME24MDM305	Smart Fluid Power	MDM	3	-	-	-	40	60		-	-	100	3	-	-	-	3
ME24PCC306	Numerical Methods and Optimization Lab	PCC	-	2	-	-	-	-	-	50	-	50	-	1	-	-	1
ME24PCC307	Design of Machine Elements Lab	PCC	-	2	-	-	-	-	-	50	-	50	-	1	-	-	1
ME24PCC308	Engineering Design and Innovation-I	PCC	-	4	-	-	-	-	25	-	-	25	-	2	-	-	2
ME24MDM309	Smart Fluid Power Lab	MDM	-	2	-	-	-	-	25			25		1	-	-	1
ME24OEL310	Workplace Ethics in German Language	OEL	2	-	-	-	-	-	50	-	-	50	2	-	-	-	2
ME24AEC311	Reasoning and Aptitude Development	AEC	-	-	1	-	-	-	25	-	-	25	-	-	1	-	1
Total			17	10	1	-	200	300	125	100	-	725	17	5	1	-	23

L- lecture P- Practical T- Tutorial CIE-Continuous Internal Evaluation

ETE- End Term Examination TW- Term work PR- Practical OR- Oral

L : 1 Hr.= 1 credit P: 2 Hr. = 1 Credit T: 1 Hr. = 1 Credit

SEMESTER V

Third Year B. Tech Mechanical Engineering

Semester-V

Course Code: ME24PCC301 **Course Name: Numerical methods and Optimization**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3

Prerequisite: Engineering Mathematics - I and II, Algebra, Statistics and Programming, Engineering Physics

Course Objectives:

After learning the course, the students will be able to:

- UNDERSTAND applications of systems of equations and solve mechanical engineering applications
- APPLY differential equations to solve the applications in the domain of fluid mechanics, structural etc
- COMPARE the system's behavior for the experimental data.
- INTERPRET Statistical measures for quantitative data.
- Optimize the solution for different real-life problems with available constraints.

Course Outcomes:

After learning the course, the students will be able to:

CO1: SOLVE system of equations using direct and iterative numerical methods

CO2: ESTIMATE solutions for differential equations using numerical techniques.

CO4: DESIGN and CREATE a model using a curve fitting and regression analysis.

CO5: APPLY statistical Technique for quantitative data analysis.

CO5: 4. Generate Solutions for real life problem using optimization techniques.

Unit	Contents	Duration (Hrs.)
1	**Solution of simultaneous equations** Gauss Elimination Method with Partial pivoting, Gauss Seidel method, Thomas algorithm for Tri-diagonal Matrix, Flow charts for all methods.	7
2	**Ordinary Differential Equations [ODE]:** Euler Method, Runge-Kutta 4th order. Simultaneous equations using Runge-Kutta 2nd order method. **Partial Differential Equations [PDE]:** Finite difference method, Simple Laplace method, PDE's Parabolic explicit solution, Elliptic explicit solution.	8
3	**Curve Fitting:** Least square technique- first order, power equation, exponential equation and quadratic equation. **Regression Analysis:** Linear regression, Nonlinear regression, Multiple regressions, Polynomial regression. Numerical interpolation, and differentiation using Newton's forward method, inverse interpolation (Lagrange's method only)	8
4	**Statistics:** Measures of central tendency: mean, median, mode. Measurement of variability and dispersion: Standard deviation, standard error, variance, range. Measure of shape: skewness, kurtosis Statistical diagram, Correlation: Karl Pearson's Coefficient of correlation and its mathematical properties, Spearman's Rank correlation and its interpretations.	8

5	**Optimization:** Introduction to Optimization, Constrained Optimization (Maximum two constrains): Graphical and Simplex Method, One Dimensional constrained optimization: Newtons Method Modern Optimization Techniques: Genetic Algorithm (GA), Simulation Annealing	8
	Total Hours	**39 Hrs.**

Text Books

1. Steven C. Chapra, 'Applied Numerical Methods with MATLAB for Engineers and Scientist', Tata Mc-Graw Hill Publishing Co. Ltd.
2. B. S. Grewal, 'Numerical Methods in Engineering and Science', Khanna Publication
3. Advanced Engineering Mathematics by S.R.K. Iyengar, Rajendra K. Jain, 4e, Alpha Science International, Ltd ISBN 1-84265-086-6.
4. Higher Engineering Mathematics by B. S. Grewal, 43e, Khanna Publication, Delhi ISBN 1-84265-086- 6

Reference Books

1. Advanced Engineering Mathematics by C. R. Wylie, McGraw Hill Publications, New Delhi. ISBN-13978-0070722064
2. Kreyszig Erwin, "Advanced Engineering Mathematics", 10th edition, Wiley Eastern Limited 2015 ISBN: 9788126554232

Online References

1. NPTEL Course: Prof. Kaushik Bal IIT Kanpur, "Ordinary Differential Equations" https://nptel.ac.in/courses/111104521
2. NPTEL Course: Prof. Ameeya Kumar Nayak Prof. Sanjeev Kumar, IIT Roorkee Numerical Methods: https://nptel.ac.in/courses/111107105
3. NPTEL Course: Prof. Hari Shankar Mahato, IIT Kharagpur, Multiple Integral: https://nptel.ac.in/courses/111105122

Third Year B.Tech Mechanical Engineering

Semester- V

Course Code: ME24PCC302 **Course Name: Design of Machine Elements**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3

Prerequisite: Engineering Mathematics, Solid Mechanics, Engineering Metallurgy, Solid Modeling

Course Objectives:

After learning the course, the students will be able to:

- To understand the various design considerations, design procedure and select materials for a specific application
- To calculate the stresses in machine components due to various types of loads and failure
- To analyze machine components subjected to variable loading for finite and infinite life
- To design various machine components such as shafts, couplings, keys, screws, joints, springs

Course Outcomes:

After learning the course, the students will be able to:

CO1: Calculate dimensions of cotter and knuckle Joints, levers and components subjected to eccentric loading.
CO2: Design shafts, keys and couplings under static loading conditions.
CO3: Evaluate dimensions of machine components under fluctuating loads.
CO4: Design power screws and different type of threaded joints and Welded joints
CO5: Apply the design and development procedure for different types springs.

