BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR
M. E. (E. M.) 1st Semester Final Examination, 2013
Subject: Hydraulic Model I (AM 908)
Full Marks 70 **Time: 3hrs**
Attempt *ANY FOUR* Questions
Two marks are reserved for neatness

Q. 1. a) A uniform wind in a desert lifts sand into the air. Assuming that all sand grains have the same diameter, list the variables that determine the weight of sand in the air, per unit area of land surface. Make a dimensional analysis of the problem.
b) An aeroplane model of scale 1:30 is tested in water which is 50 times more viscous and 800 times more dense than the air. If the pressure drop in the model during test is 225.63 N/m^2, find the corresponding pressure drop in the prototype.

Q. 2. a) What do you mean by Repeating Variables? How are the Repeating Variables selected for dimensional analysis?
b) Determine the dimensional matrix and compute the dimensionless products of variables volume Q, acceleration A, velocity V, power P, momentum M and angular velocity N.

Q. 3. A body at 10^0C is dropped into a large bath of liquid which is maintained at a uniform temperature of 100^0C. In 5 min, the temperature at a point in the body rises to 40^0 C. In how many more minutes will the temperature rise from 40^0 C to 98^0 C? Derive the expression used here.

Q. 4. a) An airplane is flying through a rainstorm. Assuming that all the raindrops have the same diameter and that the shape of the nose of the fuselage is given, list the variables that determine the number of raindrops that strike the windshield per second. Make a dimensional analysis of the problem.
b) The model of a boat is made to a scale 1:60. The model boat has a wave resistance of 0.025 N while operating in water at a velocity of 1 m/s. Determine the corresponding wave resistance of the prototype. Find also the power required for the prototype. What velocity does this test represent in the prototype?

Q. 5. a) Explain the terms 'distorted models' and 'undistorted models'. What is the use of distorted model?
b) A circular cylinder of a given length/diameter ratio is kept in steady rotations at N revolution per second in a uniform stream of fluid of velocity V. Assuming that the power P required to maintain the motion depends only on the density ρ and kinetic viscosity ν of the fluid and the diameter D of the cylinder and also on V and N, show that

$$P = \rho\gamma^3 D^{-1}\varphi\,(VD/\gamma,\ ND^2/\nu)$$