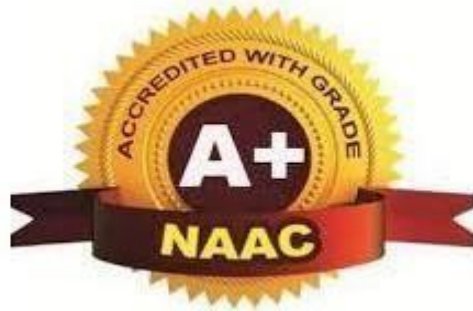




TULSIRAMJI GAIKWAD-PATIL
College of Engineering & Technology

Mohgaon, Wardha Road, Nagpur - 441 108

An Autonomous Institution



DEPARTMENT OF MECHANICAL ENGINEERING

**M.Tech. in Mechanical Engineering
Design**

Teaching Scheme

From

Academic Year 2023-24

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 the set 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)

PSO1: Apply the knowledge to work professionally and ethically in Thermal, Design, production and Manufacturing areas of Mechanical engineering.

PSO2: 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

(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

Scheme of Instructions and Syllabus

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

Semester-I (w.e.f.:AY2023-24)

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 1102	Advanced Mechanics of solids	3	1	-	4	4	15	15	10	60	100
2.	PCC	MMED1103	Mechanical Vibrations	3	-	-	3	3	15	15	10	60	100
3.	PCC	MMED1104	Advanced Mechanics of solids Lab	-	-	2	2	1	-	-	25	25	50
4.	PCC	MMED1105	Mechanical Vibrations Lab	-	-	2	2	1	-	-	25	25	50
5.	PCC	MMED1114	Advanced Mechanical Drives	3	-	-	3	3	15	15	10	60	100
6.	PEC	MMED1106-09	Professional Elective-I	3	-	-	3	3	15	15	10	60	100
7.	PEC	MMED1110-13	Professional Elective-II	3	-	-	3	3	15	15	10	60	100
8.	MCC	MAU1101	Pedagogy Studies	2	-	-	2	Audit	-	-	-	-	-
			Total	17	1	4	22	18	75	75	100	350	600

L- Lecture

T-Tutorial

P-Practical

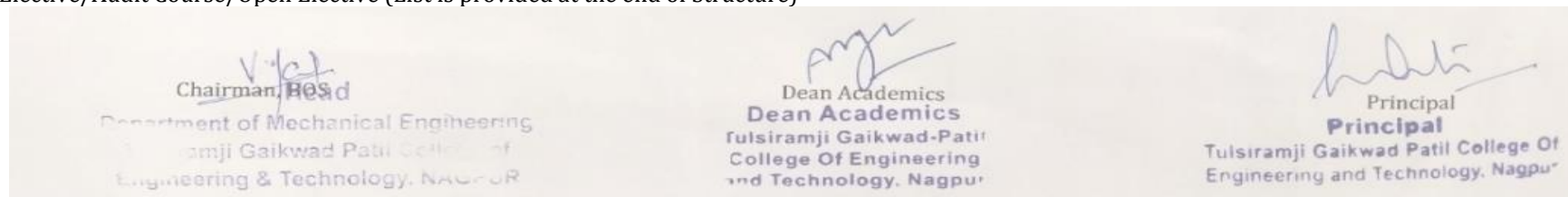
CT1-Class Test 1

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)



Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

Scheme of Instructions and Syllabus



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

List of Professional Elective Courses

Semester-I		Semester - II	
Professional Elective-I	Professional Elective- II	Professional Elective- III	Professional Elective- IV
MMED 1106: Computer Aided Mechanical Design	MMED 1110: Advance Fracture Mechanics	MMED 1206: Tribology	MMED 1210: Mechanics of Composite Materials
MMED 1107: Reliability, Maintainability & Wear	MMED 1111: Robotics Drives	MMED 1207: Design of Hydraulic And Pneumatic System	MMED 1211: System Modeling and Analysis
MMED 1108: MEMS Design and Industrial Automation	MMED 1112: Mechanization In Food Processing	MMED 1208: Optimization Methods for Mechanical Design	MMED 1212: Industrial Safety
MMED 1109: Ergonomics for Mechanical Design	MMED 1113: Additive Manufacturing	MMED 1209: Product Design and Development	MMED 1213: Reverse Engineering


