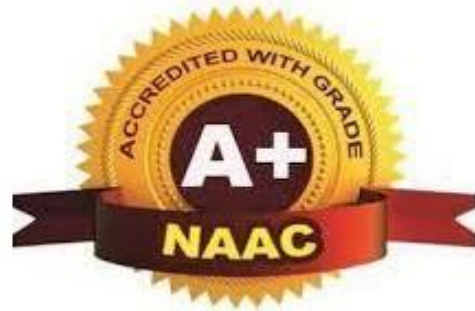




TULSIRAMJI GAIKWAD-PATIL
College of Engineering & Technology

Mohgaon, Wardha Road, Nagpur - 441 108

An Autonomous Institution



DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech.in Mechanical Engineering
Design

Teaching Scheme

From

Academic Year 2022-23

Vision of Institute

To emerge as a learning center of Excellence in the National Ethos in domains of Science, Technology and Management

Mission of Institute

- M1: To strive for rearing standard and stature of the students by practicing high Standards of professional ethics, transparency and accountability.
- M2: To provide facilities and services to meet the challenges of Industry and Society.
- M3: To facilitate socially responsive research, innovation and entrepreneurship.
- M4: To ascertain holistic development of the students and staff members by inculcating knowledge and profession as work practices.

Vision of the Department

To emerge as a premier centre in the field of Mechanical Engineering Education and produce competent Engineers

Mission of the Department

- To impart quality Technical Education through effective teaching -learning process.
- To provide a better environment to encourage innovation and entrepreneurship.
- To strengthen industry institute interaction to meet the challenges of industry and society.
- To ensure overall development of students and staff members by inculcating knowledge and professional ethics.

Program Education Objectives (PEO)

PEO-1: Demonstrate essential technical skills to identify analyze and solve problems and design issues in mechanical engineering.

PEO-2: Analyze the complex problems in the field of mechanical engineering by using modern tools.

PEO-3: Apply mechanical engineering concepts for the betterment of society and environment.

PEO-4: Develop professionals having administrative and managerial skills for mechanical engineering and allied industries.

PEO-5: Demonstrate the attributes of mechanical engineering in lifelong learning to contribute towards societal needs.

Program Outcomes (PO)

- 1. Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4. Conduct investigations of complex problems:** Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and software tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- 6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12. Lifelong learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

PSO 1: Apply the knowledge to work professionally and ethically in Thermal, Design, production and Manufacturing areas of Mechanical engineering.

PSO 2: Analyze and design mechanical components and its processes to meet the societal needs.

PSO 3: Apply Engineering and Management principles to work professionally in the industry or as an entrepreneur.

Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

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Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Mechanical Engineering Design

Semester– II (w.e.f.: AY2022-23)

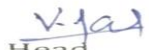
Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs/week	Credits	Exam Scheme				
									CT- 1	CT- 2	TA/CA	ESE	TOTAL
1.	PCC	MMED 1201	Finite Element Analysis	3	1	-	4	4	15	15	10	60	100
2.	PCC	MMED 1202	Stress Analysis	3	1	-	4	4	15	15	10	60	100
3.	PCC	MMED 1203	Finite Element Analysis Lab	-	-	2	2	1	-	-	25	25	50
4.	PCC	MMED 1204	Stress Analysis Lab	-	-	2	2	1	-	-	25	25	50
5.	FC	MMED 1205	Research Methodology	2	-	-	2	2	-	-	25	25	50
6.	PEC	MMED 1206- 09	Professional Elective-III	3	-	-	3	3	15	15	10	60	100
7.	PEC	MMED 1210-13	Professional Elective-IV	3	-	-	3	3	15	15	10	60	100
8.	MCC	MAU1202	Research Paper Writing	2	-	-	2	Audit	-	-	-	-	-
Total				16	2	4	22	18	60	60	110	315	550

L- Lecture T-Tutorial P-Practical CT1-Class Test 1 CT2- ClassTest2 TA/CA- Teacher Assessment / Continuous Assessment
 ESE- End Semester Examination (For Laboratory: End Semester Performance)

*-Program Elective /Audit Course/ Open Elective (list is provided at the end of structure).

