

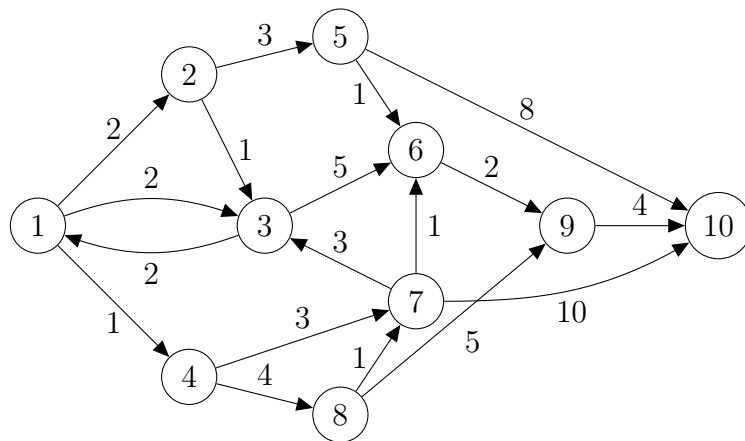
## Concepts and Algorithms of Optimization – Series 3

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### Exercise 1

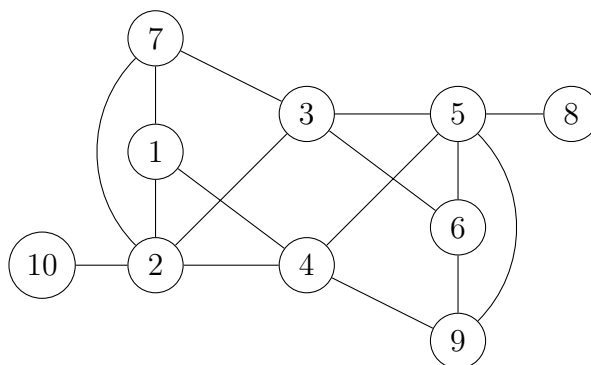
Consider the following digraph  $D = (V, A)$  with given costs  $c_a$  for  $a \in A$ .



- Give a problem formulation for finding the cost-minimal path between the nodes  $s = 1$  and  $t = 10$  in  $D$ .
- Transform the given problem into a min cost circulation problem.

### Exercise 2

Consider the following undirected graph  $G = (V, E)$ .



Please turn the page!

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- (a) Determine all nodes  $v \in V$ , for which the degree  $\delta(v)$  is odd.
- (b) Determine two subgraphs  $G' = (V', E')$  and  $G'' = (V'', E'')$  induced by the node sets  $V' = \{1, 2, 3, 4, 7\}$  and  $V'' = \{2, 5, 6, 8, 9, 10\}$ , respectively.
- (c) State whether the given subgraphs  $G'$  and  $G''$  have the following properties:
- The subgraph is spanning.
  - The subgraph is connected.
  - The subgraph is cyclic.
  - The subgraph has exactly one component.
- (d) Determine a spanning subgraph  $G^F$  of  $G$ , which is a forest but no tree. Give the necessary changes in  $G^F$ , so that it becomes a tree.