List of Audit Courses and Open Electives


Semester – I	Semester – II	Semester - III
Audit Course-I	Audit Course-II	Open Electives
MAU1101: Pedagogy Studies	MAU1201: Constitution of India	MCSXX01: Operation Research
MAU1102: Disaster Management	MAU1202: Research Paper Writing	MSEX02: Cost Management of Engineering Projects
MAU1103: Sanskrit for Technical Knowledge	MAU1203: Stress Management by Yoga	MSEX03: Energy Audit & Management
MAU1104: Value Education	MAU1204: Personality Development through Life Enlightenment Skills	MMED XX04: 3D Printing Technology
		MMBXX06: Business Analytics


	Tulsiramji Gaikwad-Patil College of Engineering and Technology WardhaRoad,Nagpur-441108 NAAC Accredited with A+ Grade (An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)			
Program: M.Tech In Mechanical Engineering Design				
Semester-I	MMED1114 :Advanced Mechanical Drives			
Teaching Scheme			Examination Scheme	
Theory	3 Hrs/Week		CT-I	15Marks
Tutorial	Nil		CT-II	15Marks
Total Credits	3		CA	10Marks
Duration of ESE:3Hrs			ESE	60Marks
Pre-Requisites : CAD/CAM			Total Marks	100 Marks
Course Contents				
Unit I	Belt Drives: Belt vibrations, additional stress due to vibration, modern development in toothed belt, fatigue, synchronization, slip due to wear. Dynamics & vibration of Arms of Pulleys by three Approaches (1)Equal sharing of load zone(2)Equilibrium of rim(3)FEM Approach.			
Unit II	Gears: Detailed dynamics of gear tooth, spur tooth vibrations, Estimation of additional stress under vibration. Fatigue in tooth due to contact stress. Exact estimation of gear meshes frequencies in signature analysis.			
Unit III	Gear Boxes: Kinematic Analysis of complex gear trains, Force Analysis including gyroscopic effects, Vibration Analysis of Gear boxes, Lubrication Methods, Contamination of Lubrication Oils.			
Unit IV	Chain Drives : Detailed dynamics of chains considering Rolling friction of hanging portion of tracks, Resistance of sprocket bearings, Resistance due to chain stiffness , chain vibrations : Lateral&longitudinal,weardebrisformation&effectonefficiency,impactloadsinchains. Analysis of power & conveyor chains.			
Unit V	Couplings: Stress analysis of coupling bolts during one rotation, Rubbing of coupling pins & its effect on signature, Analysis due to misalignment, Degree of shock absorption due to flexible elements in flexible couplings.			

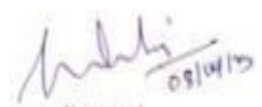
Text Books	
T.1	Machine Design, R.S.Khurmi, J.K.Gupta, Eurasia Publication pvt ltd.
T.2	Machine Design, Joseph E.Shigley Charles R.Mischke Thomas Hunter Brown,Jr.3rdEdition.
Reference Books	
R.1	Gear, Spur Helical, Worm by Earle Buckingham, Mc-GrawHill.
R.2	Rothebirt–Mechanical Design & Systems Handbook Mc-GrawHill
R.3	David W.South & JonR. Mancuso, Mechanical Power Transmission Components Marcel Dekker Inc NewYork.
Useful Links	
1	https://www.youtube.com/redirect?
2	https://www.youtube.com/watch?v=uGxfchLe-_I



Course Code	Course Outcomes	CL	Class Sessions
MMED1114.1	Calculate stress at the section of Belt Drives.	4	9
MMED1114.2	Design spur gear drive system for industrial application.	4	9
MMED1114.3	Illustrate Gear box design with detailed kinematic analysis and lubrication system.	4	9
MMED1114.4	Design chain drive system for industrial robot.	4	9
MMED1114.5	Design flexible rigid for industrial application.	4	9


 HOS Chairman
 Head
 Department of Mechanical Engineering
 Tulsiramji Gaikwad Patil College of
 Engineering & Technology, NAGPUR.