Students are expected to complete it online by appearing NPTEL/Swayam Certification for 03 credits. Weekly 02 Hrs practical in which students are expected to work on mathematical modeling, Seminar on IPR, Patent filing, Removing Plagiarisms, etc. will be done.

PROGRESSIVE CREDITS=18+18=36


 Head
 Head
 Department of Mechanical Engineering
 Tulsiramji Gaikwad Patil College of
 Engineering & Technology, Nagpur


 Dean / Director Academic
 Director Academics
 Tulsiramji Gaikwad-Patil
 College Of Engineering
 And Technology, Nagpur


 Vice Principal / Principal
 Vice Principal
 Tulsiramji Gaikwad-Patil
 College Of Engineering &
 Technology, Nagpur



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Program: M.Tech In Mechanical Engineering Design

Semester-II MMED1201: Finite Element Analysis

Teaching Scheme		Examination Scheme	
Theory	3 Hrs/Week	CT-I	15 Marks
Tutorial	1	CT-II	15 Marks
Total Credits	4	CA	10 Marks
Duration of ESE: 3Hrs		ESE	60 Marks
Pre-Requisites: CAD/CAM		Total Marks	100 Marks

Course Contents

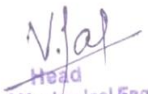
Unit I	Introduction to Engineering Analysis tool FEA and its application in Linear static Analysis and 2D problems, Study of Finite Element modeling and simulation Techniques, Use of FEA in structural vibration and thermal Analysis.
Unit II	Basics of FEM – Review of finite difference method, Initial value and boundary value problems Solution of Boundary Value problems: - weighted residual, Galerkin and Raleigh Ritz methods, Variational Method, Least square Methods. Introduction to meshless FEM, FEA and Linking mechanical design with FEA
Unit III	Two Dimensional Elements: Linear Triangular Elements, Rectangular Elements, Two Dimensional Field equations: Coordinate Systems, Isoparametric elements and numerical integration, Integral equations for the element Matrices, Heat transfer by conduction: One dimensional fins, two dimensional fins, and Long and convection Two Dimensional bodies.
Unit IV	FE Applications in Solid Mechanics: The axial force members, potential energy formulations. The Truss Element, Beam element, plane frame element, modeling of bolts for assembly, 3D problems.
Unit V	Two dimensional Elasticity: The displacement functions, Element matrices, Element Shape Functions: Evaluating shape functions FEM Computations Solution Methods, FEM Modeling and Preprocessing FEM Hardware and Post processing Survey of some FE Software Systems.

Text Books

T.1	Reddy, Junuthula Narasimha. An introduction to the finite element method. Vol. 2, no. 2.2. New York: McGraw-Hill, 1993.
T.2	Chandrupatla, Tirupathi R., Ashok D. Belegundu, T. Ramesh, and Chaitali Ray. Introduction to finite elements in engineering. Vol. 2. Upper Saddle River, NJ: Prentice Hall, 2002.
T.3	Desai, Chandrakant S., and John Fredrick Abel. Introduction to the finite element method; a numerical method for engineering analysis. Van Nostrand Reinhold, 1971.
T.4	Zienkiewicz, Olek C., and Robert L. Taylor. The finite element method: Its basis and fundamentals.

Reference Books	
R.1	K.J. Bathe, Finite Element Procedures, Klaus-Jurgen Bathe 6. Singiresu s. Rao . Finite element method in engineering.
R.2	Cook, R.D, “Concepts and application in Finite Element Analysis”, 3rd Ed, The Wiley & Sons
R.3	Dixit U.S., “Finite Element Methods for Engineers”, Cengage Learning
Useful Links	
1	https://www.youtube.com/watch?v=tH1ygapKG2g&list=PLSGws_74K018SmggufD-pbzG3thPIpF94&index=2
2	https://www.youtube.com/watch?v=UOp6JEiJctA&list=PLSGws_74K018SmggufD-pbzG3thPIpF94

