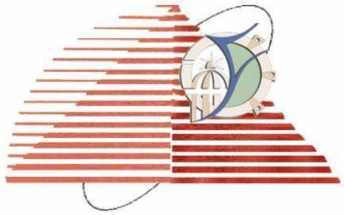

بسم الله الرحمن الرحيم

Vibration

Fayoum University



Faculty of Engineering
Mechanical Engineering Dept.

Lecture (9)

on

Vibration Analysis, and Control

By

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Faculty of Engineering
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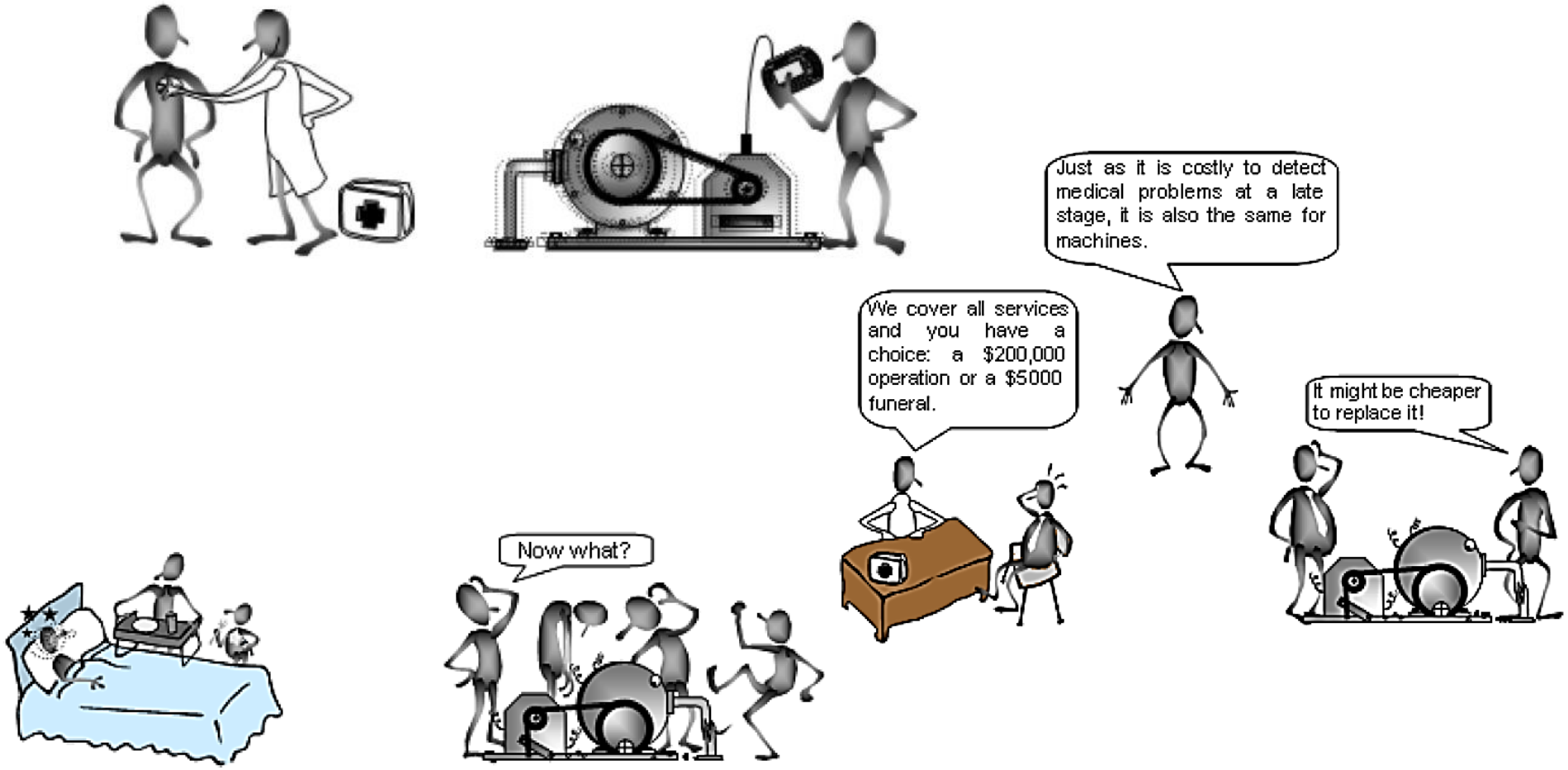
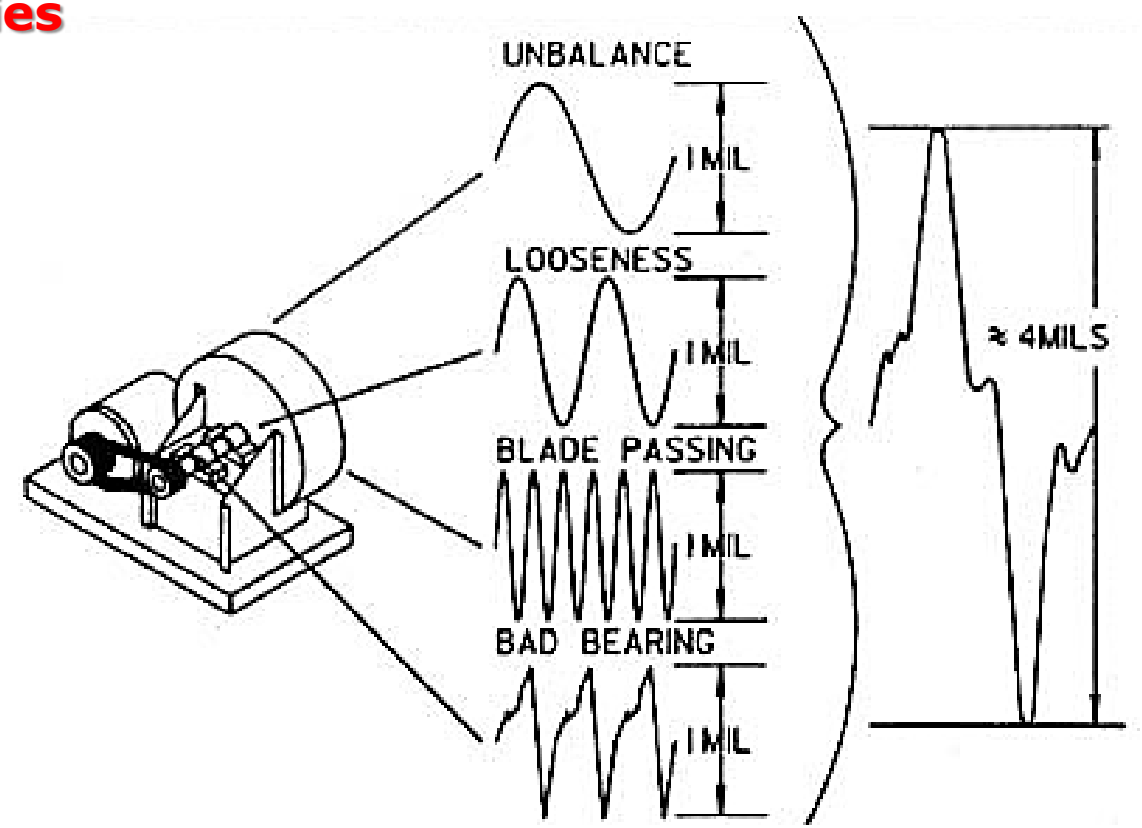
Vibration Analysis