Unit	Contents	Duration (Hrs.)
1	**Unit I: Fundamental aspect of design** Theories of failures, Phases of design, Factor of safety, Design of Cotter joint, knuckle joint, Design of levers, Design of components subjected to eccentric loading.	7
2	**Unit II: Design of Shaft, Key & Coupling** Shaft design on the Strength basis, torsional rigidity basis and lateral rigidity basis, Design of shaft as per A.S.M.E. code. Design of square and rectangular keys, Design of splines. Design of Flange Coupling and Bushed-Pin Flexible Coupling.	8
3	**Unit III: Design against Fluctuating loads** Stress concentration causes and remedies endurance limit, S-N curve, Design for completely reversed stresses –Finite and Infinite life, Cumulative damage in fatigue failure, Soderberg, Gerber, Goodman Lines, Modified Goodman diagrams.	8
4	**Unit IV: Power screws, Threaded Joints & Welded Joints** Terminology of power screw, Torque Requirement- lifting and lowering load, Efficiency of square, Acme or Trapezoidal Threads, Collar friction torque and overall efficiency, Stresses in screw and nuts. Types of screw fastening, Eccentrically loaded bolted joints. Strength of butt, parallel and transverse fillet welds, Axially loaded unsymmetrical welded joints, Eccentric load in plane of welds.	10
5	**Unit V: Design of Springs** Types and applications of springs, Stress and deflection equations for helical compression Springs, Springs in series and parallel, Design of helical springs, concentric helical springs, surge in spring, Design of Multi-leaf springs, Nipping of Leaf springs, Shot Peening.	6
	Total Hours	**39 Hrs.**

Text Books

1. Bhandari V.B., Design of Machine Elements, Tata McGraw Hill Publication Co. Ltd, 2020
2. Shigley J.E. and Mischke C.R., Mechanical Engineering Design, McGraw Hill Publication Co. Ltd, 2025

Reference Books

1. Spotts M.F. and Shoup T.E., Design of Machine Elements, Prentice Hall International, 2019
2. Juvinal R.C., Fundamentals of Machine Components Design, John Wiley and Sons, 2016
3. Black P.H. and O. Eugene Adams, Machine Design, McGraw Hill Book Co. Inc, 2018
4. Design Data - P.S.G. College of Technology, Coimbatore,2023

Online References

1. NPTEL Course: Prof. G. Chakraborty, Prof. S.K. Roychowdhury, Prof. B. Maiti, IIT Kharagpur, Design of Machine Elements I. (https:/nptel.ac.in/courses/112105124)
2. NPTEL Course: Prof. Jitendra P. Khatait, IIT Delhi, Design of Precision Machines (https://onlinecourses.nptel.ac.in/noc25_me180/preview)

Third Year B.Tech Mechanical Engineering

Semester- VI

Course Code: ME24PCC312 **Course Name: Heat Transfer**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3

Prerequisite: Engineering Mathematics - I and II, Thermofluidic

Course objectives:

- Identify modes of heat transfer and the laws applicable.
- Understand lumped heat capacitance and heat transfer through fins
- Explain the natural and forced convective mode of heat transfer
- Understand various laws in radiation heat transfer
- Explain performance parameters for heat exchangers

Course Outcomes:

After learning the course, the students will be able to:

CO1: Apply the heat transfer equations for one dimensional thermal system.
CO2: Evaluate heat transfer rate through fins and transient conditions
CO3: Estimate the heat transfer rate in natural and forced convection
CO4: Apply laws of radiation in case of black and grey surfaces.
CO5: Evaluate various performance parameters for heat exchangers.

Unit	Contents	Duration (Hrs.)
1	**Basic Concepts:** Different Modes and Laws of heat transfer, 3-D heat conduction equation in Cartesian coordinates, and its simplified equations, simplified equations in cylindrical and spherical coordinates (no derivation), Electrical analogy, Thermal contact Resistance, Composite structures: Composite wall, cylinder and sphere, **1-D steady state heat conduction without and with heat generation:** in plane wall, infinitely long hollow cylinder and sphere Critical radius of insulation.	8
2	**Heat Transfer through Extended Surfaces:** Types of fins and its applications, Governing Equation for constant cross sectional area fins, Solution for infinitely long fin, fin with insulated end tip, Fin Efficiency & Effectiveness. **Transient heat conduction:** Validity and criteria of lumped system analysis, Biot Number, Fourier Number, Time Constant and Response of thermocouple.	8
3	**Convection:** Principles of Convection: Hydrodynamic and Thermal boundary layer for a flat plate and pipe flow. **Forced Convection:** Physical significance of non-dimensional numbers, empirical correlations, forced convection for internal and external flow. **Free Convection:** Physical significance of non-dimensional numbers, free convection from a vertical, horizontal surface, cylinder and sphere. **Boiling and Condensation:** Types of boiling, Regimes of pool boiling, Critical heat flux, Film wise and Drop wise condensation.	8
4	**Heat Exchangers:** Classification and applications of heat exchangers, Heat exchanger analysis – LMTD for parallel and counter flow heat exchangers, Effectiveness– NTU method for parallel and counter flow heat exchangers, cross flow heat exchangers, LMTD correction factor, Heat Pipe.	8
5	**Radiation** Stefan-Boltzmann law, Kirchhoff's law, Planck's law and Wein's displacement law. Intensity of radiation and solid angle; Lambert's law; Shape factor, Radiation heat exchange between black and grey surfaces, Electrical analogy of radiation, Radiation shields.	7
	Total Hours	39