CourseCode	Course Outcomes	CL	Class Sessions
MMED1201.1	Apply Fundamentals of FEM for the solution of 2D object.	4	9
MMED1201.2	Apply Different FEM Methods for the Solution of Boundary Value problems.	4	9
MMED1201.3	Evaluate Integral equations for the element Matrices.	5	9
MMED1201.4	Apply FEM Methods for the solution of 3D object	4	9
MMED1201.5	Evaluate the Element matrices and Element Shape Functions.	5	9


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Program: MTech Mechanical Engineering Design

Semester-II MMED1202: STRESS ANALYSIS

Teaching Scheme

Lecture 3 Hrs/week

Tutorial 1

Total Credit 4

Examination Scheme

CT-1 15 Marks

CT-2 15 Marks

TA 10 Marks

ESE 60 Marks

Total 100 Marks

Course Contents

Unit I

Fundamentals of stress & strain, stress strain relationship, Elastic constant, plane stress, plane strain. Stress Analysis for two dimensional problems in Cartesian co-ordinate system, equations of Equilibrium, compatibility equation, Airy's stress function, Analysis of rectangular plates by polynomials.

Unit II

Two dimensional problems in polar co-ordinates, general equations in polar co-ordinates for any symmetric case, pure bending of curved beams, crane hooks, bending of beams with initial curvature, Analysis of stresses in piston rings, stresses in rotating discs, with variable and constant sections, Effect of holes on stress distribution in plates, contact stresses.

Unit III

Torsion: Torsion of non circular section, St. Venants theory, Membrane analogy, Torsion of thin walled tubes.

Unit IV

Experimental stress analysis by strain gauge & photo elasticity technique, strain rosettes, recording instruments, Thermal stresses: Thermo elasticity, thin circular discs, thermal stresses in turbine rotors, Analysis of beams under thermal load. Brittle coating techniques, polariscope, Isochromatic & isoclinic fringes, compensation techniques.

Unit V

Introduction to fracture Mechanics, Linear elastic fracture mechanics, Griffith's criterion, Elastic-plastic fracture mechanics.

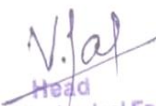
Text Books

- 1 Experimental Stress Analysis" by Sadhu Singh, Khanna Publishers
- 2 Experimental Stress Analysis" by UC Jindal, Pearson Education India
- 3 Experimental stress analysis- Dalley & Raillery, McGraw Hill Education

Reference Books

- 1 Theory of Elasticity -Timoshanko & Goodier
- 2 Experimental stress analysis- Dalley & Raillery, McGraw Hill Education;
- 3 Experimental Stress Analysis- Dove & Adams
- 4 Some Basic Problems of the Mathematical Theory of Elasticity- N I Mushelishvili

Code	Course Outcomes	CL	Class Sessions
MMED1202.1	Apply Stress and Strain Function for the solution of 2D object,	4	9
MMED1202.2	Derive the stress and strain equation for piston rings, and rotating discs.	3	9
MMED1202.3	Apply principle of St. Venants theory for finding solution of Non circular sections	4	9
MMED1202.4	Calculate thermal loads and thermal stress in simple object s	3	9
MMED1202.5	Analyze fundamental of fracture mechanics.	5	9


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Program: M.TECH (Mechanical Engineering Design)

MMED1203: Finite Element Analysis Lab

Teaching Scheme

Practical 2 Hrs/week

Practical credit 1

Duration of Exam 2 Hrs

Examination Scheme

External Practical Exam 25 Marks

Internal Practical Exam 25 Marks

Total Marks 50 Marks


Course Outcomes

After successful completion of the course, students will be able to:

- 1. Apply** Fundamentals of FEM for the solution of 2D object.
- 2. Apply** Different FEM Methods for the Solution of Boundary Value problems.
- 3. Evaluate** Integral equations for the element Matrices.
- 4. Apply** FEM Methods for the solution of 3D object
- 5. Evaluate** the Element matrices and Element Shape Functions.

