# Industrial Technologies

## Exercise 1

The following matrix identifies the bill of process of the j-th products on the i-th machines. The cycles have been defined with the objective of designing a manufacturing system organized in cells . There are 5 types of products to be made, and for the realization of all bills of process of different products are required 7 different types of machine.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | | **j-th product** | | | | |
| **1** | **2** | **3** | **4** | **5** |
| **i-th machine** | **1** | 0 | 1 | 1 | 0 | 1 |
| **2** | 1 | 0 | 0 | 1 | 0 |
| **3** | 0 | 1 | 1 | 0 | 0 |
| **4** | 1 | 0 | 0 | 1 | 0 |
| **5** | 1 | 0 | 0 | 0 | 0 |
| **6** | 1 | 0 | 0 | 1 | 0 |
| **7** | 0 | 0 | 1 | 0 | 1 |

The objectives are: (i) the number of cells for the system; (ii) the types of machine to be installed in each cell.

## Exercise 2

The following matrix identifies the bill of process of the j-th products on the i-th machines. The cycles have been defined with the objective of designing a manufacturing system organized in cells . There are 9 types of products to be made, and for the realization of all bills of process of different products are required 7 different types of machine.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **j-th product** | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **i-th machine** | **1** | 1 |  |  |  |  |  |  | 1 |  |
| **2** |  |  |  |  | 1 |  |  |  | 1 |
| **3** |  |  | 1 |  | 1 |  |  |  | 1 |
| **4** |  | 1 |  | 1 |  | 1 |  |  |  |
| **5** | 1 |  |  |  |  |  |  | 1 |  |
| **6** |  |  | 1 |  |  |  |  |  | 1 |
| **7** |  | 1 |  |  |  | 1 | 1 |  |  |

The objectives are: (i) the number of cells for the system; (ii) the types of machine to be installed in each cell.

## Exercise 3

The following matrix identifies the bill of process of the j-th products on the i-th machines. The cycles have been defined with the objective of designing a manufacturing system organized in cells. There are 9 types of products to be made, and for the realization of all bills of process of different products are required 7 different types of machine.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **j-th product** | | | | | | | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **i-th machine** | **1** | 1 | 1 |  | 1 |  |  |  | 1 |  |
| **2** |  |  |  |  | 1 |  |  |  | 1 |
| **3** |  |  | 1 |  | 1 |  |  |  | 1 |
| **4** |  | 1 |  | 1 |  | 1 |  |  |  |
| **5** | 1 |  |  |  |  |  |  | 1 |  |
| **6** |  |  | 1 |  |  |  |  |  | 1 |
| **7** |  | 1 |  |  |  | 1 | 1 |  |  |

The objectives are: (i) the number of cells for the system; (ii) the types of machine to be installed in each cell.

Furthermore, to answer to the following questions:

(iii) how many and what types of products cannot be produced in a single cell?

(iv) which machine should be duplicated in two separate cells in order to obtain totally independent cells?