Text Books	
1. Franck P. Incropera, David P. DeWitt – Fundamentals of Heat and Mass Transfer, 8th Edition, 2018 2. Y. A. Cengel and A.J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited, 6th Edition, 2020 3. S.P. Sukhatme, A Textbook on Heat Transfer, Universities Press, 4th Edition, 2005 4. M.M. Rathod, Engineering Heat and Mass Transfer, Third Edition, Laxmi Publications, New Delhi, 4th Edition, 2023	
Reference Books	
1. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited, 3rd Edition, 2011 2. J. P. Holman, Fundamentals of Heat and Mass Transfer, McGraw – Hill publication, 10th Edition, 2020 3. C.P. Kothandaraman, S. V. Subramanyam, Heat and Mass Transfer Data Book, New Academic Science, 2013 4. D. Q. Kern , Process heat Transfer, Wiley Publication, 2nd Edition, 2019	
Online References	
1. NPTEL Course: Prof. Suman Chakraborty Prof. Sankar Kumar Som, "Conduction And Convection Heat Transfer" , IIT Kharagpur (https://nptel.ac.in/courses/112105271) 2. NPTEL Course: Prof. Arunkumar Sridharan, Prof. Shankar Krishnan, Prof. S.V. Prabhu, "Convective Heat Transfer: Fundamentals and Some Applications" , IIT Bombay (https://nptel.ac.in/courses/112101907)	

Third Year B.Tech Mechanical Engineering

Semester-V

Course Code: ME24PEC304A **Course Name: Digital Manufacturing**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-		100	3		-	3

Prerequisite: Engineering Exploration Lab – 2, Manufacturing Processes

Course Objectives:

After learning the course, the students will be able to:

- To define digital manufacturing and understand its role in modern industrial production.
- To understand the design process and the role of CAD in product development.
- To understand the need and applications of reverse engineering in product development.
- To understand material selection, manufacturing steps, and post-processing in additive manufacturing.
- To understand the integration of CAD systems with rapid prototyping and 3D printing software.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Explain Architecture of Digital Manufacturing System.
CO2: Discuss on the role of CAD and design process in digital manufacturing.
CO3: Explain the application of reverse engineering / discuss on techniques for processing of CAD models for digital manufacturing
CO4: Explain the principal and process involved in development of parts by additive manufacturing.
CO5: Discuss on the use of digital manufacturing equipment / explain the role of software in digital manufacturing.

Unit	Contents	Duration (Hrs.)
1	**Introduction to Digital Manufacturing** Definition of digital manufacturing, Historical perspective on industrial production and outlook, Industrial Revolutions, Industry 4.0, Cyber- physical system, Factory of the future, Operation Mode and Architecture of Digital Manufacturing System.	7
2	**CAD Modeling** Design process and role of CAD, Types and applications of design models, Three dimensional modelling schemes, Wire frames and surface representation schemes, Solid modelling - Parametric modelling, Assembly modelling.	7
3	**Reverse Engineering** Need, Reverse engineering process, Reverse engineering hardware and software, Geometric model development. **Computer Aided Manufacturing** Component modelling, Machine and tool selection, Defining process and parameters, Tool path generation, Simulation, Post processing.	8
4	**Additive Manufacturing for Digital Transformation** Introduction to additive manufacturing, Additive manufacturing process chain, Material selection, Manufacturing, Post processing, Additive manufacturing technologies and processes, Vat photo polymerization, Material extrusion, Material jetting, Sheet lamination, Powder bed fusion, Binder jetting, Planning and slicing additive manufacturing software.	8

5	**Concept Modelers, Translators and 3D Printing Software** Introduction, Principle, Thermo jet printer, Sander's model market, 3- D printer, Genisys Xs printer, JP system 5, object quadra System-Rapid proto typing. Standard interface to convey geometric description from CAD package to Rapid prototyping system, Stereo Lithography (STL)file, Initial Graphics Exchange Specification(IGES)file, Hewlett-Packard Graphics Language(HP/GL) file..	9
	Total Hours	**39**

Text Books

1. Zude Zhou Shane (Shengquan) Xie Dejun Chen, "Fundamentals of Digital Manufacturing Science" Springer Series in Advanced Manufacturing,2012
2. Ibrahim Zeid and Sivasubramanian R, "CAD/CAM - Theory and Practice", Tata McGraw Hill Education, 2011.
3. Vinesh Raja and Kiran J Fernandes, "Reverse Engineering- An Industrial Perspective", Springer-Verlag, 2008
4. Chua C.K., Leong K.F. and Lim C.S., "Rapid Prototyping: Principles and Applications", 3rd Edition, World scientific publications, 2014

Reference Books

1. Pham D T and Dimov S, "Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping", Springer-Verlag, 2001.
2. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", Springer, 2005.
3. Antti Saaksvuori and Anselmi Immonen, "Product Lifecycle Management", Springer, 2004

Online References

1. NPTEL Course: Prof. R. K. Amit, Prof. U. Chandrasekhar, IIT Madras, "The Future of Manufacturing Business: Role of Digital Technologies" (https://onlinecourses.nptel.ac.in/noc21_mg83/preview)
2. NPTEL Course: Prof. Sajan Kapil, IIT Guwahati, "Fundamentals of Additive Manufacturing Technologies" (https://onlinecourses.nptel.ac.in/noc25_me151/preview)

Third Year B.Tech Mechanical Engineering

Semester-V

Course Code: ME24PEC304B **Course Name: Non-Traditional Machining Processes**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3		-	-	-	40	60	-	-		100	3		-	3

Prerequisite: Manufacturing Processes

Course Objectives:

After learning the course, the students will be able to:

- To classify non-traditional machining processes based on the nature of energy employed.
- To study the material removal mechanisms involved in mechanical energy based machining Processes.
- To study process parameters, tooling aspects, and performance characteristics of ECM.
- To compare different thermo-electric machining processes based on accuracy, material removal rate, and surface finish.
- To identify suitable applications of nano-finishing processes in aerospace, biomedical, optics, and micro-manufacturing industries.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Apply the knowledge of energy-based classification to select a suitable non-traditional machining process for a given application.
CO2: Describe mechanical energy based nontraditional machining processes.
CO3: Differentiate chemical and electro chemical energy-based processes.
CO4: Select suitable thermo-electric machining processes for specific engineering applications based on process capabilities.
CO5: Interpret the effect of process parameters on nano-level surface finishing performance.

