

THE OPEN UNIVERSITY OF SRI LANKA
DIPLOMA IN TECHNOLOGY- FOUNDATION (LEVEL 01)
FINAL EXAMINATION 2005
MPF 1302 – APPLIED MATHEMATICS II



DURATION – THREE (03) HOURS

DATE : 19th April, 2006

TIME: 09.30 a.m. – 12.30 p.m.

ANSWER (06) QUESTIONS ONLY BY SELECTING AT LEAST ONE QUESTION FROM EACH SECTION. YOU CAN USE CALCULATORS. YOU CANT USE MOBILE PHONES AS CALCULATORS.

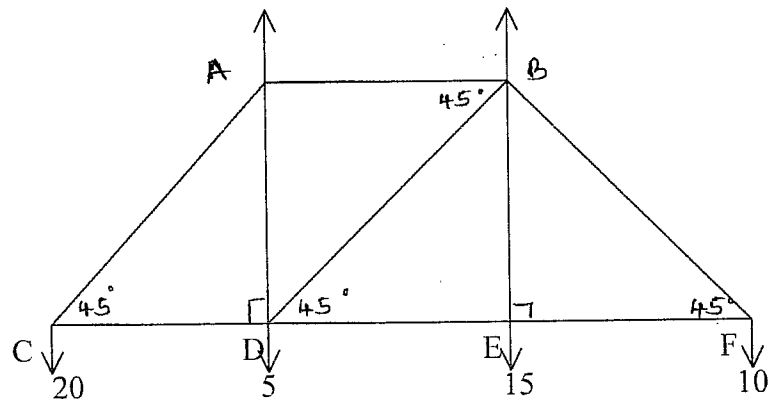
SECTION – A

01. a) ABCD is a square. Forces of magnitudes 3,2,4,3 and P acts along AB, CB, CD, AD, DB respectively in directions indicated by the order of letters. If the system is equivalent to a couple, find the value of P.
- b) The system of forces consist four forces in a plane. Fixed rectangular axes OX, OY are taken in the plane and components of the four forces parallel to OX are then respectively 1,-2, -1, 3N. While the components parallel to OY are respectively -3, 2,4, 1N. The line of action of the forces pass through the points (2,1), (4,2), (1,3), (5,4) respectively. Find the magnitude of the resultant force and show that the line of action of the resultant of the system has equation $4x-y=9$.
02. a) Forces $\lambda\vec{OP}$, $\mu\vec{OQ}$ act along the lines OP and OQ respectively. Show that the resultant is a force $(\lambda+\mu)\vec{OR}$, where R lies on PQ and $PR:RQ=\mu:\lambda$
- b) O is any point in the plane of a square PQRS whose diagonals intersect at T. Four forces are represented completely by $3\vec{OP}$, $2\vec{OQ}$, $3\vec{OR}$ and $2\vec{OS}$. Show that the resultant passes through T and find its magnitude in terms of OT.

03. A thin rod of length a is in equilibrium with its ends resting on the inner rim of a smooth circular Hoop, of radius a fixed with its plane vertical. If the center of gravity of the rod divides its length in the ratio 3:4, prove that its inclination to the vertical is $\tan^{-1} 7\sqrt{3}$.

Determine the ratio of the reaction on the lower end of the rod to that on the upper end.

04. The framework ABCDEF is composed of light rods smoothly jointed, it is hung from smooth pins at A,B and carries weight as shown. Find stresses in all the rods to the nearest unit and showing whether they are tensions or thrust.



SECTION - B

05. A train travels 3km in 2 min accelerating uniformly from rest to a maximum speed 120 kmh^{-1} , maintaining this speed for a certain time and then slowing uniformly to rest with a retardation of magnitude 5 times that of the acceleration. Sketch the velocity time graph.
- Find the travel time with the uniform velocity.
 - Find the travel distance with uniform speed.
 - Find the acceleration and retardation of the train.

06. A steamboat of A is moving due North at a speed of 12 knots, and from it a steamboat B appears to be moving South-West with a speed of 5 knots. Find the true speed and direction of motion of B.

If B is initially 10 nautical miles from A in a direction 30° East of North. Find the distance between the ships when they are nearest to one another.

07. a) A missile is project with an initial speed 91 m/s at an angle of $\sin^{-1} \frac{12}{13}$ with the horizontal. Find its range and time of flight. Three seconds later another missile is projected from the same point and hits the ground at the same time and in the same place as the first missile, find its speed and angle of projection.
- b) A light inextensible string lies on a smooth horizontal table with its ends passing over opposite edges. To these ends are attached masses M and $2m$ respectively, while a mass M is tied to the mid-point of string on the table. The system is released and when the strings are tight the particles move with acceleration f . Show that $f = g \left[\frac{m}{3m+1} \right]$ and find the tensions in the strings.

Acceleration due to gravity – 9.8ms^{-2}

08. a) Three equal spheres centers A,B,C lie at rest in a straight line, on a smooth horizontal table. The coefficient of restitution between any two spheres is e . A is projected with speed U to strike B directly. Find the velocities A and B after this impact. After that B directly strikes C. Deduce the velocities of B and C after this impact. And show that A strikes B again whatever the value of e .
- b) A train of total mass 160 tonne is ascending a hill inclined at $\sin^{-1} \left(\frac{1}{280} \right)$ with the engine working at half its maximum rate of 420kw . The train moves steadily at 63km/h . Find the resistance to motion. If the engine is now mode to work at maximum rate, find the immediate acceleration up the hill. (Take $g=9.8\text{ms}^{-2}$)

SECTION – C

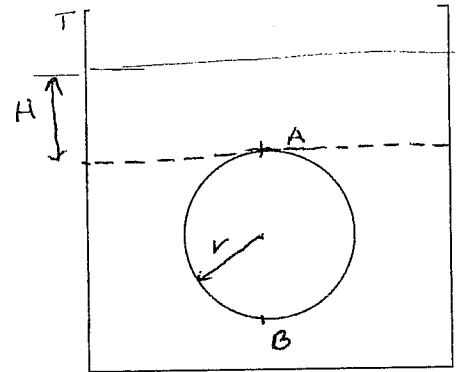
09. a) An alloy is composed of zinc and copper whose specific gravities are respectively 7 and 8.5 ; if the alloy is volume 0.0062m^3 , and its specific gravity is 8 . What volumes of zinc and copper does it contain?
- b) A cylinder of specific gravity 0.95 and height 30cm floats with it axis vertical in a vessel containing oil and water and is totally immersed. What length of the cylinder is in the oil if the specific gravity of the oil is 0.84 ?

10. Assuming that the depth of the center of pressure of a vertical circular area of radius a immersed with its center at a depth h is $\frac{a^2}{4h}$ below from the its center.

A light flap is used to close a circular hole of radius r , in the side of a tank. It is kept in place by bolts at the highest and the lowest points of the hole.

The tank is filled with water of density ρ to a height H above above the highest point of the hole.

Find the trust on the circular flab. Show that forces on the lower and upper bolts are $\frac{\pi r^2}{8}(4H + 5r)\rho g$ and $\frac{\pi r^2}{8}(4H + 3r)\rho g$.



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