

M.Tech. in Machine Design

NIT Raipur

Course Brochure

Master of Technology in Machine Design

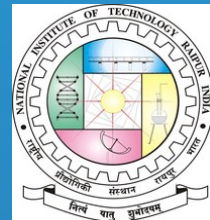
Department of Mechanical Engineering,

National Institute of Technology Raipur

G.E. Road, Raipur, Chhattisgarh – 492010

INDIA.

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ABOUT THE INSTITUTION

The institute began its first journey as Government College of Mining and Metallurgy, when the first President of independent India honorable Dr. Rajendra Prasad laid the Foundation stone of on 14th September 1956. On 14th March 1963, India's first Prime Minister Pt. Jawaharlal Nehru inaugurated the institute. The first session of the institute commenced from 1st July 1956 with the admission of 15 students each in Mining and Metallurgy Engineering. In 1958-59 with the introduction of courses in Civil, Mechanical and Electrical Engineering, the institute was renamed as Government College of Engineering and Technology (GCET) Raipur. Subsequent incorporation of graduate courses in Chemical Engineering (1965), Architecture (1984), Electronics (1985), Information Technology, Computer Science and Technology (2000), Biotechnology, Biomedical Engineering (2003) added to the name and fame of the institute. In view of its commendable performance and consistent service in contributing many engineers to the nation for more than 50 years and keeping in view its several strengths that corroborate to its excellence, the institute has been honoured by conferring it the status of a National Institute of Technology (NIT) by the Government of India on 1st Dec. 2005.

National Institute of Technology, Raipur (NITRR), hence formed in the year 2006, is an Institute of National Importance and presently houses 18 departments that offer UG (B.Tech./ B. Arch.) courses in 12 engineering disciplines and PG (M. Tech.) courses in 10 engineering disciplines. Additionally it conducts MCA programme and M. Sc. Programmes in the departments of Physics, Chemistry and Mathematics. The institute also inducts regular and part-time scholars in PhD programme in all disciplines. In addition to these, the institute intends to provide continuing education in a very broad spectrum keeping in view the needs of industries, academic institutions, research organizations and, last but not the least, the society. The institute is committed to the challenging task of development of technical education by preparing seasoned graduates in the field of engineering and technology. Development of India as an emerging industrial power is a demanding exercise as it involves the combination of cost effectiveness and efficiency along with producing world-class technology at the cutting edge. For about six decades the institute upholds the glory of relentlessly serving the country and contributing towards the progress of the nation.



Mechanical Engineering Department was established in 1958 as part of GCET Raipur and still continues to be an eminent department ever since the institute acquired the stature of NIT in 2005. The department offers one undergraduate program (B. Tech.) and three postgraduate programmes (M. Tech.) in three different specializations. It is one of the largest departments in the institute with an intake of 115 students in undergraduate programme and 41 + 10 (sponsored) students in post graduate programmes. The department also offers Ph.D. programme since 2010 in all relevant disciplines of Mechanical Engineering including Design, Production, Thermal and Industrial Engineering and Management.

The post graduate (PG) programmes are offered in the following specializations:

1. Thermal Engineering
2. Industrial Engineering and Management
3. Machine Design

The PG programme in Machine Design was incepted in the academic year 2014-15 and is now accredited to NBA till 2025.

Vision:

“To produce innovative, entrepreneurial and successful engineers and technologists of high caliber for the nation, to serve as a valuable resource for industry, academia and society”

Mission:

1. To provide the students and the faculty with opportunities to create, interpret, and apply the knowledge in the field of Mechanical Engineering.
2. Provide technological service to local, national, and international communities.

Programme Educational Objectives (PEOs)

Under the Post-graduate Mechanical Engineering programme in Machine Design, the objectives aim to produce qualified Mechanical Engineering Post-graduates who will:

- I. Be successful professionals in resulting domains with proven expertise.
- II. Contribute to society as responsible, educated, expressive and ethical citizens.
- III. Achieve appraising peer-recognition; as an individual or in a team.
- IV. Thrive to pursue life-long reflective learning to fulfill their goals.

