DOM Unit 6 Pyqs Solution:

May June 2023

Q7 a) What is vibration isolation? Discuss various methods of vibration isolators.

Vibration isolation:

- It is a process of isolating object, from any source of vibration.
- Is commonly used technique for reducing or suppressing unwanted vibration in structure and machines.

Method of vibration isolation

1. Passive Vibration Isolation:
   - Refer to vibration isolation of vibrations by passive technique such as rubber pads or mechanical springs.
   - It does not required external power to perform its function.
   - Passive isolation system such as shock mount in general contain mass spring and damping element and moves as a harmonic exiter.
   - Examples: spring or spring dampers Etc.

2. Active vibration isolation:
   - This system contained along with a spring of feedback circuit, which consist of sensor, controller and actuator.
   - Signal in it process by control circuit and amplifier.
   - This system today is used for application where structural smaller than micrometer have to be measured.
   - Examples: pneumatic actuator, linear motor etc.

3. Semi active vibration isolation:
   - Intermediate between active and passive.
   - In this system, damper change the vibration absorption properties according to characteristics of external vibration.
   - For any example of such a system in a car shock absorber. with Magneto rheological fluid.

Q7 b) Pass-by-noise:

- Our vehicle test that can refer to a procedure of measuring the noise emission level on and track is called pass by noise test.
- This test is to reflect the exterior noise emission level from the vehicle in an urban traffic environment.
- It allows you to log channels such as engine rpm, vehicle velocity and maximum vehicle noise.
- Over all, it is done to test the accuracy of the vehicle.
- ISO362 define the pass by test procedure by measuring noise emitted by accelerating road vehicles, to check whether they are following standards of vehicle exterior noise.

Q7 c) Write short notes on: Noise sources and control of industries

Sources of noise are mentioned below:

- Industrial sources: (Example of this are textile mill printing presses and metal work, etc.)
- Transport vehicles: (The other thing example of these are heavy truck bus train, etc.)
- Household: (Example of these are mixer grinder pressure cooker, exhaust fan, etc.)
- Public address system: (Example of this are loud speakers.)
- Agricultural machines: (Example of this are tractors, harvester Etc.)
- Defense equipment: (Example of this could be launching machines, launching of rockets etc)

Method of industrial noise control:

- Noise control at source: It aim to reduce hazardous noise at its source. Prevention through design promote research and design of quite equipment, helps in prevention of this through modern technology.

- Noise control in path: Through the changing of pathway, which include physical materials such as foam to absorb sound and wall to provide a sound barrier, helps in a voice control.

- Noise control at receiver: Administrative control such as restriction of personal in noisy area prevent unnecessary noise exposure. Personal protective equipment such as ear plugs or ear muffs are also helping in noise control.

Q8) a) Derive an relation between sound intensity level and sound pressure level.

Unit 6

-: Relationship between Sound Intensity level and Sound Pressure level:-

Sound intensity level is given by-

$$L_i = 10 \log_{10} \left(\frac{I}{I_{ref}} \right) \cdot dB$$

where I = Sound intensity

$$I = \frac{P_{rms}}{\rho c}$$

$$I_{ref} = \frac{P^2_{ref}}{\rho c}$$

I_{ref} = Reference Sound
ρ = Density of medium
c = Speed of sound

For air ρ = 1.21 Kg/m3 and c = 344 m/s3

$$L_i = 10 \log_{10} \left[\left(\frac{P^2_{rms}}{P^2_{ref}} \right) \times \left(\frac{P^2_{ref}}{\rho c \, I_{ref}} \right) \right]$$

i.e. $L_i = 10 \log_{10} \left[\frac{P^2_{rms}}{P^2_{ref}} \right] + 10 \log_{10} \left[\frac{P^2_{ref}}{\rho c \, I_{ref}} \right]$ ... ①

Also we know that from Sound Pressure level

$$L_P = 10 \log_{10} \left(\frac{P^2_{rms}}{P^2_{ref}} \right) \quad \dots ⑪$$

Now for air as medium
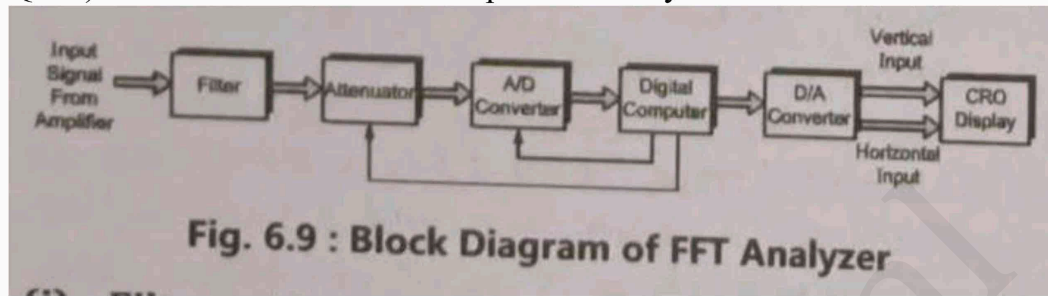P_{ref} = 2×10⁻⁵ N/m² I_{ref} = 10⁻¹² W/m²