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



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



 Principal
 Principal
 Tulsiramji Gaikwad Patil College Of
 Engineering and Technology, Nagpur


	Tulsiramji Gaikwad- Patil College of Engineering and Technology WardhaRoad,Nagpur-441108 NAAC Accredited with A+ Grade (An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)			
Program:M.Tech In Mechanical Engineering Design				
Semester-I	MMED1102:Advanced Mechanics of Solids			
Teaching Scheme			Examination Scheme	
Theory	3 Hrs/Week		CT-I	15Marks
Tutorial	1		CT-II	15Marks
Total Credits	4		CA	10Marks
DurationofESE:3Hrs			ESE	60Marks
Pre-Requisites: CAD/CAM			Total Marks	100 Marks
Course Contents				
Unit I	Introduction to kinematic synthesis: type number and dimension synthesis practical applications, degree of freedom class-I, class-II chain Grubblers criteria, concept of transmission angle.			
Unit II	Synthesis of planner mechanism: Introduction to function generation, path generation, path generation & rigid body guidance. Problems, accuracy points chebychev's spacing, Graphical approaches for synthesis for above problem Central point curve, circle point curve ,point position, inflection circle Bo-billior construction, Euler's savory equation, Hartman construction, vector approach & matrix approach, rotation matrix, displacement matrix, Freudenstein' s equation, computer approach for the above problem.			
Unit III	Optimal synthesis of planar mechanisms, Powell's search methods, least square method penalty function computer approach.			
Unit IV	Kinematic analysis & synthesis of spatial mechanisms Hi notations screw matrix, kinematic analysis for linkages like R-S-S-R, R-C-P-R-C etc.			
Unit V	Kinematics synthesis of Robot arms: Endless Tendon-Driven Mechanisms, Tendon-Driven Robotic Arm mechanism, Kinematic solution of SCARA Manipulator, Kinematic solution of PUMA Manipulator.			

Text Books	
T.1	Solid Mechanics, Kazimi S.M.A., Tata McGraw Hill, 1994.
T.2	M.H.Sadd, Elasticity: theory, applications, and numeric, 3 rd edition, Academic Press, 2014.
Reference Books	
R.1	Tao, D.C. Applied Linkages.
R.2	Erdman & Sandor, Advanced Mechanisms, Vol.-I, II.
R.3	Denavit & Hartenberg, —Kinematic Synthesis
Useful Links	
1	https://link.springer.com/article/10.1007/s00158-010-0500-3
2	https://www.researchgate.net/publication/4029306_Kinematic_synthesis_of_robotic_manipulators_from_task_descriptions



Course Code	Course Outcomes	CL	Class Sessions
MMED1102.1	Summarize various methods of synthesis.	2	9
MMED1102.2	Apply the concept of planar mechanism to solve engineering problem.	3	9
MMED1102.3	Interpret optimal synthesis of planar mechanisms to solve complex engineering problem.	3	9
MMED1102.4	Analyze Kinematic & synthesis of spatial mechanisms.	4	9
MMED1102.5	Examine of Robotic arms using concept of Kinematics synthesis.	4	9


 HOS Chairman
 Head
 Department of Mechanical Engineering
 Tulsiramji Gaikwad Patil College of
 Engineering & Technology, NAGPUR.