About the Programme



The PG programme in Mechanical Engineering requires the students/ scholars attaining the M.Tech (Machine Design) degree to acquire the skills necessary to succeed in the engineering profession. The necessary skills were identified and approved by the DAC comprising of Faculty, Students and Professionals. These requirements also meet the Graduate Attributes laid by NBA for Mechanical Engineering programs. To make sure that the skills are delivered to the students, Programme Outcomes (POs) have been established and related to the Programme Educational Objectives (PEOs).

Programme Outcomes (POs)

PO 1: *An ability to apply attained knowledge;*

- a. identify, critically analyze, formulate and solve engineering problems,
- b. select modern engineering tools and techniques and use them with dexterity,
- c. design a system and process to meet desired needs within realistic constraints,
- d. contribute by research and innovation to solve engineering problems,
- e. devise and conduct experiments, interpret data and provide conclusions.

PO 2: *An ability to understand the impact of engineering solutions;*

- a. in a contemporary, global, economical, environmental and societal context,
- b. for sustainable development.

PO 3: *An ability to function professionally with ethical responsibility;*

- a. as an individual as well as in multidisciplinary teams with positive attitude,
- b. an ability to communicate effectively.

PO 4: *An ability to appreciate;*

- a. the importance of goal setting.
- b. to recognize the need for life-long reflective learning

The various components of the teaching-learning process include quality of question paper wherein Bloom's Taxonomy is adopted to ensure that the questions conform to set standards, quality of experimental and computational laboratory work embedded in the curriculum, quality of thesis (publishing the findings in reputed conferences/journals) and finally the industry-institute interface where the participation of industry/research professionals has been brought in for the framing and development of curriculum.

Programme Scheme

National Institute of Technology , Raipur (C.G.)													
M. Tech. in Mechanical Engineering with specialization in <u>Machine Design</u>													
Course of Study & Scheme of Examination								M. Tech. 1 st Semester				Branch: Mechanical	
S. No.	Board of Studies	Sub. Code	Subject Name	Periods / week			Examination Scheme					Total Marks	Credits
				L	T	P	TA	FE	SE	ESE	Pract. ESE		
1	Mechanical	ME42111ME	Advanced Numerical Techniques	3	1	-	20	15	15	100	-	150	4
2	Mechanical	ME42112ME	Optimization Techniques	3	1	-	20	15	15	100	-	150	4
3	Mechanical	ME42113ME	Stress and Deformation analysis	3	1	-	20	15	15	100	-	150	4
4	Mechanical	ME42131ME	Elective-I	3	1	-	20	15	15	100	-	150	4
5	Mechanical	ME42132ME	Elective-II	3	1	-	20	15	15	100	-	150	4
6	Mechanical	ME42121ME	Experimental Lab-I	-	-	3	75	-	-	-	50	125	2
7	Mechanical	ME42122ME	Computational Lab-I	-	-	3	75	-	-	-	50	125	2
			Total	15	5	6	250	75	75	500	100	1000	24

National Institute of Technology , Raipur (C.G.)													
M. Tech. in Mechanical Engineering with specialization in <u>Machine Design</u>													
Course of Study & Scheme of Examination								M. Tech. 2 nd Semester				Branch: Mechanical	
S. No.	Board of Studies	Sub. Code	Subject Name	Periods / week			Examination Scheme					Total Marks	Credits
				L	T	P	TA	FE	SE	ESE	Pract . ESE		
1	Mechanical	ME42211ME	Advanced Dynamics	3	1	-	20	15	15	100	-	150	4
2	Mechanical	ME42212ME	Advanced Machine Design	3	1	-	20	15	15	100	-	150	4
3	Mechanical	ME42213ME	Composite Mechanics	3	1	-	20	15	15	100	-	150	4
4	Mechanical	ME42231ME	Elective III	3	1	-	20	15	15	100	-	150	4
5	Mechanical	ME42232ME	Elective-IV	3	1	-	20	15	15	100	-	150	4
6	Mechanical	ME42221ME	Experimental Lab-II	-	-	3	75	-	-	-	50	125	2
7	Mechanical	ME42222ME	Computational Lab-II	-	-	3	75	-	-	-	50	125	2
			Total	15	5	6	250	75	75	500	100	1000	24

