

Department of Mechanical Engineering at IIT Tirupati

MS/PhD Interviews Jan 2021

1. The MS/PhD Admission process for the department of Mechanical Engineering will involve two components: A written examination on 17-Dec-2020, followed by an oral examination on 17,18,19 Dec-2020. Only candidates selected based on the performance in the written examination will be called for the oral examination (interview).
2. The written examination will be conducted in three streams on 17-Dec-2020
Solid Mechanics and Design: 10 AM – 11 AM
Manufacturing: 11:15 AM – 12:15 PM
Fluid and Thermal Engineering: 12:30 PM – 1:30 PM
3. If a candidate has applied for multiple streams, then s/he has to attend the written (and if selected, oral) examinations in all the streams s/he has applied for.
4. The written examination will be of one hour duration, and the will include objective type questions, and may be some short answer questions. For objective type questions, there will be negative marking of 25%. All objective type questions will involve at least four choices for the answer, of which only one choice is correct. Students will have to identify the correct choice to get +1 Marks. If there is no response, then the student will be awarded 0 Marks for that question. If a student chooses an incorrect choice, then s/he will be awarded -0.25 Marks. There will be no negative marking for questions of short-answer type (such as fill-in-the blanks, answer in a word/sentence etc.)
5. The written exam will be administered using Google classrooms and Google forms, and the candidates will be monitored (proctored) using zoom. All candidates are requested to install zoom, and get familiar with zoom, Google forms, and Google classroom environments.
6. It is strongly recommended that each student ensure good uninterrupted internet connectivity for the duration of the examination, and also make sure to keep their devices fully charged to avoid any losses due to power outages.
7. To make sure that the exams on 17-Dec-2020 are conducted smoothly, we will organize **a mock session on 16-Dec-2020 at 3 PM**. All candidates who want to appear for the examination on 17-Dec-2020 should attend this mock session. Details of this mock session will be emailed to all candidates (via their registered email ids) on or before 15-Dec-2020.
8. It is recommended that the students choose a nice, calm, noise-free environment and a location where the internet connectivity is good, to write the examinations without any interruptions.
9. It is recommended that the students not take any breaks during the examinations, and also make sure that there are no interruptions (such as phone calls, conversations in the vicinity. Etc.) during the examination.
10. The exam is closed-book, closed-notes. Students are not allowed to talk to anybody else (friends, family members, or any other person) during the examination. Students are also not allowed to use the internet during the examination. Any case of malpractice will lead to disqualification of the candidature.

The results of the written examination are likely to be announced on the same day (17-Dec-2020). Please check our institute website and your emails regularly for any updates regarding examinations/results.

(Syllabus for the written and oral examinations is included at the end of this document)

General Instructions

These are only for those candidates selected to attend the oral examination (interview) based on the performance in the written examination

Dates on which oral examination (interviews) will be conducted: 17-19 Dec 2020
(Please check our institute website and your emails regularly for updates)

1. Each candidate will receive an email from the department regarding the interview schedule.
2. Each candidate will be allotted a specific slot. Efforts will be made to start the interview for each candidate according to the schedule. However, there may be unexpected delays, and each candidate should be prepared to begin his/her interview session a little earlier/later. So, the time-slots indicated in the schedule are tentative.
3. In continuation of point 2 above, each candidate is expected to be available for the interview at least one hour prior to the time-slot scheduled for that candidate. For example, if the time slot allotted to you is 10:30 AM – 11:00 AM, you must be ready from 9:30 AM. This is because, in case the previous candidate does not turn up, we may start your interview earlier.
4. The interview may last for more than half an hour, so please be prepared for it.
5. You will be sent an invitation via zoom to appear for the interview. To this end, a link will be sent one day ahead of the interview. Please check your email.
6. As mentioned in point 3, please be available at least one hour prior to your scheduled time. Five to ten minutes prior to beginning of your interview, you will receive a phone call from the department staff assistant, intimating that your interview is about to begin. After this call, you must click on the link provided, and wait for us to let you in. Please be patient, and stay calm during this waiting period. We will let you in once we get ready to start the interview.
7. As soon as you enter, please turn your microphone and video on. **Your video must be on at all times.** Please plan on being available for the full interview session (which may continue for more than half an hour) without any breaks in between, unless absolutely necessary.
8. Please choose a calm and quiet environment, and make sure there are no disturbances or any background noise. If possible, it is recommended that you choose a separate, closed room.
9. Please make sure that you have good internet connectivity at the place of your interview.
10. All details, information and updates will be communicated to you via email.
11. For purposes of communication, we will use the email id you provided in your application, and for calling you before the interview, we will use the mobile phone number that you provided in your application. It is your responsibility to make sure that your email id and mobile phones remain functional till the end of the interview.

