Solutions Book Chapter 11, SCI 113 Spring 2008

(1) **Exercise 11.1** (a) $4\mathbf{i}+7\mathbf{j}+5\mathbf{k}$ and in component form $(4,7,5)$, (b) $-4\mathbf{i}-7\mathbf{j}-5\mathbf{k}$ and in component form $(-4,-7,-5)$, (c) $\mathbf{0}$ (zero vector), (d) -9, (e) -9.

(2) **Exercise 11.4** Note that the vector $\mathbf{a}$ is perpendicular to the plane $a_1x+a_2y+a_3z=d$. Thus, to show that the vector $\mathbf{a}\times\mathbf{u}$ is parallel to the plane, it is enough to show that $\mathbf{a}\times\mathbf{u}$ is perpendicular to $\mathbf{a}$. This is indeed true since $\mathbf{a}\cdot(\mathbf{a}\times\mathbf{u})=0$ (property (d) in section 11.3 p.220).
To find a vector parallel to the plane $2x-3y-z=1$, we choose any vector $\mathbf{u}$ say $\mathbf{u}=\mathbf{i}=(1,0,0)$, and calculate $\mathbf{a}\times\mathbf{u}$ with $\mathbf{a}=(2,-3,-1)$, we get vector $\mathbf{w}=(0,-1,3)=-\mathbf{j}+3\mathbf{k}$. So $\mathbf{w}$ and $-\mathbf{w}$ are two vectors parallel to the given plane.

(3) **Exercise 11.5** We check when $|\mathbf{a}\times\mathbf{b}|=0$. Since $|\mathbf{a}\times\mathbf{b}|=|\mathbf{a}|\,|\mathbf{b}|\sin\theta$ (θ is the angle between vectors $\mathbf{a}$ and $\mathbf{b}$), we see that the cross product is zero in three cases: either $\mathbf{a}=\mathbf{0}$ or $\mathbf{b}=\mathbf{0}$ or $\mathbf{a}$ and $\mathbf{b}$ are parallel (this corresponds to the case $\sin\theta=0$).

(4) **Exercise 11.6** Since $\mathbf{a}\cdot\mathbf{b}=0$, the vectors $\mathbf{a}$ and $\mathbf{b}$ are perpendicular. The vector $\mathbf{c}=\mathbf{a}\times\mathbf{b}=-21\mathbf{i}+42\mathbf{j}-14\mathbf{k}$ is perpendicular to $\mathbf{a}$ and $\mathbf{b}$.