Mechanical Engineering

Fabrication of Fatigue Testing Machine Test Rig

Manufacturing Methodology of Fatigue Testing Machine

1. Overview: Fatigue testing machines are designed to simulate the repetitive loading and unloading conditions materials experience in real-world environments, leading to the failure of components due to fatigue. These machines help determine the durability of materials and components under cyclic loading.

2. Key Steps in Manufacturing:

- **Design and Prototyping**:
  - **Conceptualization**: Define the type of fatigue test (rotary, axial, bending).
  - **CAD Modelling**: Create a detailed design of the machine using CAD software (SolidWorks, AutoCAD).
  - **Component Selection**: Choose appropriate materials and components such as load cells, actuators, bearings, etc.
- **Material Selection**:
  - High-strength steels or alloys are often used for critical components.
  - Non-corrosive materials for the loading system, such as stainless steel.
- **Machine Fabrication**:
  - **Frame Construction**: Use precision cutting, welding, and assembly techniques for the structural components.
  - **Load Mechanism Setup**: Integrating hydraulic or electromechanical actuators for applying cyclic loading.
  - **Sensor Installation**: Load cells and displacement sensors to measure the applied force and deformation.
- **Electrical and Control System Setup**:
  - Installation of a control panel with a user interface for programming test parameters.
  - Integration of sensors with data acquisition systems to collect test data.
- **Testing and Calibration**:
  - Perform initial calibration using known load values.
  - Verify machine functionality and make necessary adjustments.

Course Outcomes (COs)

Upon completion of the PBL, students will be able to:

- **CO1**: Understand the principles and types of fatigue testing and how they apply to engineering materials.
- **CO2**: Design a basic fatigue testing machine for different test conditions (rotary, axial, or bending).
- **CO3**: Select appropriate materials and components for the construction of a fatigue testing machine.
- **CO4**: Understand and apply control systems and data acquisition techniques for fatigue testing.
- **CO5**: Conduct fatigue testing experiments, analyze results, and make design recommendations based on fatigue life data.

Assessment Rubrics

Assessment rubrics provide a clear method for grading students based on predefined criteria. Below is a sample rubric for the course:

Criteria	Excellent (90-100%)	Good (70-89%)	Needs Improvement (50-69%)	Unsatisfactory (0-49%)
Design of Testing Machine	Complete and innovative design with clear justification for choices.	Design is functional with minor limitations explained.	Design is incomplete or lacks necessary components.	Design is not feasible or poorly explained.
Material Selection	Accurate and well-justified material choices for all components.	Materials chosen are generally appropriate, with minor flaws.	Material choices do not align with requirements or function.	Inappropriate or incorrect material selection.
Data Analysis	In-depth analysis with clear insights and correct conclusions.	Analysis is mostly correct with some minor misinterpretations.	Incomplete or somewhat incorrect analysis.	Analysis is missing or entirely incorrect.
Experimental Setup	Well-executed experiment with high reliability in measurements.	Experiment setup is functional with small errors in measurement.	Experiment setup lacks proper controls or data collection.	No experiment setup or flawed data collection.
Technical Documentation	Clear, precise, and complete documentation of the process and findings.	Documentation is mostly complete, with minor omissions.	Incomplete or unclear documentation.	Lacks proper documentation or organization.
Control System and Calibration	Effective calibration and control system integration with seamless operation.	Calibration is mostly correct with minor discrepancies.	Calibration has significant errors or issues.	No proper calibration or control system used.

Assessment Strategies

- **Practical Tests**: Students will work on actual fatigue testing machines (or simulators) and complete a set of experiments to demonstrate their knowledge.

- **Project**: Design a small-scale fatigue testing machine, submit a report, and present their approach.
- **Written Examinations**: Assess theoretical understanding of fatigue testing, materials science, and control systems.
- **Case Study/Group Discussion**: Analyze real-world failure cases and simulate the fatigue testing process to propose solutions.

Report:

Mechanical Engineering Department of ITM University Gwalior has manufactured "Fatigue Testing Machine" under the PBL (Project Based Learning) under the guidance of Mr. Rajendra Singh Rajput, Associate Professor, Mechanical Engg. Deptt.

- ❖ Photograph of the machine is attached herewith.

The in- house facilities of workshop and fabrication shop have been utilized for the same. This machine is used to test endurance strength of materials under cyclic loading conditions.

The cost of this machine in the market is around Rs. 85000/- and we have managed to manufactured it within Rs. 10000/-. This machine will be extremely useful in the material testing lab of Mechanical Engineering Department.

Outcome of PBL:

Students learnt about strength of materials, engineering machine element's design, dynamics

of machines and the project cost estimation. Also Blooms level 3, 4 and 5 achieved along with COs 1, 2, 3, 4 and 5.