12. It is your responsibility to check your emails regularly and make sure that any email that we send does not land in your spam folder(s). We will not be liable for any information that you may have missed.
13. During the interview you are expected to have with you the following
 1. Your certificates (tenth class mark sheet, twelfth class mark sheet, UG and PG grade cards and mark sheets, UG and PG degree certificates, work experience certificates, and any other certificate you deem appropriate)
 2. Your PG thesis/project report.
 3. Blank sheet to draw figures/schematics or write equations or any other details asked during the interview
14. We may ask you questions during the interview for which you may have to record your response on a paper rather than answering orally. For example, to write down equations and/or to sketch graphs, plots etc. For this purpose you must have a couple of blank sheets of paper and a pen handy. You may write down whatever is needed and then project/share/show the paper for us to see your responses. These sheets should be blank, and be free of any handwritten or printed material.
15. You must not resort to any unfair means while you attend the interview. Examples of unfair means include (but are not limited to) cheating; referring to the internet, text books, or any handwritten/printed notes; taking the help of some other person. Any cases of unfair means, if suspected or detected, will lead to direct rejection.
16. Please make all necessary arrangements detailed above, and please be loud and clear when you answer questions. Remember that this is virtual interview, and there may be difficulty in hearing what you say if you are not loud and clear. It will be a good practice to pause in between at times, and make sure that we are able to hear you.
17. We recommend that you have a mock interview with a friend, to test your internet connectivity, your audio and video, your device(s). This way you can detect any dysfunctional element and fix it before the interview to ensure that the session is smooth. You can also use this mock interview as an opportunity to test your voice, your virtual presence, and your comfort/adaptability to a virtual environment. For those of you who have never attended a virtual meeting, we recommend this strongly because one or two such mock sessions will prepare you better.

(Syllabus for the written and oral examinations is included at the end of this document)

Department of Mechanical Engineering, IIT Tirupati

Syllabus for MS/PhD Written Examinations and Interviews

The written test and interview will be on engineering mathematics and the candidate's chosen stream (Design and Solid Mechanics, Manufacturing, or Fluid and Thermal Engineering)

Engineering Mathematics (Common for all candidates)

Linear Algebra: Algebra of matrices; Inverse and rank of a matrix; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalisation of matrices; Cayley-Hamilton Theorem.

Calculus: Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima. Evaluation of definite and indefinite integrals; Applications of integrals to evaluate areas and volumes, Double and triple integrals, and their applications.

Vector Calculus: Gradient, divergence and curl; applications of these concepts in engineering analyses

Ordinary Differential Equations: First order equations (linear and nonlinear); Second order linear differential equations with variable coefficients.

Fluid & Thermal Engineering

Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.

Fluid Mechanics: Introduction – definition of a fluid, continuum hypothesis, fluid properties, stress at a point, classification of flows, rheological classification; Fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies; Fluid kinematics, Lagrangian and Eulerian description, vorticity and rotationality; Reynolds transport theorem, Bernoulli equation, conservation of mass, continuity equation, stream function, potential function, conservation of momentum, momentum analysis of flow systems; Dimensional analysis; Internal flow, flow through pipes, head losses in pipes, laminar and turbulent flow in pipes, Moody's chart; External flow, lift and drag, flow over flat plates, cylinders and spheres; Viscous flow of incompressible fluids, boundary layers; Elementary turbulent flow

Heat Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, Stefan-Boltzmann law, Wien's displacement law, black and grey surfaces, view factors, radiation network analysis.

Applied Thermal Engineering and CFD: Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. I.C. Engines: Air-standard Otto, Diesel and dual cycles. Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes. Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines. Classification of PDEs, finite difference approximations, order of accuracy, Taylor's series, explicit and implicit time-stepping

Solid Mechanics and Design

Engineering Mechanics: Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; Instantaneous center, impulse and momentum (linear and angular) and energy formulations, collisions.

Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; thermal stresses; strain gauges and rosettes, testing of materials with universal testing machine; testing of hardness and impact strength. Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic gear trains.

Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance.

Manufacturing

Material Science and Engineering: Introduction to crystallography: Crystal Structure – Atomic bonding, Unit cells and crystal systems, Metallic crystal structures, imperfections in solids; Principles of alloy formation: Solid solution, Hume-Rothery rules, Binary phase diagrams, Development of microstructure under equilibrium cooling and effects of non-equilibrium cooling, Iron-Iron Carbide Phase diagram; Elastic and Plastic deformation: Slip systems, Critical resolved shear stress, Frank-Read source, Work hardening and dynamic recovery, Strengthening Mechanisms, Recovery, Recrystallization and Grain growth, Cold and hot working; Heat Treatment: Types of heat treatment, isothermal transformation diagram and continuous cooling transformation diagram.

Manufacturing Technology: Methods of manufacturing – metal casting, metal joining, and metal forming: basic principles, Classification, equipment, process variables, defects in manufactured components, and applications; Non-destructive examination of manufactured components.

Metal Cutting and Metrology: Machine Tools – Types, Parts, Working, Machining time estimation; Tool Geometry - ASA system, Significance of various angles, Orthogonal Rake System (ORS), Normal Rake System (NRS), Mechanics of chip formation, Merchant's analysis, Effect of tool geometry on cutting forces and surface finish, Tool materials, Thermal aspects in machining, Grinding and finishing processes, Cutting fluids; Advanced machining processes – mechanical, thermo-mechanical, thermo-electrical, chemical, thermo-chemical and hybrid processes; Basic terminology, Errors in Measurement, Uncertainty and Calibration, Limits, Fits, Tolerances and Gauging, Comparators, Surface Roughness Measurement, Geometric Form Measurement.