Unit	Contents	Duration (Hrs.)
1	**Introduction to Non-traditional machining** Introduction to Non-traditional machining, Need for Non-traditional machining process, Comparison between traditional and non-traditional machining, general classification Non-traditional machining processes, classification based on nature of energy employed in machining, selection of non-traditional machining processes, Specific advantages, limitations and applications of non-traditional machining processes.	7
2	**Mechanical Energy Based Processes** Ultrasonic Machining (USM): Introduction, Equipment and material process, Effect of process parameters: Effect of amplitude and frequency, Effect of abrasive grain diameter, effect of slurry, tool & work material. Process characteristics: Material removal rate, tool wear, accuracy, surface finish, applications, advantages & limitations of USM. Abrasive Jet Machining (AJM): Introduction, Equipment and process of material removal, process variables: carrier gas, type of abrasive, work material, stand-off distance (SOD), Process characteristics-Material removal rate, Nozzle wear, accuracy & surface finish. Applications, advantages & limitations of AJM.	7
3	**Electro Chemical and Chemical Energy Based Processes** Electro-chemical machining: Principle, Equipment, Process characteristics, Process parameters, Tooling, Applications ECM: Electrochemical grinding and electrochemical honing process. Advantages, disadvantages and application of ECG, ECH. Chemical Machining: Elements of the process, Process characteristics, advantages, limitations and applications.	8

4	**Thermo-Electric Energy Based Processes** Principles, equipment's, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining.	9
5	**Nano Finishing Processes** Principles, equipment's, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magnetorheological finishing, Magneto rheological abrasive flow finishing.	8
	Total Hours	**39**

Text Books

1. Adithan. M., "Unconventional Machining Processes", Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458
2. Anand Pandey, "Modern Machining Processes", Ane Books Pvt. Ltd., New Delhi, India, 2019.
3. Hindustan Machine Tools, "Production technology", McGraw Hill Education India Pvt. Ltd 2001

Reference Books

1. Benedict, G.F., "Non-traditional Manufacturing Processes", Marcel Dekker Inc., New York 1987. ISBN-13: 978-0824773526
2. Jagadeesha T., "Non-Traditional Machining Processes", I.K. International Publishing House Pvt.
3. Golam Kibria, Bhattacharyya B. and Paulo Davim J., "Non-traditional Micromachining Processes: Fundamentals and Applications", Springer International Publishing., Switzerland, 2017, ISBN:978-3-319-52008-7
4. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., "Hybrid Machining Processes: Perspectives on Machining and Finishing", 1st edition, Springer International Publishing., Switzerland, 2016, ISBN-13: 978-3319259208

Online References

1. NPTEL Course: Prof. Shantanu Bhattacharya, IIT Kanpur, "Advanced Machining Processes" (https://onlinecourses.nptel.ac.in/noc24_me72/preview)
2. NPTEL Course: Prof. Manas Das, IIT Guwahati, "Advanced Machining Processes"
3. (https://nptel.ac.in/courses/112103202)
4. NPTEL Course: Prof. Asimava Roy Choudhury, IIT Kharagpur, "Non Traditional Abrasive Machining Processes Ultrasonic, Abrasive Jet and Abrasive Water Jet Machining" (https://nptel.ac.in/courses/112105212)

Third Year B. Tech Mechanical Engineering

Semester-V

Course Code: ME24PEC305C **Course Name: Advanced Engineering Materials**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3		-	-	-	40	60	-	-		100	3		-	3

Prerequisite: Engineering Metallurgy, Solid Mechanics

Course Objectives:

After learning the course, the students will be able to:

- Understand the evolution and classification of advanced engineering materials and recognize their importance in modern engineering applications.
- Explain the structure, properties, and manufacturing methods of composite materials.
- Identify and compare high-strength and lightweight materials for engineering design.
- Introduce nanomaterials and nanocomposites and their emerging applications in mechanical engineering.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Explain the evolution, classification, and selection criteria of advanced engineering materials for modern engineering applications.

CO2: Describe the constituents, manufacturing processes, mechanical properties, and applications of polymer matrix composites.

CO3: Describe the constituents, manufacturing processes, mechanical properties, and applications of metal matrix composites.

CO4: Identify high-strength and lightweight engineering materials and justify their selection for automotive and aerospace applications.

CO5: Classify nanomaterials based on dimensionality and explain their properties and applications of nanocomposites in mechanical engineering.

Unit	Contents	Duration (Hrs.)
1	**Introduction** Evolution of engineering materials, Classification of advanced engineering materials, Need for advanced materials in modern engineering, Material selection criteria for engineering applications.	7
2	**Polymer matrix Composite materials** Introduction and classification of composites materials, Polymer matrix composite, Reinforcements: fibers, particles, whiskers, Effect of reinforcement – volume fraction – rule of mixtures, Manufacturing techniques: hand lay-up, filament winding, pultrusion, resin transfer molding, Mechanical properties of PMC, Applications in aerospace, automotive and marine area, Introduction to natural fiber reinforced composites	8
3	**Metal matrix composite materials** Introduction to meatal matrix composite (MMC) and its comparison with PMC, advantages and limitations of MMC, Reinforcements: particles and fibers, Role of reinforcement size, shape, and volume fraction Processing of MMC: powder metallurgy process, diffusion bonding, stir casting, squeeze casting and Liquid infiltration	8

4	**High strength and lightweight engineering materials** High-strength steels and HSLA steels, Importance of light-weighting in engineering design, Lightweight materials: Aluminum alloys, Magnesium alloys, Titanium alloys, Metal foams and cellular materials, Applications in automotive and aerospace industries	8
5	**Nanomaterials and its Applications** Nanomaterials and nanotechnology, Classification: 0D, 1D, 2D, and 3D nanomaterials, Mechanical, electrical, thermal, and optical properties, Carbon nanomaterials and their nanocomposites, application of nanocomposite in mechanical engineering.	8
	Total Hours	**39**

Text Books

Chawla K.K., "Composite materials Science and Engineering", Springer – Springer New York- 2016.
S.C. Sharma -Composite Materials, Narosa Publishing House—2000
William D. Callister, Jr, "Fundamentals of Materials Science and Engineering", John Wiley & Sons, Inc., 2018.
Visakh P. M., María José Martínez Morlanes, "Nanomaterials and Nanocomposites: Zero- to Three-Dimensional Materials and Their Composites", Wiley-VCH, 2016.

