November 9, 2019 Lecturer Dmitri Zaitsev

MAU22E01 2019 (SF Engineers & MSISS & MEMS)

S h e e t 8

Due: at the end of the tutorial

Exercise 1

Find the orthogonal projection of the vector $\mathbf{v}$ onto the plane spanned by the orthogonal basis $\{\mathbf{u}_1, \mathbf{u}_2\}$ (with respect to the standard dot product), where

$$\mathbf{u}_1 = (1, 3, 0), \quad \mathbf{u}_2 = (-3, 1, -1),$$

and

(i) $\mathbf{v} = (1, 0, -1)$;

(ii) $\mathbf{v} = (1, 1, -1)$.

Exercise 2

Use the Gram-Schmidt process to transform the given basis into orthogonal one:

(i) $\mathbf{u}_1 = (-1, 0)$, $\mathbf{u}_2 = (2, -3)$;

(ii) $\mathbf{u}_1 = (1, 0, -1)$, $\mathbf{u}_2 = (1, 0, 0)$, $\mathbf{u}_3 = (2, -1, 0)$.

Exercise 3

Find the characteristic polynomials of the following matrices:

(i) $\begin{pmatrix} 1 & -2 \\ 0 & -1 \end{pmatrix}$;

(ii) $\begin{pmatrix} 0 & -2 \\ 1 & 0 \end{pmatrix}$;

(iii) $\begin{pmatrix} 1 & 2 & 1 \\ 0 & 3 & -2 \\ 0 & 0 & -3 \end{pmatrix}$;

(iv) $\begin{pmatrix} 0 & 2 & -1 \\ 1 & 0 & 2 \\ 0 & -2 & 1 \end{pmatrix}$.