Experiment No.	Name of Experiment	CO Attained
1.	Analyze the Static structure of bar with 1-D elements using standard FEA package.	CO1
2.	Analyze the Static structure of truss with 2-D elements using standard FEA package.	CO1
3.	Design Static structure with 2-D CST element using standard FEA package.	CO2
4.	Design Static structure with 2-D Axis-symmetric element using standard FEA package.	CO2
5.	Evaluate Static structure of a beam in transverse loading using standard FEA package.	CO3
6.	Evaluate Thermal analysis to estimate nodal temperatures using standard FEA package.	CO3
7.	Analyze the Dynamic structural analysis to determine natural frequency and mode shapes, using standard FEA package.	CO4
8.	Analyze the 3-D truss component using standard FEA package.	CO4
9.	Analyze the live problem/case reported or identified by an Industry	CO5

Course Code	Course Outcomes	CL	Class Sessions
MMED1203.1	Apply Fundamentals of FEM for the solution of 2D object.	4	9
MMED1203.2	Apply Different FEM Methods for the Solution of Boundary Value problems.	4	9
MMED1203.3	Evaluate Integral equations for the element Matrices.	5	9
MMED1203.4	Apply FEM Methods for the solution of 3D object	4	9
MMED1203.5	Evaluate the Element matrices and Element Shape Functions.	5	9


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Program: M.TECH (Mechanical Engineering Design)

MMED1204: Stress Analysis Lab

Teaching Scheme

Practical 2 Hrs/week

Practical credit 1

Duration of Exam 2 Hrs

Examination Scheme

External Practical Exam 25 Marks

Internal Practical Exam 25 Marks

Total 50 Marks

Course Outcomes

After successful completion of the course, students will be able to:

- 1. Apply** Stress and Strain Function for the solution of 2D object,
- 2. Derive** the stress and strain equation for piston rings, and rotating discs.
- 3. Apply** principle of St. Venants theory for finding solution of Non circular sections
- 4. Calculate** thermal loads and thermal stress in simple object s
- 5. Analyze** fundamental of fracture mechanics.

Experiment No.

Name of Experiment

CO Attained

1

Determine the stress for different types of loading by using strain gauges.

CO1

2

Determine the force and pressure by using stain gauge

CO1

3

Determine the component of Principle strain using delta rosette.

CO2

4

Calibrate the Photo-elastic model materials by using circular disc under tensile condition.

CO2

5

Calibrate the photo-elastic model materials by using circular disc under diametric compression.

CO3

6

Calibrate the photo elastic model material by using a beam subjected to pure bending.

CO3

7

Determine the direction of principle stress using plane Polariscope method.


CO4

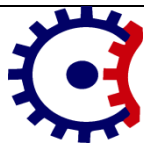
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Evaluate of stress concentration factor by photo elasticity.

CO5

Code	Course Outcomes	CL	Class Sessions
MMED1204.1	Apply Stress and Strain Function for the solution of 2D object,	4	9
MMED1204.2	Derive the stress and strain equation for piston rings, and rotating discs.	3	9
MMED1204.3	Apply principle of St. Venants theory for finding solution of Non circular sections	4	9
MMED1204.4	Calculate thermal loads and thermal stress in simple object s	3	9
MMED1204.5	Analyze fundamental of fracture mechanics.	5	9


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Program: M.TECH (Mechanical Engineering Design)

MMED1205: Research Methodology

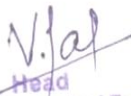
Teaching Scheme		Examination Scheme	
Lectures	2Hrs/week	CT-1	
Tutorial	Nil	CT-2	
Total Credit	2	TA	25 Marks
		ESE	25 Marks
		Total	50 Marks
		Duration of ESE: 01 Hour	

Course Contents

Unit I	Research Foundation What is Research, Objectives of Research, Types of Research, Scientific Research, Research and Theory, Conceptual and theoretical Models, Philosophy of research, Physical, psychological health and research.
Unit II	Review of Literature Need for Reviewing Literature, What to Review and for what purpose, Literature Search Procedure, Sources of Literature, Planning of Review work, Note Taking, Library and documentation.
Unit III	Planning of Research The planning process, Selection of a Problem for Research, Formulation of the Selected Problems, Hypothesis, Research Design and Sampling, Measurement, Research Design/Plan.
Unit IV	Processing of Data and Statistical Analysis of Data Introduction to Statistical Software, Statistical analysis of data MINITAB, SPSS, Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation, Questioners Preparation and Presentation Skills, Application Orientation in Research.