Reference Books

Clyne T.W. and Withers P.J, "Introduction to Metal Matrix Composites", Cambridge University Press, 1995.
Ganesh S. Kamble, "2D Functional Nanomaterials: Synthesis, Characterization, and Applications", Wiley-VCH, 2016.
S. Thirumalai Kumaran, T. J. Ko, S. S. Kumar, T. Varol, "Materials for Lightweight Constructions", CRC Press, 2024.

Online References

NPTEL Course: Prof. J. Ramkumar, IIT Kanpur, "Manufacturing of Composite" (https://nptel.ac.in/courses/112104221)
NPTEL Course: By Prof. Ranjit Bauri, "Aluminium based Alloys and Metal Matrix Composites" (https://onlinecourses.nptel.ac.in/noc22_mm41/preview)
NPTEL Course: By Prof. Jayanta Das , IIT Kharagpur, "Advanced Materials and Processes" (https://onlinecourses.nptel.ac.in/noc19_mm13/preview)

Third Year B. Tech Mechanical Engineering

Semester-V

Course Code: ME24MDM305 **Course Name: Smart Fluid Power**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-		100	3	-	-	3

Prerequisite: Thermofluidic, Applied Thermofluidic, Industrial Robotics

Course Objectives:

After learning the course, the students will be able to:

- Identify the fundamental components, fluid properties, and standard ISO symbols used in fluid power systems.
- Analyze the construction and working principles of direction, flow, and pressure control valves.
- Design hydraulic, pneumatic and electro-pneumatic circuits to solve industrial automation logic problems.
- Select appropriate components from manufacturer catalogues to design fluid power systems.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Understand working principle of components used in hydraulic & pneumatic systems.
CO2: Selection of appropriate components required for hydraulic and pneumatic systems.
CO3: Analyze hydraulic and pneumatic systems for industrial/mobile applications.
CO4: Design a system according to the requirements.
CO5: Develop and apply knowledge to various applications.

Unit	Contents	Duration (Hrs.)
1	**Components of Hydraulic and Pneumatic Systems:** Introduction to Fluid Power systems, Types of Fluid power systems, Advantages of Fluid power systems, Properties of hydraulic fluids, Fluid power symbols, fluid power distribution, and energy loss in hydraulic systems.	8
2	**Fluid Power Control:** Direction control valves: Center positions, methods of actuation, two stage valves Flow control valves: Pressure and temperature compensated. Pressure control valves: Pressure reducing valve, sequence valve, unloading valve, brake valve, back pressure valve, counter balance valve, check valves, prefill valve, servo valves, cartridge valves, proportional valves.	7
3	**Hydraulic Systems and Hydraulic Circuit:** Fundamentals of hydraulic systems, Hydraulic circuits: Simple reciprocating, regenerative, speed control (meter in, meter out and bleed off), sequencing, synchronization, traverse and feed, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, unloading circuit, motor breaking circuit and applications.	8
4	**Pneumatic Systems and Pneumatic Circuit Design:** Fundamentals of Pneumatic systems, speed and flow control circuits, pressure control and safety circuits, sequencing and logic circuits, electro-pneumatic circuit design and applications	8
5	**Hydraulic and Pneumatic System Design and Analysis:** Design of hydraulic/pneumatic circuits for practical application, selection of different components such as reservoir, control elements, actuators, accumulator, intensifier, filters, pumps. (Students are advised to refer manufacturers' catalogues for design and use simulation tool like Automation Studio for analysis). **Contamination control:** Contamination, sources of contamination, suction strainer, filters, filtration, filter ratings.	8
	Total Hours	**39**

Text Books

1. Esposito A, "Fluid Power with application", Prentice Hall, 2019.
2. Majumdar S.R, "Oil Hydraulic system- Principle and maintenance", Tata McGraw Hill, 2020.
3. Majumdar S.R, "Pneumatics Systems Principles and Maintenance", Tata McGraw Hill, 2020.
4. Stewart H. L, "Hydraulics and Pneumatics", Taraporewala Publication, 2019.

Reference Books

1. Pipenger J.J, "Industrial Hydraulics", McGraw Hill
2. Pinches, "Industrial Fluid Power", Prentice Hall
3. Yeaple, "Fluid Power Design Handbook"
4. Andrew A. Parr, "Hydraulics and Pneumatics", Elsevier Science and Technology Books
5. ISO - 1219, "Fluid Systems and components", Graphic Symbols.

Online References

1. NPTEL Course: Prof. Somashekhar S., IIT Madras, "Oil hydraulics and pneumatics" (https://www.youtube.com/playlist?list=PLIMdd_mE4yZGWJ32cgnK2-bs44Gpj81xi)

Third Year B.Tech Mechanical Engineering

Semester-V

Course Code: ME24PCC306 **Course Name: Numerical Methods and Optimization Lab**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	2	-	-	-	-	-	-	-	50	50	-	1	-	1

Prerequisite: Engineering Mathematics - I and II, Algebra, Statistics and Programming

Course Objectives:

After learning the course, the students will be able to:

- Understand applications of systems of equations and solve mechanical engineering applications
- Apply differential equations to solve the applications in the domain of fluid mechanics, structural
- Compare the system's behavior for the experimental data.
- Interpret Statistical measures for quantitative data.
- Optimize the solution for different real-life problems with available constraints.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Understand applications of systems of equations and solve mechanical engineering applications
CO2: Apply differential equations to solve the applications in the domain of fluid mechanics, structural etc
CO3: Compare the system's behavior for the experimental data.
CO4: Interpret Statistical measures for quantitative data.
CO5: Analyze datasets using probability theory and linear algebra

