

### Exercise 1

Show that if a graph  $G$  has a bridge then  $G$  has no nowhere zero  $\mathbb{Z}_n$ -flow, that is, the flow counting function  $\varphi_G(n) = 0$ .

### Exercise 2

Find a formula for the flow counting function  $\varphi_G(n)$  of the following graphs:

- (i) a cycle with  $k$  nodes.
- (ii) the graph consisting of two vertices and  $k$  (multiple) edges connecting them.
- (iii) a complete graph with 4 nodes.

### Exercise 3

Let  $G = (V, E)$  be a bridgeless connected graph. Show that  $\varphi_G(n)$  agrees with a polynomial with integer coefficients of degree  $|E| - |V| + 1$  and leading coefficient 1.

Hint: Use a deletion-contraction argument.

### Exercise 4

Show that the Petersen graph has no nowhere  $\mathbb{Z}_4$ -flow. Find a formula for its flow polynomial  $\varphi_G(n)$ .

