

B.E. Civil Engineering (Part Time) 5<sup>th</sup> Year 2<sup>nd</sup> Semester Examination (Old), 2017

Subject: Wind Engineering

Time: Three Hours

Full Marks: 100

Answer Any Four (4)

Question 1 (a) Define Buckingham PI theorem. Using the principle of dimensional analysis obtain the expression for (i) Force coefficient (ii) Reynold's number and (iii) Mach number and hence show that the aerodynamic force coefficient is a function of Reynold's number and Mach number. (15)

(b) Consider a flow over two cylinders, one having four times the diameter of the other. The flow over the smaller cylinder has a free stream density, velocity and temperature given by  $\rho_1$ ,  $V_1$  and  $T_1$  respectively and the flow over the larger cylinder has the parameters given by  $\rho_2$ ,  $V_2$  and  $T_2$ . It is stated that  $\rho_2 = \rho_1/4$ ,  $V_2 = 2 V_1$  and  $T_2 = 4 T_1$ . Assume that the speed of sound in the fluid and the viscosity are proportional to  $T^{1/2}$  show that the flows are dynamically similar. (10)

Question 2 (a) Define a stationary, ergodic process in the context of stochastic vibration process. (5)

(b) Prove that for a random variable the variance is equal to the difference of mean square value and the square of the mean value. (5)

(c) Calculate the (a) mean value (b) autocorrelation function (c) mean square value (d) Variance and (e) Standard deviation for the function shown in figure 1. Also plot the autocorrelation function as a function of time. (2 + 6 + 2 + 1 + 1 + 3)

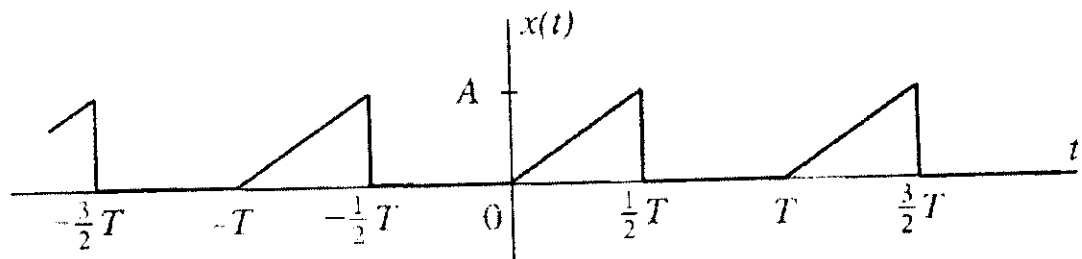


Figure 1

Question 3 Write short notes on

- Cross wind excitation due to turbulence
- Wake Excitation
- Aerodynamic damping and Galloping
- Flutter
- Boundary layer formation and flow separation

(5 x 5)

Question 4 Using Gust Factor approach as per IS 875 (part 3) calculate the wind pressure at the top and the mid height of a 150 m tall RCC building with a plan area of 30 m x 30 m. The building is to be constructed in the centre of the city of Chennai with large number of closely spaced tall structures around. Assume the basic wind speed to be 50 m/s, probability factor = 1.0 and topography factor = 1.0. (25)

Question 5 (a) Develop the expression for Gust Spectrum on a point like object as a function of Wind Speed Spectrum. State the limitation of the developed relationship. (10)

(b) Define aerodynamic admittance. How is the developed Gust Spectrum modified in terms of aerodynamic admittance? (3 + 2)

(c) How is the peak Gust Response estimated in terms of Resonant part and Background part? (10)