Agricultural and Food Engineering Department
IIT Kharagpur
End Spring Semester Examination 2009

Sub: Computational Techniques in Fisheries Subject No.: AG 60110
Date of Examination: 24.04.2009 (F.N.) Full Marks: 100 Time: 3 hrs. No. of students: 08
Answer any five questions. Make reasonable assumptions. **Answer different parts of a question at one place.**

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1. (a) A twine is drawn into a straight line, fixed at points O_1 and O_2. A force F perpendicular to the twine is applied at its centre. Show that the tension of the twine T is given by

$$T = \frac{F}{2}\left(\frac{2EA}{F}\right)^{1/3}$$

where, A = cross-sectional area of twine and E = modulus of elasticity of twine. (10)

(b) A rectangular pontoon 18 m long with a breadth of 6 m has a displacement of 300 tonnes with its CG 3.0 m above the keel. Calculate metacentric heights before and after the addition of a 50 tonnes weight at 0.5 m above the bottom of the pontoon. (10)

2. (a) A cylinder of radius 'r' and length 'l' is supported at two points at the floor and the adjacent wall respectively. The cylinder retains water only at the opposite side of the wall. Derive the expressions for the horizontal reaction at the wall and the vertical reaction at the floor. (10)

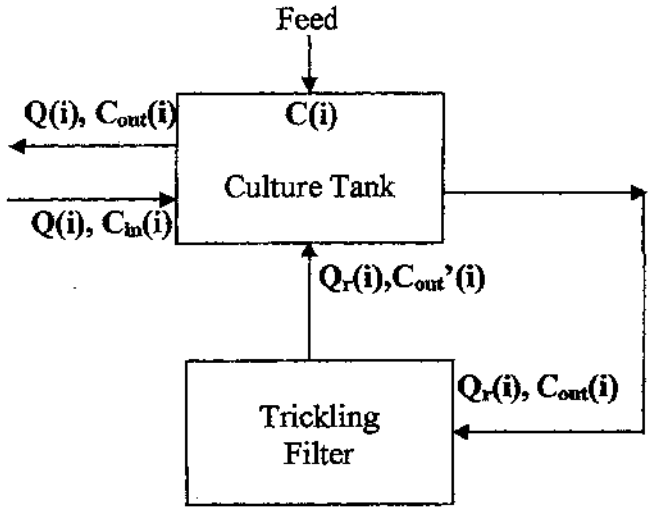
(b) A fishing vessel was found to have the following principal dimensions at one stage of design: L = 360 m, B = 42 m, T = 12 m, Δ = 1200 MN, KB = 7 m, KM = 21 m and KG = 18 m. It is desired to reduce draft to 11 m keeping length, displacement and block coefficient constant. Assuming KG remains unaltered, calculate the new GM and new breadth. (10)

3. (a) A ship of 6000 tonnes displacement is under inclining experiment. The weights for inclining the vessel are arranged in four equal units of 10 tonnes and each is moved transversely through a distance of 10 m. The pendulum deflections recorded are 31, 63, 1, -30, -62 and 0 cm with pendulum length of 7 m. Calculate the metacentric height of the vessel at the time of experiment graphically. (10)

(b) Prove that distance of centre of buoyancy from water level is $\frac{1}{3}\left(\frac{T}{2}+\frac{\nabla}{A_{wp}}\right)$.

4. The material flow diagram of a recirculating aquaculture system is shown in the following figure. C(i) represents concentration of any pollutant inside the culture tank, Q(i) and Q_r(i) represent make up flow rate and recirculating flow rate respectively, C_{out}(i) and C_{out}'(i) represent

concentration of any pollutant at the inlet and at the outlet of the trickling biofilter respectively, $C_{in}(i)$ represent concentration of any pollutant in the freshwater that is added as a make up water to the culture tank and 'i' represents at any instant. Develop a set of model expressions for Q(i) and $Q_r(i)$, assuming the culture tank to be a completely mixed system and the trickling filter to be a plug flow reactor.



(20)

5. Develop a steady state model for trickling filter for predicting the concentration profiles of ammonium, nitrite and nitrate along the filter depth as a function of the operating parameters in continuous operation. (20)

6. a) Develop a mathematical model to predict the nitrogen (N) dynamics in an extensive fish culture pond. Assume fertilizer and formulated feed are not added to the pond. (12)

b) State Newton Raphson method. Also write down a computer algorithm for solving an equation using this method. (8)