Math 461 HW 4.

Let A be a square $n \times n$ matrix . The command $E = eig(A)$ will produce a vector whose entries are the n eigenvalues of A (counting with multiplicities). Eigenvalues can be real or complex numbers.
The command $[V\ D] = eig(A)$ will produce a diagonal matrix D whose diagonal entries are the eigenvalues of A and an $n \times n$ matrix V whose columns are respective eigenvectors.
If A has n distinct eigenvalues then eigenvectors of A form a basis of $\mathbf{R}^n$ and V is invertible.
However, if there are repeated eigenvalues , then it may happen that there is no eigenbasis and then V may be noninvertible. To see an example apply $[V\ D] = eig(A)$ to the matrix $A = [1, 1; 0, 1]$.

The trace of a matrix is the sum of its diagonal entries. To find the trace use $trace(A)$. To find the characteristic polynomial use $poly(A)$. That will return an n vector whose entries are coefficients of the characteristic polynomial. There is a difference between matlab and the textbook. $poly(A)$ uses $det(\lambda I - A)$ not $det(A - \lambda I)$ as the textbook. In the case of an odd n it results in the change of sign.

Problem 1. Generate random square matrices and calculate the following quantities : the sum of the eigenvalues, the product of the eigenvalues, the characteristic polynomial, the trace and the determinant. Check the basic formulas relating trace and determinant to the eigenvalues counted with multiplicities

$$det(A) = \prod_i \lambda_i$$

$$trace(A) = \sum_i \lambda_i$$

Problem 2. Section 5.2 problem 28.

Problem 3. Use matlab commands discussed above to do problem 36 section 5.3. Check that $AP = PD$ where P is the transition matrix from the eigenbasis to the standard basis in $\mathbf{R}^5$.
Remark. $randint(4, 4, [0, 10])$ produces a random matrix with integer entries from 0 to 10.

Problem 4. Section 5.4 problem 32.