THE OPEN UNIVERSITY OF SRI LANKA

DIPLOMA IN TECHNOLOGY– FOUNDATION (LEVEL 02)

FINAL EXAMINATION 2011/2012

MPZ 2311 – APPLIED MATHEMATICS – PAPER II

DURATION – THREE (03) HOURS

DATE : 28th February 2012   TIME: 0930 – 1230 hrs.

ANSWER (06) QUESTIONS ONLY. YOU CAN USE CALCULATORS.
YOU CAN'T USE MOBILE PHONES AS CALCULATORS.

01. a) A motor car starts from rest with a uniform acceleration $3f$. After a certain time the acceleration ceases and it experiences a uniform retardation $4f$, until it is brought to rest. If the total distance travelled is d, and the total time taken is T. By sketching velocity time graph find the maximum velocity of the motor car in terms of f and T.

Show that $d = \dfrac{6fT^2}{7}$

b) A boat X whose full speed $60 \, kmh^{-1}$ is located 20km due west of ship Y, which is travelling uniformly with speed $20 \, kmh^{-1}$ in the direction due north the boat X travels at full speed in a direction chosen so as to intercept ship Y as soon as possible. Find the direction of X, and calculate to the nearest minute the time that X would take to reach Y.

02. a) A particle of mass 3m slides down a smooth face, of inclination 30^0 to the horizontal of a wedge of mass nm which is free to move on a smooth horizontal table. Show that the acceleration of the wedge is $\left(\dfrac{3\sqrt{3}g}{4n+3} \right)$ and find the reactions between the particle and the wedge(R)and between the wedge and the table(S).

If the wedge is fixed, deduce the value for R.

b) A particle is projected from the point O with velocity $10 \, ms^{-1}$ at an elevation $Sin^{-1} \, 3/5$ strikes the horizontal plane, through O at A. Find the distance OA. Show that if another particle is projected from O with the same elevation to hit a target at a height 6m above A, then the velocity of the projection must be $10\sqrt{6} \, ms^{-1}$.
(Where $g = 10 \, ms^{-2}$).

03. a) A smooth sphere of mass m, moving with speed u on a smooth horizontal table, impinges directly on an equal sphere of mass m' which is at rest. If half the kinetic energy is lost in the impact, prove that $m = m'(1 - 2e^2)$ where e is the coefficient of restitution between the two spheres.

Deduce that $e < \dfrac{1}{\sqrt{2}}$

b) A train of total mass 600 metric tons travelling at a constant speed of $72 kmh^{-1}$ on a straight level track and the total resistance to the motion is 60 Newtons per metric ton. Calculate the power of its engine. The rear coach of mass 90 metric tons, then gets disconnected, but the tractive force of the engine remains unaltered. Assume that the motion of this coach is retarded by the resistance alone.

Find (i)   the retardation of the disconnected coach.
     (ii)   the distance moved by the disconnected coach before coming to rest.

04. a) A rough horizontal plate rotates with constant angular velocity ω about a fixed vertical axis. A particle of mass m lies on the plate at a distance $\dfrac{3a}{2}$ from this axis. If the coefficient of friction between the plate and the particle is $\dfrac{2}{5}$ and the particle remains at rest relative to the plate. Show that $\omega^2 \le \dfrac{4g}{15a}$.

b) A particle is travelling between two points A and B with linear simple Harmonic Motion. If the distance AB is 8m and the maximum acceleration of the particle is $12 ms^{-2}$. Find the time taken to travel

i.   Distance 2.0m from A.
ii.   From A to the mid point O of AB.
iii. From the mid point of AO to the mid point of OB.

05. a) Forces (3,0), (0,4), (2,0), (0,5) and (X_0, Y_0) act at the points (0,0)(3,0), (3,4), (0,4) and (a,0) respectively. The anticlockwise moments of the system about the points (0,0) (3,0) , (3,4) are M_1, M_2 , M_3 respectively. Find the values of X_0, Y_0 interms of M_1, M_2 and M_3.

i.   If $M_1 - M_2 = 27$, find the value of Y_0.
ii.   If $M_3 - M_2 = 20$, find the value of X_0.

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b)   A uniform rod PQ of weight w is hinged at the end P and held so that PQ makes an angle $\theta = Sin^{-1} \frac{3}{5}$ with the downward vertical by a string connecting Q to a point L vertically above the hinge P such that LP = PQ. Find the magnitude and direction of the reaction at the hinge.

06.   a)   A uniform rod AB of weight W is in limiting equilibrium with end A on horizontal ground and B against a vertical wall. The vertical plane containing AB is perpendicular to the wall. The coefficient of friction between the rod and the ground is $\frac{3}{7}$. The coefficient of friction between the rod and the wall $\frac{3}{4}$. Given that the inclination of AB to the horizontal is α. Calculate,

      i.   the normal reaction at A and B
      ii.   Find the value of Tan α

b)   The framework consists of four light rods AB, BD, DC and CB freely jointed at B,C,D and attached to a vertical wall at A and D.A weight of 600N is suspended from C. Find the reactions at A and D. Find the stresses in all the rods by graphical method.
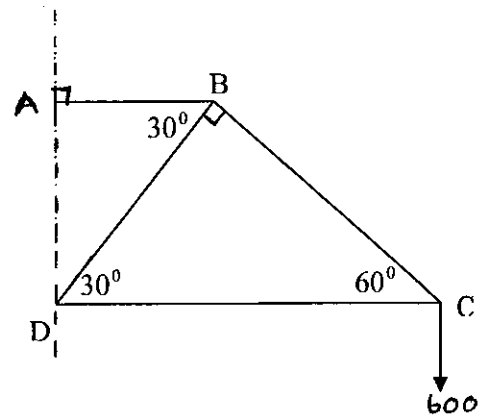
07.   A hollow vessel in the form of a closed right circular cone, of radius r and slant height $2r$, is made of uniform thin sheet metal. Show that its centre of gravity is at a distance $\frac{7}{3\sqrt{3}} r$ from the vertex. If, when a concentric circular portion of radius a $(<r)$ has been removed from the base then the new centre of gravity lies at a distance $\frac{10\sqrt{3}}{13} r$ from the vertex. Find the value of a.

{you can assume that the centre of gravity of a uniform hollow right circular cone of height h is at a distance $\frac{2}{3}h$, on its axis, from the vertex}

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08. a) Two events A and B are such that $P(A) = 0.2$; $P(A' \cap B) = 0.22$
   $P(A \cap B) = 0.18$ Evaluate
   i. $P(A \cap B')$
   ii. $P(A|B)$

   b) The probability that it will rain on a given morning is ¼ . If it rains the probability that Mr. X misses his train is 2/3. If it does not rain the probability that Mr.X catches his train is 5/6.

   If he catches his train the probability that he is early for work is 4/5. If he misses his train the probability that he is late for work is 3/5. Draw a tree diagram to represent the above data. Calculate the probability that on a given morning.
   i. It rains and Mr. X is late for work.
   ii. It does not rain and he is early for work.

09. 100 students were tested to determine their intelligence quotient (I.Q) and the results were as follows.

I.Q	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100
f	4	20	52	16	8

All I.Q's are given to the nearest integer, calculate mode, median and standard. deviation.

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