Unit V	<p>Report and Thesis writing Types of Reports, Planning of Report Writing, Research Report Format, Principles of Writing, Data and Data Analysis Reporting in a Thesis, Use of Endnote, Language Proficiency, Citations and Plagiarism, Bibliography, API , appendix, table, Observations arrangement, Preparation of type script and lay-out of thesis, Use of LATEX Indexing of Journals, Impact factor and social Media for Researchers.</p>
Text Books	
1	Research Methodology: Methods and Techniques by C. R. Kothari, New Age International Publishers, ISBN:81-224-1522-9
2	Statistical Methods for Research Workers by Fisher R. A., Cosmo Publications, New Delhi ISBN:81-307-0128-6
Reference Books	
1	Design and Analysis of Experiments by Montgomery D.C. (2001), John Wiley, ISBN: 0471260088
2	Methodology of Research in Social Sciences by O. R. Krishnaswamy and M. Rangnatham Himalaya publication House, 2005, ISBN: 8184880936
3	SPSS online manual
Useful Links	
1	https://nptel.ac.in/courses/127/106/127106227

Course Code	Course Outcomes	CL	Class Sessions
MMED1205.1	Learn philosophy of research.	2	9
MMED1205.2	Describe conceptual and methodological issues that will conduct successful research	3	9
MMED1205.3	Describe process of planning and proposing, testing of hypothesis.	3	9
MMED1205.4	Describe different statistical analysis methods.	3	9
MMED1205.5	Develop research and article writing skills.	3	9


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Program: M.Tech In Mechanical Engineering Design

Semester-II **MMED1207: Design of Hydraulic And Pneumatic System (Professional Elective-III)**

Teaching Scheme

Examination Scheme

Lecture

3 Hrs/Week

CT-I

15 Marks

Tutorial

CT-II

15 Marks

Total Credits

3

CA

10 Marks

Duration of ESE: 3Hrs

ESE

60 Marks

Pre-Requisites: Fluid Mechanics, Hydraulic machines

**Total
Marks**

100 Marks

Course Contents

Unit I

Oil Hydraulic Systems: Hydraulic Power Generator, selection and specification of pumps, pump characteristics.
Hydraulic Actuators: Linear & Rotary Actuators, Selection, Specification and Characteristics.

Unit II

Control & Regulation Elements: Pressure, direction and flow control valves, relief valves, and non return and safety valves actuation systems.

Unit III

Hydraulic Circuits: Reciprocating quick return, sequencing synchronizing circuits, accumulator circuits, industrial circuits, press circuits, hydraulic milling machine, grinding, planning copying, forklift earthmover circuits, design and selection of components, safety and emergency modules.

Unit IV

Pneumatic System, and Circuits : Pneumatic fundamentals, control elements, position and pressure sensing, logic circuits, switching circuits, fringe condition modules and their integration, sequential circuits, cascade methods, mapping methods, step counter method, compound circuit design, combination circuit design.

Unit V

Installation, Maintenance and Special Circuits: Pneumatic equipments, selection of components, design calculations, application, fault finding, hydro pneumatic automation, robotic circuits.