 Director/Dean Academics
 Dean Academics
 Tulsiramji Gaikwad Patil
 College Of Engineering
 and Technology, Nagpur



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


 Principal
 Tulsiramji Gaikwad Patil College Of
 Engineering and Technology, Nagpur


	Tulsiramji Gaikwad- Patil College of Engineering and Technology WardhaRoad,Nagpur-441108 NAAC Accredited with A+ Grade (An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)			
Program: M.Tech In Mechanical Engineering Design				
Semester-I	MMED1103:Mechanical Vibrations			
Teaching Scheme			Examination Scheme	
Theory	3Hrs/Week		CT-I	15Marks
Tutorial	Nil		CT-II	15Marks
Total Credits	03		CA	10Marks
Duration of ESE:3Hrs			ESE	60Marks
Pre-Requisites: CAD/CAM			Total Marks	100Marks
Course Contents				
Unit I	Introduction To Vibration And The Free Response: Introduction to Free Vibration, Harmonic Motion, Viscous Damping, Modeling and Energy Methods, Stiffness, mass system, Measurement, Design Considerations, Stability, Numerical Simulation of the Time Response.			
Unit II	General Forced Response: Impulse Response Function, Response to an Arbitrary Input , Response to an Arbitrary Periodic Input, Transform Methods, Response to Random Inputs, Shock Spectrum, Measurement via Transfer Functions, Nonlinear Response Properties, Problems.			
Unit III	Multi Degree Freedom Systems: Two-Degree-of-Freedom Model (Undamped), Eigen values and Natural Frequencies, Modal Analysis, More Than Two Degrees of Freedom, Systems with Viscous Damping, Modal Analysis of the Forced Response, Lagrange’s Equations, Computational Eigen value Problems for Vibration, Numerical Simulation of the Time Response			
Unit IV	Vibration Instrumentation: Instrumentation amplification, real time analysis digital Fourier transforms FFT analysis structural frequency response measurement random sinusoidal and transient test methods model testing of beams.			
Unit V	Finite Element Method: The Bar, Three-Element Bar, Beam Elements, Lumped-Mass Matrices Trusses, Problems.			

Text Books	
T.1	Engineering Vibration: Daniel J. Inman, University of Michigan, Fourth Edition.
T.2	Mechanical Vibrations: Applications to Equipment, Yvon Mori, 13 January 2017.
T.3	Mechanical Vibrations : Theory and Application, S. Graham Kelly.
Reference Books	
R.1	J.S. Rao and K. Gupta Advanced theory of vibration. Wiley Eastern. 1992
R.2	P. Srinivasan Mechanical Vibration Analysis, Tata McGraw Hill, New Delhi 1982.
R.3	N.L. Meirovitch, Elements of vibration Analysis, McGraw Hill New York 1986.
Useful Links	
1	https://www.digimat.in/nptel/courses/video/112107212/L01.html
2	file:///C:/Users/admin/Downloads/Engineering_Vibration_Fourth_Edition.pdf
3	https://archive.nptel.ac.in/courses/112/105/112105048/

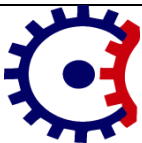

Course Code	Course Outcomes	CL	Class Sessions
MMED1103.1	Interpret concept of vibration phenomenon.	2	9
MMED1103.2	Apply Laplace and Fourier transform methods to find out response of Systems.	3	9
MMED1103.3	Apply vibration techniques to determine natural frequency of the system for any DOF system.	3	9
MMED1103.4	Analyze Frequency response using FFT analyzer.	4	9
MMED1103.5	Analyze vibration of system using finite element techniques.	4	9


 HOD
 Department of Mechanical Engineering
 Tulsiramji Gaikwad Patil College of
 Engineering & Technology, NAGPUR.



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



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



 Principal
Principal
 Tulsiramji Gaikwad Patil College Of
 Engineering and Technology, Nagpur

