CALEDONIAN COLLEGE OF ENGINEERING

FINAL EXAMINATION

Programme: B.Sc. Degree in Chemical Engineering

Session: 2013 – 14
Level: 1
Date: 12 Jun 2014

Semester: B
Duration: Two Hours
Max Marks: 100

MSES108 Engineering Physics

Candidates should attempt ANY FOUR Full Questions

Please read the Questions carefully

Materials to be Supplied/Allowed:
Question paper (Supplied)
Blank Examination Script (Supplied)
Non-programmable calculator (Allowed)
Q1(a) Consider a system of four masses moving with a constant acceleration of \(2\text{m/s}^2\) as shown in Figure Q1(a). By neglecting the effect of friction, evaluate \(\frac{T_1}{T} + T_2\).

\[2\text{m/s}^2\]

\[m_3 = 6\text{kg}\]
\[m_4 = 8\text{kg}\]

\[2\text{m/s}^2\]
\[m_2 = 5\text{kg}\]

\[m_1 = 4\text{kg}\]

Figure Q1(a)

(b) Consider a non-viscous liquid that enters with a velocity \(v_1\text{m/s}\) at one end of a glass tube having an area of cross section \(A_1\). The liquid comes out at the other end of the tube with a velocity \(v_2\text{m/s}\) having an area of cross section \(A_2\). If the diameter of the entry part of the tube is known, how could Equation of Continuity be used to calculate the Diameter of the other end of the tube?

\[5\]

(c) (i) Explain the concept of Heat Transfer.

\[4\]

(ii) Write any two modes of heat transfer.

\[2\]

(d) Two bodies of masses 7kg and 4kg are located respectively at the origin and (-5, 4) of an X-Y coordinate system. Locate the Position where the entire mass of the system is supposed to be concentrated.

\[4\]
Q2(a) Calculate the Change in Kinetic Energy acquired by a body of mass 20kg initially at rest and subjected to a force of 80N in 12seconds. [7]

(b) The acceleration at extreme position of a system undergoing in simple harmonic motion is -23cm/s². If the amplitude of oscillation is 6cm, calculate the

(i) Period of Oscillation. [6]

(ii) Frequency of Oscillation. [2]

(c) Compare Isothermal Process from Adiabatic Process. [6]

(d) (i) State Pascal’s Law. [2]

(ii) Define Buoyancy [2]

Q3(a) (i) Identify the physical quantity given by the expression \( \frac{2\pi}{r} \sqrt{r^2 - y^2} \) and hence derive the given relation. Where \( r \) is the amplitude and \( y \) is the displacement at any instant. [6]

(ii) Discuss the variation of that physical quantity at the origin and the extreme ends. [4]

(b) If the Torque (\( \tau \)) acting on a body is zero, prove that the Rotating Analogue of Linear Momentum (L) of the body will be a constant. [7]

(c) State the Law of conservation of Energy. [2]

(d) Write any six Characteristics of Uniform Motion. [6]
Q4(a) A 2kg mass hung on a spring and moves simple harmonically as
function of time as $y = 4 \sin 1.4t$, where $y$ is measured in meters and $t$ in
seconds.

(i) Write the Equation for Acceleration of the body in simple harmonic
motion in terms of sine function.

(ii) Calculate the Spring Constant.

(iii) Calculate the Restoring Force exerted on the mass by the spring for
a displacement of 3cm.

(b) A stone is tied to the end of a string 3m long is whirled in a horizontal
circle with constant speed. If the stone makes 12 revolutions in
0.4 minutes, calculate the Magnitude of the Centripetal Acceleration.

(c) Moment of inertia of a rigid body about a fixed axis is defined as the
sum of the products of the masses of the entire particle constituting the
body and the square of their respective distance from the axis of
rotation. Explain the Physical Significance of Moment of Inertia of a
rigid body.

(d) Explain the concept of Internal Energy.

Q5(a) (i) By keeping the pressure constant, $140^\circ$C steam is made by heating
7kg ice at $-20^\circ$C. Estimate the amount of Heat required for this
conversion at constant pressure. [Specific heat of ice =2100J/kg K,
Latent heat of fusion of ice =3.36×10^3J/kg, Specific heat of water
=4200J/kg K, Latent heat of vaporization of water =2.25×10^6J/kg]

(ii) Compare the Variation of Specific Heat of a gas during Isothermal
Process and Adiabatic Process.

(b) Distinguish between Stream Lined Flow and Turbulent Flow.

(c) A machine is doing a work of 400KJ by consuming a power of 700W.
Calculate the Time (in minutes) taken by the machine for completing
this work.
Q6(a) A truck of length 140m initially at rest accelerates to a particular direction with a velocity of 42km/h. A bus of length 105m starts at the same time and moves in opposite direction of motion of the truck with velocity 30km/h. By neglecting the effect of friction, When these two vehicles will completely cross each other. [7]

(b) Calculate the Angular Momentum of Neptune about sun. The mass of Neptune is \( M_N = 10^{27} \text{kg} \), its distance from the sun is \( r = 5 \times 10^{12} \text{m} \) and the period of revolution around the sun is \( 5 \times 10^5 \text{s} \). [7]

(c) Explain the following

(i) Thermal Equilibrium. [4]
(ii) Periodic Motion. [3]
(iii) Hydraulic Lift. [4]

End of Question Paper