National Institute of Technology , Raipur (C.G.)													
M. Tech. in Mechanical Engineering with specialization in <u>Machine Design</u>													
Course of Study & Scheme of Examination								M. Tech. 3 rd Semester				Branch: Mechanical	
S. No.	Board of Studies	Sub. Code	Subject Name	Periods / week			Examination Scheme					Total Marks	Credits
				L	T	P	TA	FE	SE	ESE	Pract. ESE		
1	Mechanical	ME42321ME	Preliminary Dissertation Work	-	-	24	100	-	-	-	200	300	12
2	Mechanical	ME42322ME	Comprehensive Examination	-	-	-	-	-	-	-	200	200	4
			Total	-	-	24	100	-	-	-	400	500	16

National Institute of Technology , Raipur (C.G.)													
M. Tech. in Mechanical Engineering with specialization in <u>Machine Design</u>													
Course of Study & Scheme of Examination								M. Tech. 4 th Semester				Branch: Mechanical	
S. No.	Board of Studies	Sub. Code	Subject Name	Periods / week			Examination Scheme					Total Marks	Credits
				L	T	P	TA	FE	SE	ESE	Pract. ESE		
1	Mechanical	ME42421ME	Dissertation + Seminar	-	-	32	200	-	-	-	300	500	16
			Total	0	0	32	200	-	-	-	300	500	16

List of Electives

List of Electives offered in First Semester of the Specialization:

Elective-I AND II

ME42131ME	Advanced Finite Element Method
ME42132ME	Engineering Tribology
ME42133ME	Experimental Methods for Engineers
ME42134ME	Advanced Mechanism Design
ME42135ME	Product Design
ME42136ME	Computer Aided Design
ME42137ME	Rotor Dynamics

List of Electives offered in Second Semester of the Specialization:

Elective-III AND IV

ME42231ME	Industrial Robotics
ME42232ME	Experimental Stress Analysis
ME42233ME	Biomechanics
ME42234ME	Fault Diagnosis and Condition Monitoring
ME42235ME	Pressure Vessel Design
ME42236ME	Design for Manufacturing
ME42237ME	Advanced Material

Faculties involved in PG Programme in Machine Design

The Department is equipped with 27 regular faculties with specializations in the major streams of Mechanical Engineering. They unanimously contribute to the fruitful conduction of the PG courses in the various streams and strive towards excellence in value addition for the students. The Machine Design specialization is fortified with 10 regular and dedicated faculties who are the major contributors towards enrichment of the programme.

Faculty Members

1. Dr. Shubhashis Sanyal, Professor

Area of Interest: Synthesis of Mechanisms, Machine Design.

2. Dr. Surendra Pal Singh Matharu, Professor

Area of Interest: Machine Design, Tribology of Rolling Element Bearings.

3. Dr. Nitin Jain, Associate Professor

Area of Interest: Solid Mechanics, Composites.

4. Dr. Shubhankar Bhowmick, Associate Professor

Area of Interest: Structural Mechanics, Functional grading of materials, Fluid-Structure interaction and Finite element method.

5. Dr. N.V. Swamy Naidu, Associate Professor

Area of Interest: Mechanical Design, Biomechanics, Nano-composites structures.

6. Dr. Somnath Bhattacharya, Associate Professor

Area of Interest: Design, FEM, XFEM, Computational Continuum Mechanics and Dynamics.

7. Dr. G Srinivasu, Assistant Professor

Area of Interest: Material characterization (Titanium alloys), Tribology, Composite materials, Finite element modeling, Artificial neural networks.

8. Dr. Raj Kumar Sahu, Assistant Professor

Area of Interest: Smart materials, Mechanical characterization, Electro active Polymers, and application of smart materials in actuator design.

9. Dr. Rajana Suresh Kumar, Assistant Professor

Area of Interest: Structural Dynamics, Piezo-electric materials, Finite element method.