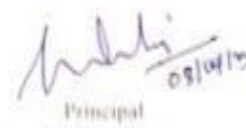
		Tulsiramji Gaikwad- Patil College of Engineering and Technology WardhaRoad,Nagpur-441108 NAAC Accredited (A +Grade) (An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)			
Program: M.Tech. course in Mechanical Engineering Design					
Semester-I		MMED1104: Advanced Mechanics of solids Lab			
Teaching Scheme			Examination Scheme		
Practical	2 Hrs/week		CA	25 Marks	
Total Credit	1		ESE	25 Marks	
			Total	50 Marks	
			Duration of ESE:02Hrs		
Sr. No.	List of Experiment				COS
1	Synthesis using function generation.				C01
2	Synthesis using path generation.				C01
3	Synthesis using path generation &rigid body guidance.				C01
4	One numerical on chebychev's spacing.				C02
5	Kinematic analysis and synthesis of spatial mechanisms.				C04
6	Kinematic synthesis of robot arm.				C05
7	Graphical approaches for synthesis of mechanisms.				C04
8	Study of Powell’s search methods.				C03
9	Study of least square method.				C03
10	One numerical on Freudenstein’s equation				C03
Text Books					
1	Solid Mechanics, Kazimi S.M.A.,Tata McGraw Hill,1994.				
2	M.H.Sadd, Elasticity: theory, applications, and numeric, 3 rd edition, Academic Press, 2014.				
Reference Books					
1	Tao,D.C. Applied Linkages.				
2	Erdman & Sandor, Advanced Mechanisms,Vol.-I,II				
3	Denavit & Hartenberg,—Kinematic Synthesis				
Useful Links					
1	https://www.sciencedirect.com/science/article/abs/pii/S0094114X12002091				
2	https://link.springer.com/article/10.1007/s00158-010-0500-3				

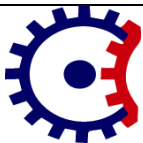

Course Code	Course Outcomes	CL
MMED 1104.1	Integrate various methods of synthesis.	3
MMED 1104.2	Apply the concept of planner mechanism to solve engineering problem.	3
MMED 1104.3	Apply the concept of optimal synthesis of planar mechanisms to solve complex engineering problem.	3
MMED 1104.4	Analyze Kinematic & synthesis of spatial mechanisms.	4
MMED 1104.5	Develop Robotic arms using concept of Kinematics synthesis.	4


 BoS Chairman
 Head
 Department of Mechanical Engineering
 Tulsiramji Gaikwad Patil College of
 Engineering & Technology, NAGPUR.

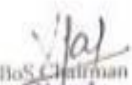

 Director/Dean Academics
Dean Academics
 Tulsiramji Gaikwad-Patil
 College Of Engineering
 and Technology, Nagpur



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

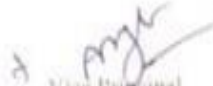

 Principal
Principal
 Tulsiramji Gaikwad Patil College Of
 Engineering and Technology, Nagpur.

		Tulsiramji Gaikwad- Patil College of Engineering and Technology WardhaRoad,Nagpur-441108 NAAC Accredited (A+Grade) (An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)			
Program: M.Tech. course in Mechanical Engineering Design					
Semester-I		MMED1105:Mechanical Vibrations Lab			
Teaching Scheme			Examination Scheme		
Practical	2 Hrs/week		CA	25 Marks	
Total Credit	1		ESE	25 Marks	
			Total	50 Marks	
		Duration of ESE:02Hrs			
Sr.No.	List of Experiment				COS
1	Summarize vibration analysis.				C01
2	Perform single degree of freedom system for forced vibration.				C02
3	Perform single degree of freedom system for free vibration.				C02
4	Experiment two degree of freedom system for forced vibration.				C03
5	Experiment two degree of freedom system for free vibration.				C03
6	Examine multi degree of freedom system for forced vibration.				C03
7	Examine multi degree of freedom system for model analysis.				C03
8	Calculate natural frequency of the given system using matrix iteration method.				C04
9	Calculate natural frequency using Holzen’s method.				C04
10	To study concept of vibration based condition monitoring using FFT analyzer oscillator.				C05
Text Books					
1	Engineering Vibration: DaniEl J. inman, University of Michigan, Fourth Edition.				
2	Mechanical Vibrations: Applications to Equipment, YvonMori,13 January 2017.				
Reference Books					
1	J.S.Rao and K. Gupta Advanced theory of vibration. Willey Eastern.1992				
2	P.Srinivasan Mechanical Vibration Analysis, Tata McGraw Hill,New Delhi1982.				
3	N.L.Meirovitch, Elements of vibration Analysis,McGraw Hill NewYork1986.				
UsefulLinks					
1	https://www.digimat.in/nptel/courses/video/112107212/L01.html				
2	https://archive.nptel.ac.in/courses/112/105/112105048/				



