MEL 314: Noise Engineering

Major test (Part II)

Total Time for the two parts: Two hours Max. Marks: 60

Note: Make suitable assumptions, if required, giving justification. If not given, the speed of sound and the density of air can be taken as 343 m/sec and 1.206 kg/m3 respectively.

Q1. A pulsating sphere of radius 0.01m has a radial surface displacement which varies harmonically at 50Hz with a surface velocity magnitude of 0.1m/s. a) Calculate the magnitude of the pressure fluctuations generated at a distance of 10m from the center of the sphere. (b) Calculate the phase difference between the radial acoustic particle velocity and acoustic pressure at 0.5m and 10m from the center of the sphere and comment on the difference in the two results. (8)

Q2. A baffled thin rectangular plate of thickness 2mm is acted upon by a transverse harmonic force of frequency 60Hz. The amplitude of transverse velocity of vibration of the plate is 2m/sec. The properties of the plate material are: E= 2e+11 N/m2, surface density = 16 kg/m2, Poison's ratio= 0.3. Treat the plate as an infinite plate for this problem.
a) What is the critical frequency and the radiation efficiency of the plate? b) What is the sound power radiated by the plate. Justify your answer in b). (8)

Q3. An outdoor compressor is generating a sound power level of 120 dB at 500 Hz. The government regulations require sound pressure level at the property line 10 m away not to exceed 75 dB during the day and 70 dB during the night operation in an industrial area. Evaluate the minimum insertion loss for which the acoustic enclosure for the compressor should be designed in order to meet the statutory limit for 24-hour operation of the compressor. (8)

Q4. A 4m high and 5m long acoustic barrier is erected in the center of a $10m \times 8m \times 5m$ (high) room with average sound power absorption coefficient of 0.2 in the 500-Hz band as shown in the figure below. What is the insertion loss of the barrier in this frequency band for a set of source (S) and receiver (R) if both are located 1.5 m from the ground and 3m on opposite sides of the barrier? Explain with reasons the insertion loss you got. (8)

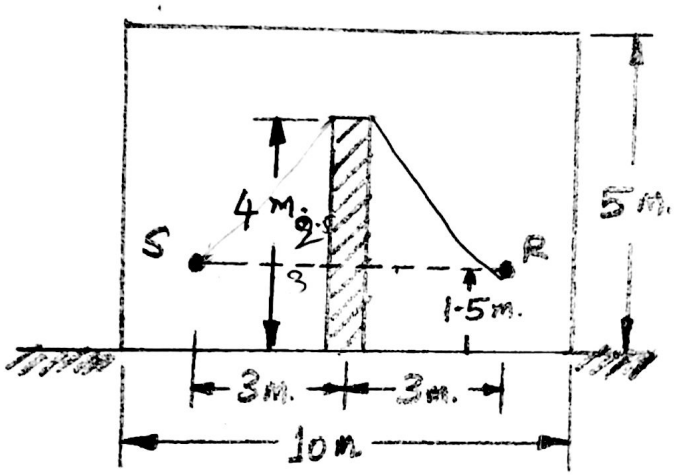
Q5. A pump is operating in a room at 6000 RPM. It is proposed to line the surfaces of the room with sheets of sound absorbing material. a) What is the minimum thickness of the sheet needed for effective sound absorption? b) Explain the principle involved in arriving at the thickness. (8)

Q6. What do you mean by the acoustic near-filed and acoustic far-field? How sound power of a source can be estimated by making far-field measurements? (5)

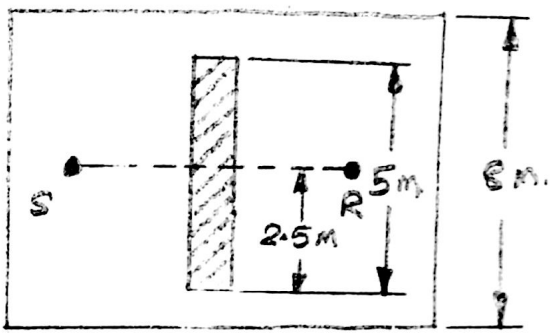
Q7. Sketch qualitatively the polar directivity patterns of the far-field complex pressure due a baffled piston of radius 0.1m being driven at a frequency of (i) 500Hz (ii) 2.5kHz and (iii) 10kHz. (5)

Q8. What is a Dipole and a Quadrupole model of a sound source? Give one example of each. (5)

Q9. Why the flexural waves in structures are called dispersive? (5)



FRONT VIEW



TOP VIEW