10. Dr. Ankur Gupta, Assistant Professor

Area of Interest: Vibration & Solid Mechanics

Laboratories

Mechanical Engineering Department is home to many state of the art laboratories. These are equipped with various specialized and high-end equipments which are used for various academic and research facilities for UG, PG and PhD research scholars of the institute. Students have open access to the labs, to understand as well as apply their knowledge to explore their engineering skills. The facilities available are as follows:

1. Tribology Lab with four ball tester, rolling element bearing tester.
2. Dynamics of Machines Lab.
3. Material testing lab with UTM, Brinell hardness, Rockwell Hardness tester, Compression testing machine, Impact testing machines and Fatigue and cupping testing machines.
4. Instrumentation lab.
5. CAD Lab with access to design and simulation software CATIA, DELMIA, SOLIDWORKS, ANSYS and Autodesk Inventor.
6. Computing lab with programming environments in MATLAB, C++ and PYTHON.
7. Workshop with latest CNC trainer and production capacity Lathe and Milling machine.

List of Equipments/Facilities Available in the Department:

S. No.	Equipment/ Facility Name
1	Universal Testing Machine 10 kN
2	Optical Microscope
3.	Modular Compact Rheometer (MCR 102)
4.	Electric-discharge machine (Die-sinking)
5.	Surface Roughness Tester
6.	Vacuum Oven
7.	Hot Air Oven
8.	MIG, TIG and SAW based welding machine & equipment
9.	KD2 Pro Thermal Properties Analyzer
10.	Universal Testing Machine 200 kN

Thesis/ Dissertation Work

The 3rd and the 4th semesters of the course are dedicated to dissertation work of the students, which they perform under the deft guidance of the faculty supervisors. The broad categories of work may be experimental or computation based or a combination of both. The students are always encouraged to explore the state of the art and/or emerging topics in relevant fields for their study. The students are also motivated to carry out pertinent research which render their research findings suitable for conference/journal publications and hence propel them to take up R & D related jobs or gear up for higher/doctoral studies. The thesis accomplished by the students for the last two academic years are presented in the following page.

AY 2020-21

Student Name	Thesis Title
ABHIJEET SINGH TOMAR	Dynamic Behaviour of Cracked Functionally Graded Beam Under A Moving Load
ABHISHEK TIWARI	Vibrational Analysis of Porous FG Beams Using Unified Formulation
ADITYA KUMAR SAO	Analytical Modelling For Vibration Analysis of Orthotropic Cracked Cylindrical Shell in Thermal Environment
ANKIT GUPTA	Modified Model For Enhanced Performance of VHB-4905 In Thermal Environment
BATTULA KRISHNA CHAITANYA	Strength Analysis of 3d Printed ABS Material By Experimentation And Modelling
LAXMIKANT	Vibrational Analysis of Non-Porous FG Beams Using Unified Formulation
MAHENDRA SINGH	Finite Element Analysis Of Human Hip Implant Mg Alloy Material Under Static Loading Using ANSYS Software
MOBASSIR SALIM	Prediction of Wear And Friction Behaviour of Electrolysis Ni-P Using Different Techniques and Finding out Best Techniques Using TOPSIS
MONALISA SHARMA	Design of Soft Robotic Gripper To Handle Delicate/Fragile Lab Equipment of Various Diameters
PYLA PRASAD	Study The Effect of Tool Geometry on The Development of Residual Stresses, Microstructure And Properties of AA7039 FSW Joint
VIKAS KUMAR MISHRA	Analytical Modelling For Vibration Analysis of Isotropic and FGM Cracked Cylindrical Shell in Thermal Environment
YELPALE SUMIT RAJARAM	Pull-In Analysis of a Partially Actuated, Tapered Width Microcantilever MEMS