Vibration Analysis



Vibration Analysis

Main machinery problems occur at specific frequencies



Vibration Analysis- Detection mode

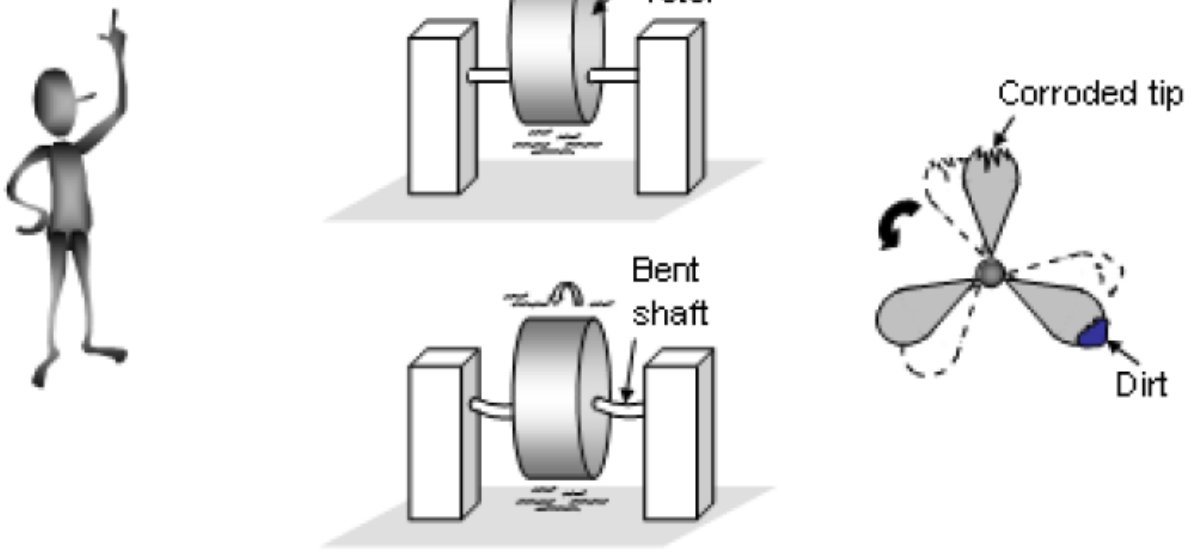
Vibration analysis is used to determine the operating and mechanical condition of equipment. A major advantage is that vibration analysis can identify developing problems before they become too serious and cause unscheduled downtime. This can be achieved by conducting regular monitoring of machine vibrations either on continuous basis or at scheduled intervals.

Regular vibration monitoring can detect :

- **deteriorating or defective bearings,**
- **mechanical looseness**
- **worn or broken gears.**
- **misalignment and unbalance before these conditions result in bearing or shaft deterioration.**

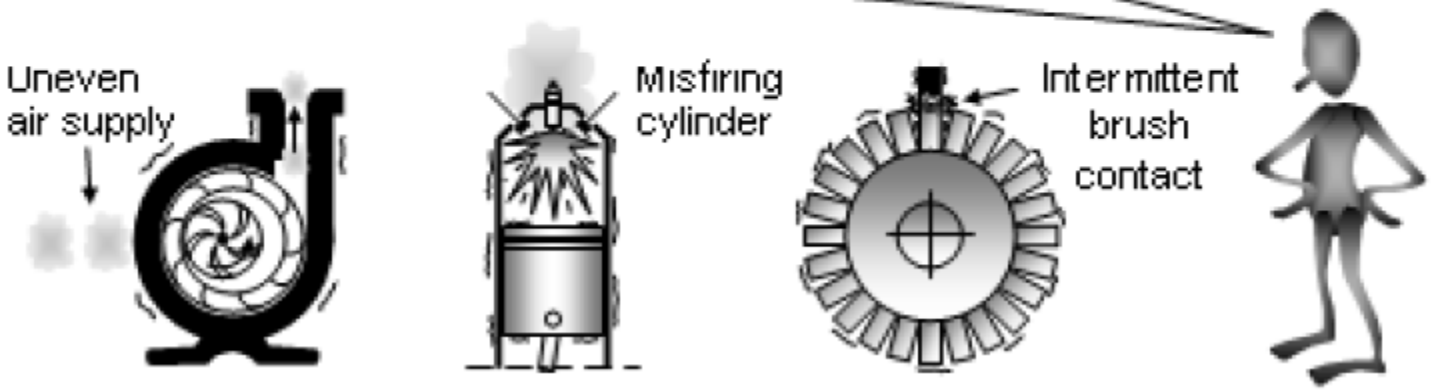
Vibration Analysis- Detection mode

Imbalanced machine components contain 'heavy spots' which when rotated, exert a repeating force on the machine. Imbalance is often caused by machining errors, non-uniform material density, variation in bolt sizes, air cavities in cast parts, missing balance weights, incorrect balancing, uneven electric motor windings, and broken, deformed, corroded, or dirty fan blades.