List of Experiments

Sr. No.	Name of the Experiment	Duration (Hrs.)
1	Solution of simultaneous equations (Min 2 methods) using Matlab/Scilab with solver	04
2	Solution of Ordinary Differential Equations [ODE] (Min 2 methods) using Matlab/Scilab with solver	04
3	Solution of Partial Differential Equations [PDE] (Min 2 methods) using Matlab/Scilab with solver	04
4	Solution of Least square technique using Matlab/Scilab with solver (All methods)	04
5	Solution of Regression Analysis using Matlab/Scilab with solver (One method only)	04
6	Perform a statistical analysis using suitable software	02
7	One program based mini project using mechanical engineering application	04
	Total Hours	**26**

Text Books

1. Steven C. Chapra, 'Applied Numerical Methods with MATLAB for Engineers and Scientist', Tata Mc-Graw Hill Publishing Co. Ltd.
2. B. S. Grewal, 'Numerical Methods in Engineering and Science', Khanna Publication
3. Advanced Engineering Mathematics by S.R.K. Iyengar, Rajendra K. Jain, 4e, Alpha Science International, Ltd ISBN 1-84265-086-6.
4. Higher Engineering Mathematics by B. S. Grewal, 43e, Khanna Publication, Delhi ISBN 1-84265-086- 6

Reference Books

1. Steven C. Chapra, 'Applied Numerical Methods with MATLAB for Engineers and Scientist', Tata Mc-Graw Hill Publishing Co. Ltd.
2. B. S. Grewal, 'Numerical Methods in Engineering and Science', Khanna Publication
3. Advanced Engineering Mathematics by C. R. Wylie, McGraw Hill Publications, New Delhi. ISBN-13978-0070722064
4. Kreyszig Erwin, "Advanced Engineering Mathematics", 10th edition, Wiley Eastern Limited 2015 ISBN: 9788126554232

Online References

1. NPTEL Course: Prof. Kaushik Bal IIT Kanpur, "Ordinary Differential Equations" https://nptel.ac.in/courses/111104521
2. NPTEL Course: Prof. Ameeya Kumar Nayak Prof. Sanjeev Kumar, IIT Roorkee Numerical Methods: https://nptel.ac.in/courses/111107105
3. NPTEL Course: Prof. Hari Shankar Mahato, IIT Kharagpur, Multiple Integral: https://nptel.ac.in/courses/111105122

Third Year B.Tech Mechanical Engineering

Semester- V

Course Code: ME24PCC307 **Course Name: Design of Machine Elements Lab**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	2	-	-	-	-	-	-	-	50	50	-	1	-	1

Prerequisite: Engineering Mathematics, Solid Mechanics, Engineering Metallurgy, Solid Modeling

Course Objectives:

- To apply principles of machine design in the design of mechanical components through analytical calculations for specified applications.
- To develop skills in preparing manufacturing drawings with appropriate tolerances, fits, and surface finish symbols as per standards.
- To understand practical aspects of material selection, safety, and manufacturability in machine element design.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Design machine elements such as joints, couplings, and screw jacks considering load and safety requirements.

CO2: Apply tolerances and surface finish symbols in manufacturing drawing.

CO3: Apply design concepts to solve practical mechanical design problems for real-life engineering applications.

List of Experiments

Sr. No.	Name of the Experiment	Duration (Hrs.)
The design project shall consist of design calculations, Manufacturing drawing with tolerances, surface finish symbols.		
1	Project 1: - Design of Cotter joint/ knuckle joint for a specified application	8
2	Project 2: - Design of Bush Pin Flexible Coupling for specified application	8
3	Project 3: - Design of Screw Jack for vehicles	8
	Total Hours	**24**

Text Books

1. Bhandari V.B., Design of Machine Elements, Tata McGraw Hill Publication Co. Ltd, 2020
2. Shigley J.E. and Mischke C.R., Mechanical Engineering Design, McGraw Hill Publication Co. Ltd, 2025

Reference Books

1. Spotts M.F. and Shoup T.E., Design of Machine Elements, Prentice Hall International, 2019
2. Black P.H. and O. Eugene Adams, Machine Design, McGraw Hill Book Co. Inc, 2018
3. Design Data - P.S.G. College of Technology, Coimbatore,2023

Online References

1. NPTEL Course: Prof. G. Chakraborty, Prof. S.K. Roychowdhury, Prof. B. Maiti, IIT Kharagpur, Design of Machine Elements I. (https:/nptel.ac.in/courses/112105124)

Third Year B. Tech Mechanical Engineering

Semester-V

Course Code: ME24PCC308 **Course Name: Engineering Design and Innovation-I**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	4	-	-	-	-	-	25	-	-	25	-	2	-	2

Prerequisite: Solid Modeling, Design Thinking, Experiential Learning Lab

Course Objectives:

1. To develop critical thinking and problem-solving skills through real-world and societal problem analysis
2. To evaluate alternative approaches, and justify the use of selected tools and methods
3. To develop an ecosystem to promote entrepreneurship and research culture among the students

Course Outcomes:

After learning the course, the students will be able to:

CO1: Apply formal idea generation and decision-making tools to develop multiple engineering design solutions
CO2: Build models/ prototypes to develop diverse set of design solutions
CO3: Demonstrate effective communication, teamwork, problem-solving, conflict resolution, and leadership skills.
CO4: Engage in independent and life-long learning by identifying personal knowledge gaps, seeking relevant resources, acquiring new skills

Preamble:

Engineering Design and Innovation–I (EDI-I) enables students to work in areas aligned with their interests and strengths while addressing real-world and socially relevant problems. The curriculum is implemented through semester-long engineering design and development projects across domains such as healthcare, agriculture, defense, smart cities & energy solutions, waste management & SDG initiatives. Students acquire essential skills through faculty mentorship, online courses, and diverse learning resources. Overall, EDI-I advances higher-order thinking by encouraging analysis, design, and application, as emphasized in Bloom's Taxonomy.