Course Code	Course Outcomes	CL
MMED 1105.1	Estimate vibration analysis.	2
MMED 1105.2	Apply the concept of single degree of freedom system for free and forced vibration.	3
MMED 1105.3	Apply the concept of two degree and multi degree of freedom system for free and forced vibration.	3
MMED 1105.4	Analyze natural frequency using matrix iteration method and Holzen's method.	4
MMED 1105.5	Analyze the vibrations using FFT Analyzer.	4


 BoS Chairman
 Head
 Division of Mechanical Engineering
 Tulsiramji Gaikwad Patil College of
 Engineering & Technology, NAGPUR.


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



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



 Principal
Principal
 Tulsiramji Gaikwad Patil College Of
 Engineering and Technology, Nagpur.

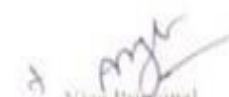
	Tulsiramji Gaikwad- Patil College of Engineering and Technology WardhaRoad,Nagpur-441108 NAAC Accredited with A+ Grade (An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)			
Program: M.Tech In Mechanical Engineering Design				
Semester-I	MMED1106: Computer Aided Mechanical Design			
Teaching Scheme			Examination Scheme	
Theory	3Hrs/Week		CT-I	15Marks
Tutorial	Nil		CT-II	15Marks
Total Credits	03		CA	10Marks
DurationofESE:3Hrs			ESE	60Marks
Pre-Requisites: CAD/CAM			Total Marks	100Marks
Course Contents				
Unit I	Introduction To CAD/CAM And Product Cycle: Representation of Line, Circle, & Other analytic curves, Algorithms & Programs. Drafting of machine elements with dimension and tolerances using 2-D drafting packages. Graphic standards GKS [Graphical Kernel System] IGES [Initial Graphic Exchange Specifications].			
Unit II	CAD of Machine Elements: Development of interactive design programs [with drafting] for machine elements, incorporating choice of materials and other parameters, Generation of several alternate designs and evaluation.			
Unit III	Geometric Modeling: Mathematical representation of Hermite cubic, Bezeir &B-spline curves. Introduction to difference type of surfaces and solids generated in surface and solid model respectively. Assembly modeling and interference checking.			
Unit IV	Mechanical Design Analysis and Optimization: Design analysis for mass properties, Stress, Thermal stress, using CAD/CAE packages, Optimum design of machine components using multivariable non linear optimization techniques using iterative CAD/CAE software tools.			
UnitV	Finite Element Analysis: Basic concept of the finite element method, comparison of FEM with direct analytical solutions; Steps in finite element analysis of physical systems, Finite Element analysis of 1-D problems like spring, bar, truss and beam elements formulation by direct approach; development of elemental stiffness equations and their assembly, solution and its post processing.			

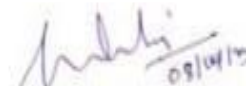
Text Books	
T.1	Ranky,P.G. Computer Integrated Manufacturing, Prentice Hall,1986.
T.2	Radhakrishanan, P.and Kothandaraman, C.P.Computer Graphics & Design, Dhanpat Rai &Sons, Delhi,1990.
T.3	Groover,M.P.andZimmers,E.WCAD/CAM,Computer Aided Design and manufacturing, Prentice Hall of India 1986
Reference Books	
R.1	Dimarogons, A.D.Computer Aided Machine Design, Prentice Hall, 1986.
R.2	Ibrahim Zeid,CAD/CAM Theory and Pratices,McGrawHill,1991.
R.3	Software Manualson GEODRAW, GEOMOD, and SUPERTAB, Structural Dynamics Research Corporation, U.S.A. 1986
Useful Links	
1	https://nptel.ac.in/courses/112102101 .
2	https://nptel.ac.in/courses/112102102 .



