HG1M02—Applied Algebra for Engineers

Coursework 2

To be handed in no later than Friday 16th March. Coursework **must** be handed in to one of the designated mathematics coursework collection points; **not** to me, and **not** to [any] school office. For more details, see overleaf.

1. *(a)* Find the angle between the vectors $2\boldsymbol{i}+\boldsymbol{j}-\boldsymbol{k}$ and $\boldsymbol{i}-\boldsymbol{j}+2\boldsymbol{k}$.

   (b) Find the angles between (i) a long diagonal [corner to opposite corner] of a cube and an edge that has a common vertex [corner] with it; (ii) the long diagonal and a face diagonal [corner to the opposite corner of a face] of a cube that have a common vertex; and (iii) two face diagonals of a cube that have a common vertex. [HINT: Because of the symmetry, it doesn't matter which of the available diagonals or edges you choose. Choose axes such that one vertex of the cube is at the origin, and the edges are of length one and lie along the axes. In this case, what are the positions of the other vertices?]

2. Find *(a)* a vector form, and *(b)* the cartesian form of the straight line through the points $(0,1,2)$ and $(1,-1,-1)$. What is the closest approach that this line makes to the x-axis?

3. Find, by vector methods, the equation of the plane through the points $(1,1,1)$, $(2,0,3)$ and $(0,3,-2)$ in the form $\boldsymbol{r}\cdot\boldsymbol{n} = k$. Find also the distance of this plane from the origin, and the angle it makes with the xy-plane.

4. A particle moves so that its position $\boldsymbol{r}(t)$ at time t is

$$\boldsymbol{r}(t) = \sin(t)\,\boldsymbol{i}+\cos(t)\,\boldsymbol{j}-t^2\boldsymbol{k}.$$

   Find the velocity, speed and acceleration of the particle as functions of t.

Marks: Q1: *(a)* 3 marks; *(b)* 2, 3 and 2 marks respectively; total 10. **Q2:** *(a)* 3 marks; *(b)* 3 marks; and 4 marks for the distance; total 10. **Q3:** 5 marks for the plane, 3 for the distance, and 2 for the angle; total 10. **Q4:** 4 marks for the velocity, 3 for the speed and 3 for the acceleration; total 10. Grand total: **40**.

Handing in coursework:

All mathematics coursework **must** be handed in to one of the **coursework collection points** in either the Pope building [near room B2] or the Mathematics and Physics building [in the far corner of the area at the top of the main stairs].

You need to use a **green** cover sheet [provided at the collection point]. Fill in sections A and C of the cover sheet, **time-stamp** the receipt [instructions at the collection point], tear off your recipt, and **staple** the rest of the sheet to your work [stapler provided]. These instructions are also given at the collection points. Make sure your name is on every sheet, in case of accident, and drop your work into the box. In section A, the bits you *need* to get *right* are your **name**, and the module **code** [HG1M02].

You have to sign that your work is not plagiarised. This means that it is your work, and is not copied from work done by someone else. There is no reason why you should not talk about the problems with your friends, but there is a clear moral difference between that and simply copying down their solutions. Plagiarists are not fit to be members of this or any other academic community, and plagiarism is a very serious offence.

You are reminded that this coursework counts $6\frac{2}{3}\%$ towards your assessment for this module. If you are late [without acceptable reason], you will lose 5% per working day; after five days, you will receive a mark of zero. Applications for any extension to the deadline should be made to me, and *must* be accompanied by a completed 'Extenuating Circumstances Form' giving your reasons for the application and signed by your personal tutor. You can get these forms from your school office or from your tutor. I will tell you whether or not your application will be allowed, and if so what your new deadline is; if you believe my decision to be unfair, then you may appeal to the Director of Mathematics Service Teaching, Dr S. Hibberd. — ANW