∴ from ① & ⑪

$$L_i = L_P + 10 \log_{10} \left[\frac{(2×10^{-5})^2}{1.21 × 344 × 10^{-12}} \right]$$

$$\boxed{L_i = L_P - 0.1728}$$

Q.8 b) Write short notes on: FFT Spectrum analyzer

Fig. 6.9 : Block Diagram of FFT Analyzer
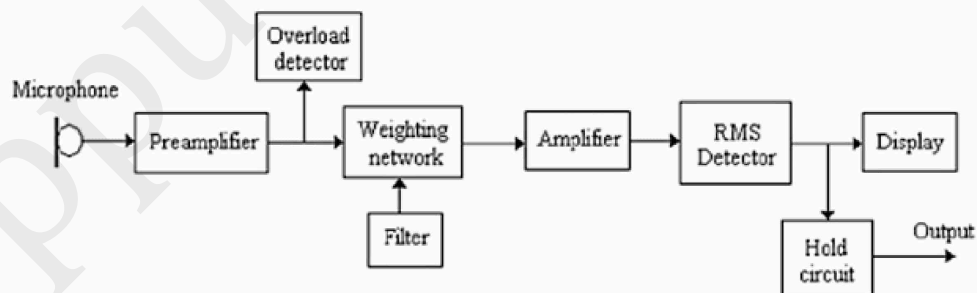
Fast Fourier transform analyzer (FFT): It is an instrument which convert input signal into frequency spectrum and display it in graphical form. Detail info of each component is mentioned below:

- Filter: Input signal are sent through filter it used to do of removing unwanted signals.
- Attenuator: It used to set level of signals that is to be filled to the analog digital converter. Main purpose is to prevent converter from overloading
- Analog digital converter (A/D converter): Signals are converted from analog to digital type in it.
- Digital computer: converted data is stored in the memory of computer. The computer has programmed for calculation and using the program.
- Digital to analog converter. (D/A converter): It used to convert , digital signal from computer into analog signal and and send to CRO to display the spectrum.
- CRO display: displace the spectrum

Q.8 c) Explain with neat sketch the working of sound level.

- Microphone: It is a primary sensor that captures soundwave and convert into electrical signals. It is a typically condenser microphone.
- Pre amplifier: It is used for amplifying electrical signal from microphone to a suitable level for accurate measurement.
- Frequency wetting network: Two commonly used frequency weighting are A-weighting and C -weighting. A-weighting is used for general environmental noise measurement While C -weighting is used for measuring high sound levels.

- Route Main Square detector (Rms detector) : Use for measuring average power of the signal. The rms value is proportional to sound pressure level.
- Display and control: The sound level matters include display unit to show major sound level. It can be analog meter, a digital or both.

May June 2024

Q7) a) Differentiate Time domain and frequency domain Analysis. Explain how frequency spectrum can be used to detect vibration related faults in a system.

Parameter.	Time domain analysis.	Frequency domain analysis.
Definition.	Analysis signal or system basis on how they vary over the time.	Analysis, signal or system basis on their frequency components.
Representation.	Signal or system is represented as function of time.	Signal or system is represented as a function of frequency.
Focus	Steady state responses.	Magnitude
Application.	For calculating time delays	Used for analysis of frequency responses and signal processing.
Advantages	Of real world behavior over time.	Understanding system stability and resonance in frequency term
Visualization.	Graphs are plotted as amplitude versus time.	Graphs are plotted as amplitude versus frequency.
Examples.	Circuit voltage changes overtime.	How circuit response over different frequency.

A frequency spectrum show the vibration frequencies present in a system. Steps to detect faults:
- Collect vibration data from the system.
- Convert data into frequency spectrum.
- Look for unusual pics or pattern in the spectrum.

Q7) b) Write a short note on piezoelectric accelerometer.