Group Size: 3-4 students can form a group for the Capstone project. A mentor teacher will be assigned to project group

Sr. No.	Capstone Project	Duration (Hrs.)
1	**Selection of Project:** • The course begins with the identification of a real-world problem. • Students shall initiate and define the project idea independently or in teams. • Interdisciplinary approaches are encouraged during analysis and solution development. • The selected problem shall be exemplary and aligned with intended learning outcomes. • Project ideas should preferably be drawn from socially relevant domains such as Healthcare, Agriculture, Defense, Education, Smart City, Smart Energy, Swachh Bharat Abhiyan, Environment, and Women Safety. • The listed domains are indicative; additional areas addressing societal needs may be included with faculty approval.	52

2	**Project Domains (Use Design Thinking Approach)** Projects shall be identified and developed using a Design Thinking framework, emphasizing problem understanding, ideation, and solution development. Project domains may include, but are not limited to: 1. Thermal Systems and Energy-Efficient Design 2. Robotics and Mechanism Design Systems 3. Production and Advanced Manufacturing Processes 4. Materials Engineering (Composite and Nanomaterials) 5. Automation and Control Systems 6. Mechatronic System Design 7. Agricultural System Design and Innovation 8. Smart Systems Design using AI and Machine Learning	

Expected Outcomes:

After learning this course, the expected outcomes from students are:

1. Ability to identify real-world and socially relevant engineering problems and develop innovative design solutions using the design thinking approach.
2. Development of functional prototypes, working models, or proof-of-concept solutions demonstrating technical feasibility and creativity.
3. Enhancement of research aptitude through literature review, analysis, and experimentation, leading to research paper publications in reputed journals or conferences.
4. Encouragement of intellectual property generation through patent drafting and filing of novel and innovative project outcomes.
5. Strengthening of teamwork, professional communication, entrepreneurship mindset, and lifelong learning aligned with sustainable development goals

Third Year B.Tech Mechanical Engineering

Semester-V

Course Code: ME24MDM309 **Course Name: Smart Fluid Power Lab**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	2	-	-	-	-	-	25	-	-	25	-	1	-	1

Prerequisite: : Thermofluidic, Applied Thermofluidic, Industrial Robotics

Course Objectives:

- Apply ISO symbols for interpreting fluid power circuit diagrams.
- Analyze the performance characteristics of pumps, actuators, and control valves through testing.
- Design industrial-grade fluid power systems using manufacturer catalogues and Automation Studio software software.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Interpret ISO symbols to represent hydraulic and pneumatic components in technical drawings.

CO2: Analyze the performance characteristics of gear pumps, pressure relief valves, and actuators.

CO3: Design and operate various hydraulic and pneumatic circuits

CO4: Simulate fluid power systems by selecting components from manufacturer catalogues using Automation Studio software.

List of Experiments

Sr. No.	Name of the Experiment	Duration (Hrs.)
1	Assignment: Symbols for different components as per standards	02
2	Test on Gear pump	02
3	Following experiments to be done on hydraulic trainer a) Regenerative circuit b) Speed control circuit c) Sequencing circuit	04
4	Following experiments to be done on pneumatic trainer a) Automatic reciprocating circuit b) Speed control circuit c) Pneumatic circuit involving Shuttle valve/ Quick exhaust valve	04
5	Test on pressure relief valve/flow control valve	02
6	Test on linear /rotary actuator	02
7	Design of simple hydraulic systems used in practice using manufacturers' catalogue and analysis using software such as Automation Studio.	04
8	Design of simple pneumatic systems used in practice using manufacturers' catalogue and analysis using software such as Automation Studio.	04
9	Industrial visit to study Hydraulic / Pneumatic based Automation systems	02
	Total Hours	26

Text Books

1. Esposito A, "Fluid Power with application", Prentice Hall, 2019.
2. Majumdar S.R, "Oil Hydraulic system- Principle and maintenance", Tata McGraw Hill, 2020.
3. Majumdar S.R, "Pneumatics Systems Principles and Maintenance", Tata McGraw Hill, 2020.
4. Stewart H. L, "Hydraulics and Pneumatics", Taraporewala Publication, 2019.

Reference Books

1. Pipenger J.J, "Industrial Hydraulics", McGraw Hill
2. Pinches, "Industrial Fluid Power", Prentice Hall
3. Yeaple, "Fluid Power Design Handbook"
4. Andrew A. Parr, "Hydraulics and Pneumatics", Elsevier Science and Technology Books
5. ISO - 1219, "Fluid Systems and components", Graphic Symbols.

Online References

1. NPTEL Course: Prof. Somashekhar S., IIT Madras, "Oil hydraulics and pneumatics" (https://www.youtube.com/playlist?list=PLIMdd_mE4yZGWJ32cgnK2-bs44Gpj81xi

Third Year B.Tech Mechanical Engineering

Semester- V

Course Code: ME24OEL310 **Course Name: Workplace Ethics in German Language**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
2	-	-	-	-	-	-	50	-	-	50	2	-	-	2

Course Objectives:

After completing the course, the students will be able to:

- Develop foundational German language skills
- Build basic conversational competence in German
- Enhance grammatical accuracy, foster cultural awareness and ethical sensitivity
- Improve written and oral expression

Course Outcomes :

After completing the course, the students will be able to:

CO1: Learners will be able to introduce themselves and communicate basic personal and professional information in German.
CO2: Learners will handle simple workplace conversations, emails, phone calls, and customer interactions in German.
CO3: Learners will apply relevant vocabulary and grammar to real-life job situations with cultural awareness.