Text Books

1

Hydraulics and Pneumatics Controls- Shanmuga Sundaram, S. Chand Publication

2

Industrial Hydraulics and Pneumatics-Purushottam Balaso Pawar, Sankalp Publication

3

Hydraulics and Pneumatics - T Jagadeesha, I K International Publishing House Pvt. Ltd

Reference Books

1

Peter Rohner, —Fluid power logic circuits design, the Macmillan Press

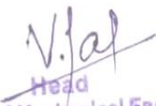
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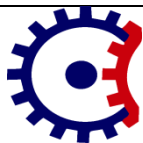
Stewart, H.L., —Hydraulic and pneumatic power for production, Industrial press, New York

3

Walter Ernest, —Oil hydraulic power and industrial applications, Mc Graw Hill Book, Co

Code	Course Outcomes	CL	Class Sessions
MMED1207.1	Select components of hydraulic system for industrial hydraulic application	3	9
MMED1207.2	Describe Control & Regulation Elements of hydraulic system.	3	9
MMED1207.3	Design Hydraulic Circuits for Industrial Application.	5	9
MMED1207.4	Design Pneumatic System for Industrial Application	5	9
MMED1207.5	Describe methods of installation and Maintenance hydraulic and pneumatic System	3	9


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Program: MTech Mechanical Engineering Design			
Semester-II		MMED1213:Reverse Engineering (Professional Elective-IV)	
Teaching Scheme		Examination Scheme	
Lecture	3 Hrs/week	CT-1	15 Marks
Tutorial		CT-2	15 Marks
Total Credit	3	TA	10 Marks
		ESE	60 Marks
		Total	100 Marks
Course Contents			
Unit I	Introduction: Reverse engineering fundamentals-The generic process-Three phases of reverse engineering-Phase I: Scanning, Phase II: Point processing, Phase III: Geometric model development.		
Unit II	Methodologies and techniques of Reverse Engineering: Computer aided reverse engineering, Computer vision and reverse engineering, Structured light range imaging, Scanner pipeline		
Unit III	Reverse engineering hardware and software: Introduction, Reverse engineering hardware, Reverse engineering software, Selection of a reverse engineering system, Case studies with implementation.		
Unit IV	Introduction to rapid prototyping: Need & Development of RP systems, RP process chain, Impact of Rapid prototyping and Tooling on Product Development, Benefits, Digital prototyping, Virtual prototyping, Applications, Relationship between reverse engineering and rapid prototyping, Case studies with implementation.		
Unit V	Curve and Surface Modeling: Parametric form of curves and a surface, Hermite curve and surface, Bezier curve and surface, B-spline curve and surface, introduction of NURBS.		
Text Books			
1	K. Otto and K. Wood, Product Design: Techniques in Reverse Engineering and New Product Development, 1st edition, Prentice Hall, 2001. ISBN-13: 978-0130212719.		
2	V. Raja and K. Fernandes, Reverse Engineering: An Industrial Perspective, Springer- Verlag, 2008. ISBN: 978-1- 84628-855-5		
3	K. A. Ingle, Reverse Engineering, McGraw-Hill, 1994. ISBN-13: 978-0070316935.		
Reference Books			
1	L. Wills and P. Newcomb, Reverse Engineering, 1st edition, Springer-Verlag, 1996. ISBN-13: 978-1475788280		
2	C. K. Chua, K. F. Leong and C. S. Lim, Rapid Prototyping: Principles and Applications, 4th edition, World Scientific, 2010. ISBN: 978-981-277-897-0		
Useful Links			
1	https://archive.nptel.ac.in/courses/112/104/112104265/.		

Code	Course Outcomes	CL	Class Sessions
MMED1213.1	Describe phases of reverse engineering for geometric model development	4	9
MMED1213.2	Describe methodologies and techniques used for reverse engineering	4	9
MMED1213.3	Select a reverse engineering system	4	9
MMED1213.4	Develop an understanding on the relationship between the reverse engineering and rapid prototyping.	4	9
MMED1213.5	Analyze the use of reverse engineering in creating curves.	4	9


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 Dean / Director Academic
Director Academics
Tulsiramji Gaikwad-Patil
College Of Engineering
And Technology, Nagpur


 Vice Principal / Principal
 Vice Principal
 Tulsiramji Gaikwad-Patil
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 Technology, Nagpur.