Course Code	Course Outcomes	CL	Class Sessions
MMED1106.1	Analyze the modeling, drafting and dimensioning of machine elements by using computer Software.	4	9
MMED1106.2	Apply Basics of CAD to Generate several alternate design options very easily.	3	9
MMED1106.3	Examine the requirements of hardware & software for computer aided design process.	3	9
MMED1106.4	Interpret Mechanical Design Analysis and Optimization	3	9
MMED1106.5	Solve FEM Technique to analyze the Spring, truss and beam element.	3	9


 BoS Chairman
 Head
 Department of Mechanical Engineering
 Tulsiramji Gaikwad Patil College of
 Engineering & Technology, NAGPUR.


 Director/Dean Academics
 Dean Academics
 Tulsiramji Gaikwad Patil
 College Of Engineering
 and Technology, Nagpur



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



 Principal
 Principal
 Tulsiramji Gaikwad Patil College Of
 Engineering and Technology, Nagpur.


	Tulsiramji Gaikwad- Patil College of Engineering and Technology WardhaRoad,Nagpur-441108 NAAC Accredited with A+ Grade (An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)			
Program: M.Tech In Mechanical Engineering Design				
Semester-I	MMED1111:Robotics Drives			
Teaching Scheme			Examination Scheme	
Theory	3Hrs/Week		CT-I	15Marks
Tutorial	Nil		CT-II	15Marks
Total Credits	03		CA	10Marks
Duration of ESE: 3Hrs			ESE	60Marks
Pre-Requisites: CAD/CAM			Total Marks	100Marks
Course Contents				
Unit I	Introduction to Robot Drives: Introduction Robot Drives, classification of drive systems, open loop control, closed loop control with feedback, functions and classification of drive systems, chain and linkages, lead screw, ball screws ,belt drives, gear drives, precision gear boxes, Harmonic drives, speed reducers, classification of grippers.			
Unit II	Electric Drives: Introduction, classification, AC motors, DC motors, stepper motors, types of stepper motors, half step mode operation, micro step mode, linear actuators, direct drive actuators.			
Unit III	Pneumatic Drives: Introduction, advantages and disadvantages, components of pneumatic Control drives, linear pistons, rotary pistons, flow control valves, pneumatic proportional controller, applications.			
Unit IV	Hydraulic Drive: Introduction, advantages and disadvantages, components of hydraulic Control drives, piston and transfer valves, hydraulic circuit with control amplifiers, fluid consideration, rotary and linear hydraulic actuators, hydraulic components in robots.			
Unit V	Servo Systems: Introduction, arrangement of actuators in robots, fundamentals of control techniques, modelling of robot servos, error response, steady state errors in robot servos, feedback and feed forward compensations, hydraulic position servo, computer controlled servo systems, selection of robot drives.			

Text Books	
T.1	Knapczyk,J.(2014).Basics of Robotics: Theory and Components of Manipulators and Robots. Austria: Springer Vienna.
T.2	DeSilva, C.W.(2015).Sensors and Actuators: Engineering System Instrumentation, Second Edition. United States: CRC Press.
Reference Books	
R.1	Agrawal,S.K.,Kinzel,G.L.,Waldron,K.J.(2016).Kinematics,Dynamics,andDesignofMachinery. United Kingdom: Wiley.
R.2	Norton, R. L.(2014).MachineDesign:AnIntegratedApproach.UnitedKingdom:PrenticeHall.
UsefulLinks	
1	https://archive.nptel.ac.in/courses/112/105/112105249/
2	https://nptel.ac.in/courses/112105249

Course Code	Course Outcomes	CL	Class Sessions
MMED1111.1	Understand the various drives of robotic system.	2	9
MMED1111.2	Summarize the application of electric drives in robotic system.	2	9
MMED1111.3	Apply pneumatic and hydraulic system in robotic application.	3	9
MMED1111.4	Design a robot using appreciates servo systems.	3	9
MMED1111.5	Demonstrate the application of various drives.	3	9


 HOS Chairman
 Head
 School of Mechanical Engineering
 Tulsiramji Gaikwad Patil College of
 Engineering & Technology, NAGPUR.


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


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


 Principal
 Tulsiramji Gaikwad Patil College Of
 Engineering and Technology, Nagpur