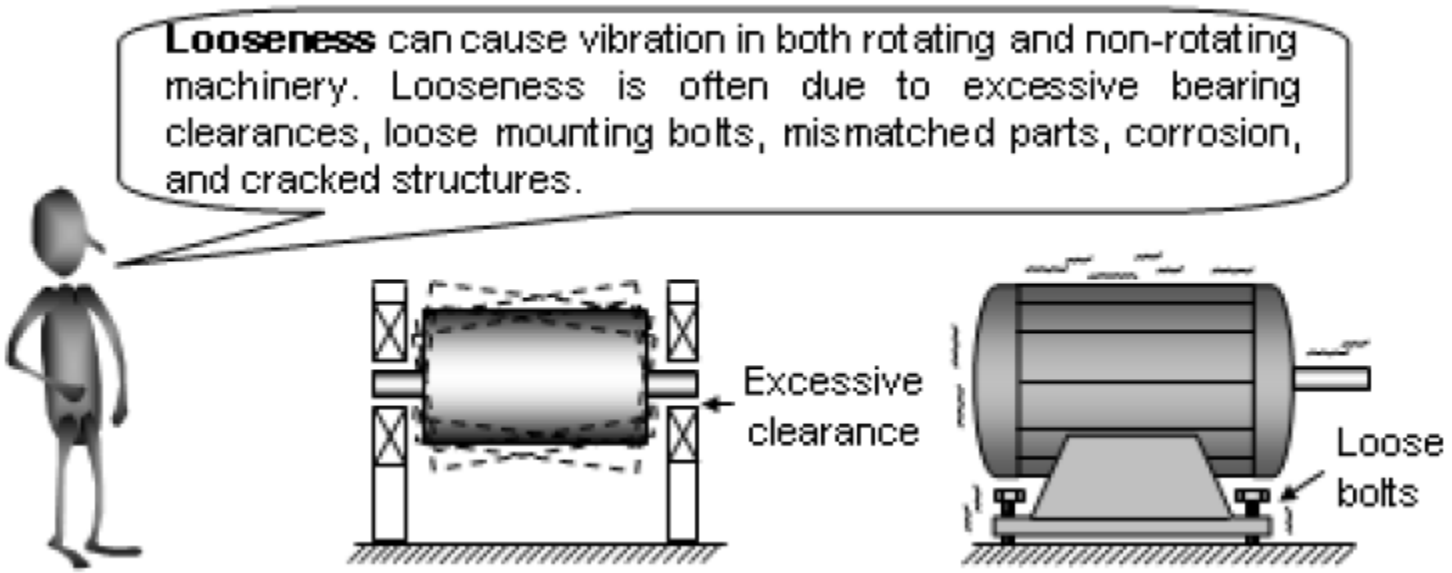


Vibration Analysis- Detection mode

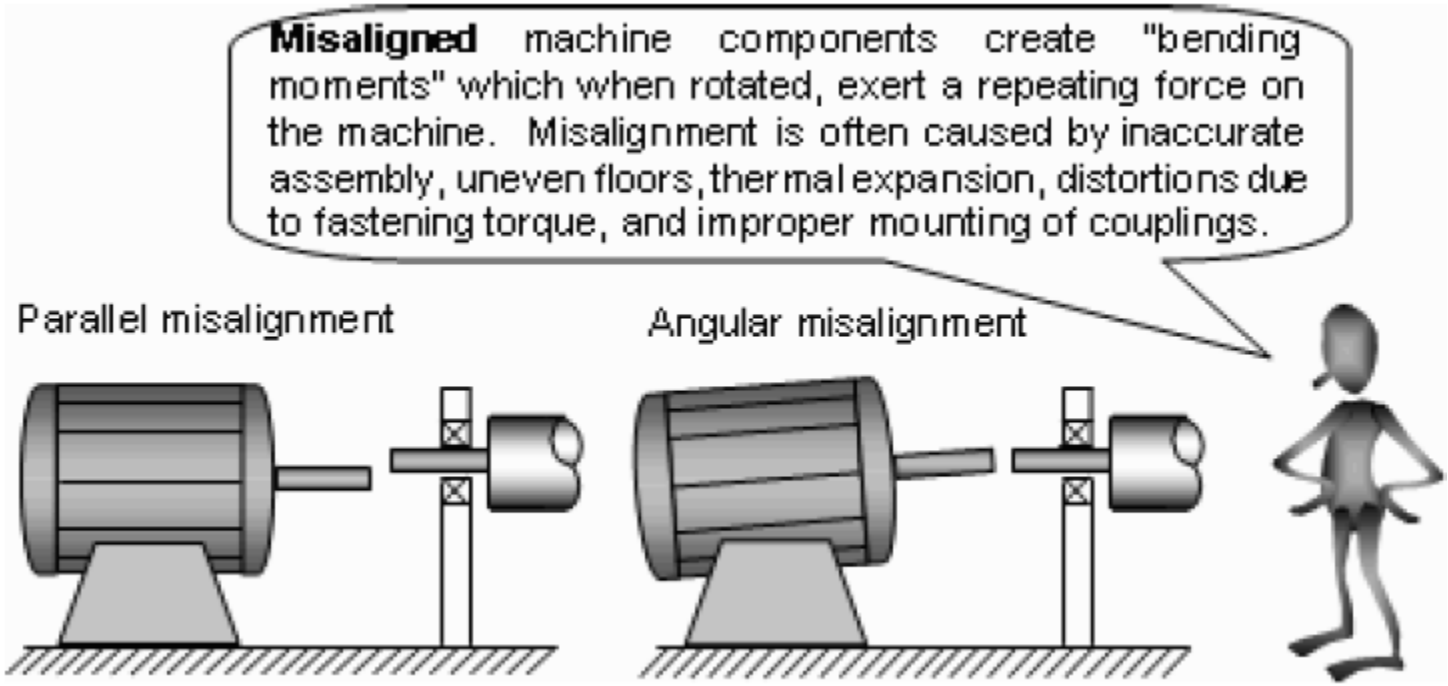
Improperly driven machine components exert a repeating force on the machine because of intermittent power supply. Examples include pumps receiving air in pulses, internal combustion engines with misfiring cylinders, and intermittent brush-commutator contact in DC motors.



