**INDIAN MARITIME UNIVERSITY**
(A Central University, Government of India)
End Semester Examinations December 2018
M.Tech. (Marine Engineering and Management)
Semester-I
Marine Machinery and Plant Design (PG13T1102)

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Date :27-12-2018   Maximum Marks : 100
Time: 3 Hrs   Pass Marks   : 50

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Note: Answer any five questions. All questions carry equal marks.
                                         (5 x 20 Marks = 100 Marks)

1. For the tank system shown, the differential equation is
   $\frac{dh}{dt} + \frac{kh}{A} = \frac{Q_{in}}{A}$,where Q_{in} is inflow rate , A is the surface area of the fluid , and k is proportional constant relating fluid level, h , to outflow rate Q_{out}
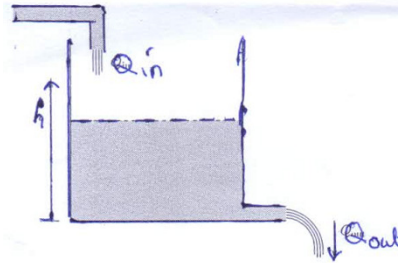
   (a) Find the transfer function, relating Q_{in} to h assuming that the tank starts off empty condition.

   (b) Using the Laplace transforms, determine the time domain response to a unit step and a unit ramp input   [10+10=20]

2. (a) A pair of spur gears with 20^0 full depth involute teeth consists of a 20 teeth pinion meshing with a 41 teeth gear . the module is 3 mm while the face width is 40 mm. The material for the pinion as well as for the gear is steel (UTS=600 N/mm^2). The gears are machined to meet the specifications of Grade 8 and heat-treated for a surface hardness of 400 BHN. The pinion rotates at 1450 r.p.m and the surface factor for the application is 1.75. If Lewis Form Factor is 0.32 for 20 teeth, calculate the beam strength and wear strength.[Assume factor of Safety=1.5]

(b) Discuss key success factors of Wärtsilä diesel engine for optimizing lifecycle efficiency.   [14+6=20]

3. Ships emissions may be transported hundreds of kilometers, median transport velocity of SOx and NOx is about 400 km per day and the mean residence times of 1 to 3 days, indicating mean transport distances of 400 to 1200km. In this context, discuss

   a) Hazardous Effects of SOx and NOx emissions.

   b) MARPOL Legislation /other IMO Major regulations

   c) Methods of SOx and NOx emission reduction
                                                        [07+06+07=20]

4. Make a modeling of exhaust system of 6 cylinder Marine Diesel Engine with direct injection (power ranging up to 331 kW) and for a maximum speed of 1800 rpm.   [20]

5. (a) Describe Process of condition monitoring by a flow chart, advantages of condition monitoring and types of sensor used, measurement process of metal temperature in condition monitoring.

   (b) Describe the measurement process of metal temperature, piston ring measurement and fuel injection pressures   [10+10=20]

6. (a) A reliability test was carried on Christmas tree light bulbs. The time at which failures occurred (in units of 10^3 hours) were as follows :
   0.4, 0.9, 1.3, 1.7, 1.9, 2.4, 3.0, 3.3, 3.6, 4.1, 4.5, 5.0, 5.3, 5.6, 6.1,6.4, 6.9, 7.1, 7.5, 7.9,8.3, 8.6, 8.9, 9.5, 9.9
   Use the data to estimate mean time to failure and mean failure rate.

   (b) Draw the bathtub hazard rate curve and discuss its three important regions.
                                                        [10+10=20]

7. (a) Estimate the maximum Hertizian contact pressure, size of the contact area and maximum shear stress when a 10 mm dia cylinder in contact vertically with a 30 mm dia cylinder with 85 N loading [take E_1 and E_2 are 70 & 80 GPa respectively , v_1 and v_2 are each 0.35]

(b) An marine vessel safety system is made up of eight independent subsystems in series and it specified failure rate 0.009 failures/h. Subsystems 1, 2, 3, 4, 5, 6, and 7 estimated failure rates from previous experience are 0.001 failures/h, 0.002 failures/h, 0.003 failures/h, 0.004 failures/h, 0.005 failures/h, 0.006 failures/h, and 0.007 failures/h,0.0008 failures/h , respectively. Allocate the specified system failure rate to seven subsystems.

[10+10=20]

8. (a) Discuss Life cycle assessment of ships

   (b) Define Reliability, Availability & Maintainability

[14+6=20]

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