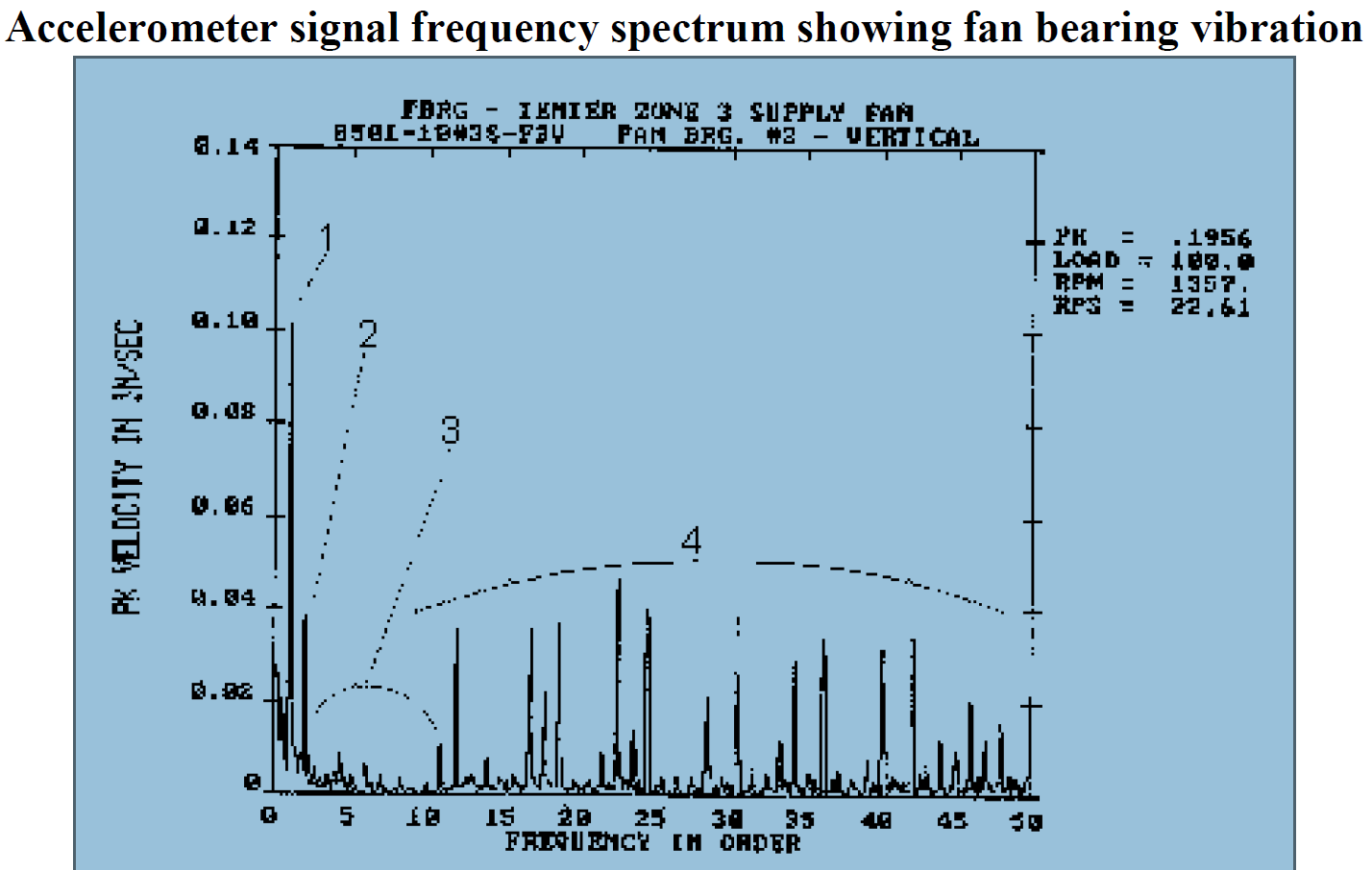
TQME 1: Maintainability Engineering

1. State four important and distinct equipment condition monitoring technologies used in predictive maintenance (condition-based maintenance)
2. State four important causes of vibration in rotating machinery. Each of the causes must be distinguishable as a function of the shaft rotating speed.
3. Explain the principle of pulse-echo ultrasonic testing of a metallic block specimen. Use a figure to illustrate the method and state how a defect at a location within the block can be detected by this approach.
4. What is the most common type of transducer material used in an ultrasonic probe?
5. The graph below shows vibration signal (measured by an accelerometer placed vertical to the shaft axis) frequency spectrum characteristic of a ball bearing. (frequency is in ‘order’) 

**i. \_\_\_\_\_ Pointer 1 on the figure indicates**

A. Parallel misalignment

B. Imbalance

C. Ball bearing defects.

D. Looseness

**ii. \_\_\_\_\_ Pointer 2 on the figure indicates**

A. Angular misalignment

B. Parallel misalignment

C. Imbalance

D. Looseness

**iii. \_\_\_\_\_ Pointer 3 on the figure indicates**

A. Looseness

B. Ball bearing defects

C. Parallel misalignment

D. Angular misalignment

**iv. \_\_\_\_\_ Pointer 4 on the figure indicates**

A. Looseness

B. Combined angular and parallel misalignment

C. Ball bearing defect frequencies

D. Thermal defects

**45. \_\_\_\_\_ Pointer 4 on the figure indicates**

A. Looseness

B. Combined angular and parallel misalignment

C. Ball bearing defect frequencies

D. Thermal defects