AY 2021-2022

Name of the Student	Title of Dissertation
OMKAR SANJAY PATIL	Impact Analysis of Bulletproof Vest of Kevlar Composite material using FEM
GUNTI KUMAR	Prediction of Surface Roughness of 3D printed objects using Machine Learning
SAGAR TOPE	Parametric study of slots and its effect on CL/ Cd ratio of NREL s809 aerofoil
ANUSHREE PAUL	Effect of thermal field on stress concentration of nozzles in internally pressurized thin vessels
ANKIT OJHA	Fracture Analysis of cracked Spherical shell using Extended Finite Element Method (XFEM)
AJAY KUMAR MISHRA	Modelling And Simulation of Fluid Electrode Dielectric Elastomer Actuators For Soft Robotics Application
SUJIT KUMAR GIRI	Modelling of Tidal Wave System For The Generation Of Electricity Using Dielectric Elastomer
NANDA KUMAR VERALLA	Investigation of Wear Characteristics of 3D Printed Nylon Composites Suitable For Gear Material
RUTUJ VASANT RAJPUT	Prediction of Mechanical Properties of Aluminium Metal Matrix Hybrid Composites Synthesized using Stir Casting Process by Machine Learning
ADITYA SHIVARKAR	Phase Field Modelling of Brittle Fracture
PRIYAL VERMA	Failure analysis of cracked spur gear's under static and dynamic loading conditions
RAGHVENDRA DIWAN	Analysis of hemispherical shell structure subjected to low velocity impact using finite element simulations
ABHISHEK MANDAL	Vibration analysis of cracked plates subjected to fluid structure interaction
NAVEEN RAI	Vibration Analysis of plate with hole(s) subjected to fluid interaction

Research Publications by the Students in Recent Academic Years

1. *Monalisa Sharma and Shubhashis Sanyal*, Design of Pneumatically Actuated Soft Robotic Gripper for Gripping Cylindrical Objects of Varying Diameters, pp 547–558, Recent Advances in Machines and Mechanisms (LNME), 4 October 2022.
2. *Manikanta B. Pithani, Shubhashis Sanyal, Anuj K. Shukla*, Bilinear and Bicubic Interpolations for Image Presentation of Mechanical Stress and Temperature Distribution, Power Eng. Eng Thermophys., vol. 1, no. 1, pp. 8-18, 2022. <https://doi.org/10.56578/peet010103>.

3. *A. Gupta, O. P. Prabhakar, and R. K. Sahu*, Modified model for mechanical behavior of electroactive polymer in thermal environment, *Eur. Phys. J. Spec. Top.*, vol. 123, 2022, doi: 10.1140/epjs/s11734-022-00673-9.
4. *S. Bhattacharya, K. Sharma, and V. Sonkar* Numerical Simulation of Elastic Plastic Fatigue Crack Growth in Functionally Graded Material Using the Extended Finite Element Method, *Mechanics of Advanced Materials And Structures*, Vol. 24, No. 16, pp. 1367-1380, 2016.
5. *Rutuj Rajput, Abhishek Raut, Srinivasu Gangi Setti*, Prediction of mechanical properties of aluminium metal matrix hybrid composites synthesized using Stir casting process by Machine learning, *Materials Today Proceedings*, Elsevier, Volume 59, Part 3, 2022, Pages 1735-1742.
6. *D. S. Kushan, Shubhashis Sanyal, Shubhankar Bhowmick*, Parametric Study of Interaction effect between closely - spaced nozzles in a thin cylindrical pressure vessel, *International journal of Pressure Vessel and Pipings*, Elsevier Publication, <https://doi.org/10.1016/j.ijpvp.2018.05.009>, 2018.
7. *J Satish, S. Sanyal, S Bhowmick*, Effect of Temperature on Stress Concentration Factor, *Recent Trends in Mechanical Engineering*, 641-648, 2020.
8. *HS Yadav, S Sanyal*, Generation of Coupler Curves for Planar Kinematic Chains Using Link Joint Equations, *Machines, Mechanism and Robotics*, 491-501, 2022.
9. *A Biradar, S Sanyal*, Effect of Structural Characteristics on Kinematics of Planar Kinematic Chains, *Machines, Mechanism and Robotics*, 257-267, 2022

Concluding Remarks

NIT Raipur, being an institute of national importance contributes to the advancement of knowledge in emerging areas of Machine Design engineering through high quality research. Research efforts are primarily focused towards acquisition and advancement of knowledge as well as development of society. The institute strives to broaden the academics and align the curriculum in the direction of National Education Policy (NEP) 2020. Its major thrust is towards improvement of employability, entrepreneurship and innovation amongst the students as per the needs of industry and society at large. The institute encourages and extends to all design inquisitive graduates, a warm welcome to the PG course in Machine Design.