- It is a sensor which is used for measuring and analyzing vibration and acceleration
- It is based on piezoelectric effect, where certain material can generate an electric charge when subjected to mechanical stress or any kind of deformation.
- In it, piezoelectric crystal or ceramic material is typically used.
- When the accelerometer is subjected for performing acceleration, the material expense mechanical stress and form electric charge.

- This charge is then measured by electric circuit and converted into electrical signal and then send further processing and analyzing.

Q7) c) Explain any one vibration isolator with a neat sketch.

- Vibration isolator is a device or system which is used for reduction of transmission of vibration between two objects or structure.
- Commonly used in structure from external vibration so that they should perform properly and prevent from damage.
- One example of vibration isolator is passive rubber mount.
- Rubber mound used to absorb the vibration and prevent them from being transmitted to the isolated object.
- Which help to reduce the effect of vibration such as mechanical noise, stocks and vibration from other machineries in environment.

Q8) a) Derive a relation between sound intensity level and sound pressure level

Repeated question, solution is already provided.

Q8) b) Explain anechoic chamber and reverberant chamber.

Anechoic chamber:
- It is a special room with no echoes or reflections.
- Walls, floors and selling are covered with sound absorbing materials.
- It is used for accurate sound measurement, antenna testing and electromagnetic compatibility testing.

Reverberant chamber.

- A room designed to create a lot of echoes and reflections.
- Hard reflective surfaces like metal or concrete are used.
- It is used for testing the sound quality of audio equipment acoustic measurement and electromagnetic compatibility testing.

Q8) Define the following terms:

i) Sound absorbing coefficient.
ii) Sound transmission coefficient.

- Sound absorbing coefficient: It is a measure of how much sound energy is absorbed by a material. Its number between 0 (No absorption) and 1 (total absorption.)
- Sound transmission coefficient: It is a measure of how much sound energy passes through a material or partition. Its number between 0 (No transmission.) and 1 (total transmission.)

Nov-Dec 2022.

Q7) a) What are various frequency measuring instruments? Explain any one in detail

Frequency measuring instrument are of mechanical type and based on principle of resonance. There are three frequency measuring instrument

- Fullarton tachometer
- Frahm tacometer.
- Stroboscope.

Stroboscope:

- It is a instrument that provide intimate illumination of rotating or vibrating object, to study motion of the object means that through this instrument, we use to determine rotary speed or vibration frequency.
- Also known as strobe.
- The frequency of light pulses, which are produced, can be changed or read easily from control panel instrument.
- It is used for measuring angular speed between the range of 600 to 20,000 rpm.

Q7) b) Explain in brief various sources of noise.

Repeated question, solution is already provided.

Q7) c) Explain anechoic chamber and reverberant chamber?

Repeated question, solution is already provided.

Q8) a) What is meant by time domain and frequency domain analysis? Explain how frequency spectrum can be used to detect vibration related faults.

b) Write short note on "Noise control in industries"

Q8 c) Write a short note on condition monitoring of machines.

Condition monitoring checks a machine held while it's running. This helps to detect problem early, reducing time and saving money. Condition monitoring is done for catching problem early and keep your machine running smoothly.

Methods:

- Vibration analysis: Measures vibration to detect imbalance or wear in machines.
- Temperature monitoring: It used to check the temperature to detect overheating or cooling issues.
- Oil analysis: it is used to detect and analysis of oil from contamination or wear
- Acoustic emission: It used to listen high frequency sound to detect defects.

Advantages:

- Predictive maintenance, means that schedule maintenance before problem occur.
- reduces downtime
- Increase in the productivity of machines.
- Machine life get expanded.

Nov-Dec 2023

Q7) a) What is FFT analyzer? Explain the importance of frequency spectrum for machinery fault detection.

Repeated question, solution is already provided.

Q7) b) Explain the process of vibration measurement.

Vibration measurement process could be classified into four categories:
- Preparation.
- Measurement.
- Data analysis.
- Reporting

1. Preparation:
   - Choose the location where measurement should be done
   - Select the sensor as per the requirement.
   - Calibrate the sensors, so that it should work properly.

2. Measurement:

- Attach the sensor to the machine..
- Connect us insert to the machine
- Take the proper readings over a set period of time.
- Measure the vibration parameters.

3. Data analysis:
   - Use the software to analyze the collected data.
   - Look the pattern in the data.
   - Assess the vibration level and its impact.

4. Reporting:
   - Record a measure. Result and analysis..
   - Suggest action to address any vibration issues.

Q8) a) What are different methods of vibration control? Explain any one in detail.

b) Explain with neat sketch the working of sound level meter.

c) Explain anechoic chamber and reverberant chamber.

Repeated question, solution is already provided.