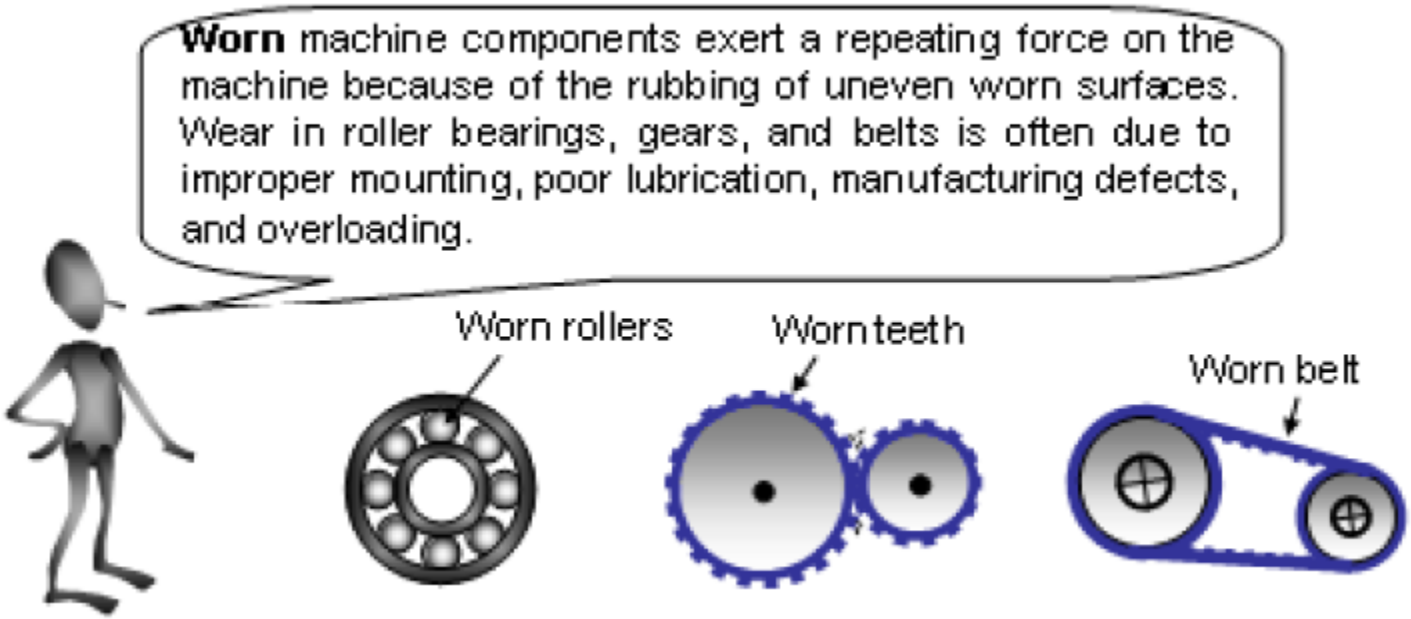
Vibration Analysis- Detection mode



Vibration Analysis- Detection mode

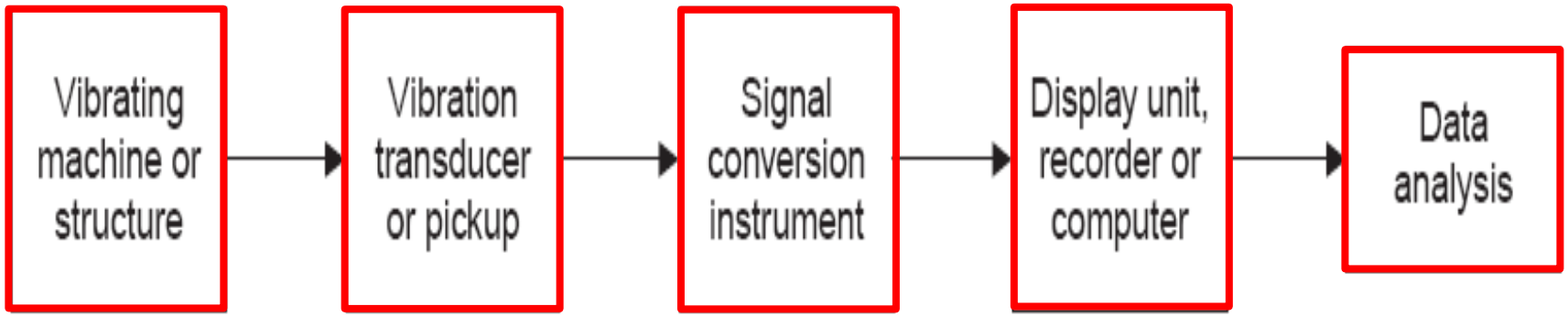


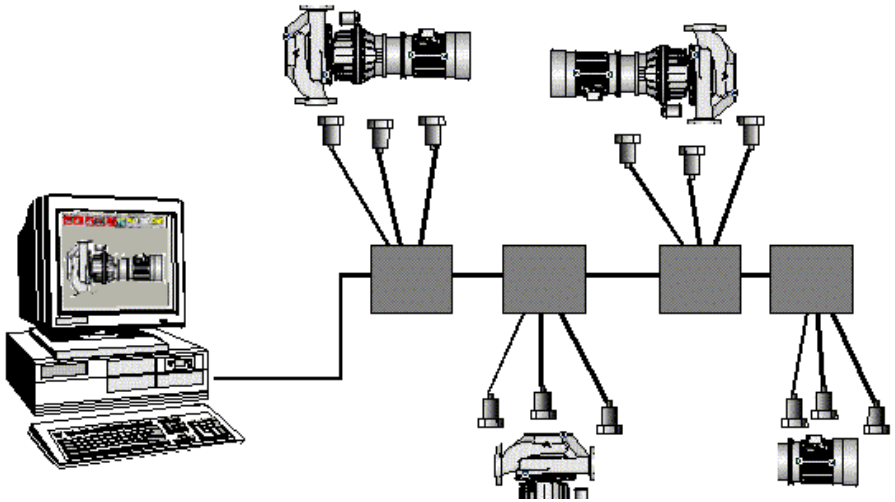
Vibration Analysis- Detection mode



Vibration Analysis- Detection mode

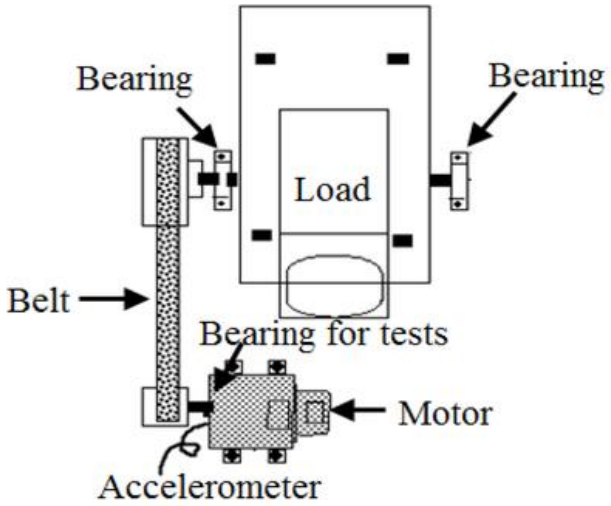
Vibration analysis system



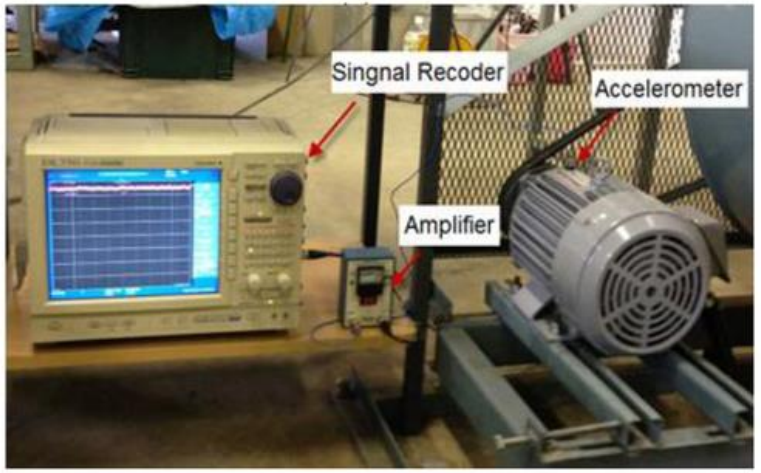


Vibration Analysis- Diagnosis mode

Vibration measurements in analysis (diagnosis) mode can be cost-effective for less critical equipment, particularly if budgets or manpower are limited. Its effectiveness relies heavily on someone detecting unusual noises or vibration levels. This approach may not be reliable for large or complex machines, or in noisy parts of a plant. Furthermore, by the time a problem is noticed, a considerable amount of deterioration or damage may have occurred.



(a)



(b)

Experimental Model Analysis

Experimental model analysis, also known as model analysis or model testing, deals with the determination of:

1. natural frequencies,
2. damping ratios,
3. mode shapes through vibration testing.

Two basic ideas are involved:

1. When a structure, machine, or any system is excited, its response exhibits a sharp peak at resonance when the forcing frequency is equal to its natural frequency when damping is not large.
2. The phase of the response changes by 180° as the forcing frequency crosses the natural frequency of the structure or machine, and the phase will be 90° at resonance.

Experimental model analysis