Unit	Contents	Duration (Hrs.)
1	**REVISITING THE SCHOOL** -Rewinding the school times -German school system and school types Grammar: -Definite articles (Genitive) -Revision of Perfect tense -Neben Satz: Weil	8
2	**MULTI MEDIA AND FILMS** -Multi media and films Grammar: -Modal verbs (Past tense) -Dativ (Possessive articles)	8
3	**FEELINGS & EMOTIONS** -Expressing emotions and feelings -Writing blogs Grammar: -Comparative & Superlative -Positive degrees of comparison "als" & "wie" -Conjuction "dass" for Nebensatz -Wenn, ob & reflexive verbs	8
4	**STROLLING AROUND THE CITY** -Stadt- Tour (City tour) -Describing city -Bank conversations Grammar: -Akkusativ & Dativ prepositions -Konjuktiv II	8

	-Sport Grammar: -Conjuctions: deshalb, trotzdem -Dativ, Akkusativ verbs	
5	**LEARNING DIFFICULTIES** -Lernprobleme (learning difficulties and remedies) Grammar: -Konjuktiv II -Was für eine (What type of) - Träume, Wünsche, Pläne Grammar: -Konjuktiv II -W-fragen with prepositions	7
	Total Hours	**39**

Reference Books

1. **Netzwerk A1**

List of Assessment

Sr. No.	Name of the Assessment	Duration (Hrs.)
1	Write a blog- write about the advantages and disadvantages of media using comparative and superlative degree	1
2	Guest lecture	3
3	Lesen - reading and understanding a difficult text. Tipps to understand a difficult german text.	1
4	Describe the city . tell about famous places of your city.	1
	Total Hours	**6**

Third Year B.Tech Mechanical Engineering

Semester-V

Course Code: ME24AEC311 Course Name: Reasoning and Aptitude Development 1

Teaching Scheme (Hours/Week)					Examination Scheme						Credits					
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	OL	ODL	TOTAL
		1					25						1			1

Prerequisite: Basic Mathematical Concepts

Course Objectives:

- To develop fast and accurate mental calculation skills using Vedic Mathematics techniques for arithmetic operations.
- To strengthen students' understanding of number systems, divisibility rules, and numerical properties for efficient problem solving.
- To enhance competency in percentages, profit–loss, discounts, ratios, and partnerships for real-life and competitive exam applications.
- To build logical reasoning abilities through linear, circular, and complex puzzle-based arrangements.
- To improve analytical thinking by applying concepts of syllogisms, blood relations, and direction sense.
- To prepare students for aptitude-based assessments and competitive examinations by integrating speed, accuracy, and logical reasoning skills.

Course Outcomes:

After learning the course, the students will be able to:

1. Perform rapid mental calculations involving addition, subtraction, multiplication, squaring, square roots, and cube roots with high accuracy.
2. Analyze and solve number system problems involving divisibility, unit digits, factorials, HCF–LCM, and remainders.
3. Apply percentage, profit–loss, discount, ratio, and partnership concepts to solve quantitative aptitude problems efficiently.
4. Solve seating arrangement and puzzle-based problems, including linear, circular, matrix, and scheduling puzzles, using logical reasoning.
5. Evaluate syllogism problems and blood relation cases using Venn diagrams, family trees, and logical inference.
6. Demonstrate improved speed, accuracy, and confidence in quantitative and reasoning sections of placement and competitive examinations.

Unit	Contents - Foundations & Numerical Proficiency	Duration (Hrs.)
1	**Vedic Math & Mental Calculation** • Speed Addition & Subtraction (Left-to-Right method) • Base Method Multiplication (Numbers near 10, 100, 1000) • Squaring Techniques (Base 50/100 and numbers ending in 5)	2

	• Cube Roots and Square Roots of perfect numbers	
2	**Number Systems** • Classification (Rational, Irrational, Prime, Composite) • Divisibility Rules (2 to 19) • Unit Digit and Cyclicity • Factorial theory and Number of Zeroes • HCF & LCM (Models: Remainder cases) • Remainder Theorem basics	2
3	**Percentages** • Percentage Increase/Decrease and Multiplying Factors • Successive Percentage Change Formula • Product Constancy Rule	2
4	**Profit, Loss & Discount** • CP, SP, and Profit/Loss Percentage • Relation between Markup, Discount, and Profit • Successive Discounts and Single Equivalent Discount	2
5	**Ratio, Proportion & Partnership** • Ratio Scaling and Merging (A:B and B:C to A:B:C) • Mean, Third, and Fourth Proportional • Coin-based problems • Partnership: Profit sharing based on (Capital $\times$ Time) • Problems on Ages	2
6	**Linear Arrangements** • Single Row: All facing North/South • Dual Row: Facing each other • Directional cues (Left of, Second to the right, Immediate neighbours) • Ranking and Ordering (Tallest/Shortest, Top/Bottom)	2
7	**Circular & Polynomial Arrangements** • Circular: Facing Centre vs. Facing Outwards • Inward/Outward Mixed configurations • Square and Rectangular Table arrangements • Relationship-based seating (Combining Seating + Blood Relations)	2
8	**Complex Puzzles** • Grid/Matrix Puzzles (3 or 4 variables: Name, City, Profession, Color) • Scheduling Puzzles (Days of the week, Months, Years) • Floor-based Puzzles • Box-based Puzzles (Stacking logic)	2
9	**Syllogisms** • Standard Propositions (All, Some, No, Some Not) • Venn Diagram Method • "Only a Few" and "Few" cases • Possibility-based conclusions • Complementary pairs (Either-Or cases)	2
10	**Blood Relations & Direction Sense**	2

	• Family Tree Construction (Standard symbols) • Coded Blood Relations • Direction Compass and Degree Turns	
	Total Hours	**20**

Reference Books

Quant Basics	R.S. Aggarwal	Concept Clarity
Speed Math	M. Tyra	Time Management
Logic/Puzzles	K. Kundan / R.S. Aggarwal	Exam-specific Patterns
Critical Thinking	M.K. Pandey	Logical Derivations
DI / Advanced	Arun Sharma	Complex Data & CAT

Assessment

Assessment will be done by Course Teacher. MCQ Test can be conducted based on the syllabus.

MARATHWADA MITRAMANDAL, PUNE
'Welfare of Masses'
Est.1967

MARATHWADA MITRAMANDAL, PUNE
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Est.1967