# Расчетная работа по дисциплине «Математические методы сетевого моделирования»

### Задача 1. Основные понятия

Граф задан матрицей инцидентности (в строках вершины, в столбцах – ребра). Изобразить граф и записать его в виде списка ребер. Определить степени вершин. Найти диаметр, центр и радиус.

**Контрольные вопросы**

1. Какой граф называется планарным?
2. Что такое изоморфные графы?
3. Чем отличаются связные и несвязные графы?
4. Что такое степень вершины?
5. Какие дуги называются кратными?
6. Как найти длину пути в графе?
7. Какой граф называется полным? регулярным? деревом?
8. Как можно задать граф в виде матрицы?
9. Что такое диаметр и радиус графа? Как их найти?
10. Что такое центр графа?
11. Чем отличается матрица расстояний от матрицы смежности?

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 | e11 | e12 |
| V1 | 1 | 1 |  |  |  |  |  |  |  |  |  |  |
| V2 |  |  | 1 | 1 | 1 |  |  |  |  |  |  |  |
| V3 | 1 |  |  |  |  | 1 | 1 | 1 |  |  |  |  |
| V4 |  |  | 1 |  |  |  |  |  | 1 |  |  |  |
| V5 |  |  |  | 1 |  | 1 |  |  | 1 | 1 | 1 |  |
| V6 |  | 1 |  |  |  |  | 1 |  |  | 1 |  | 1 |
| V7 |  |  |  |  | 1 |  |  | 1 |  |  | 1 | 1 |
| Вес Wi | 18 | 15 | 20 | 11 | 12 | 10 | 15 | 7 | 9 | 7 | 7 | 8 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 | e11 |
| V1 | 1 |  |  |  |  |  |  |  |  |  |  |
| V2 |  | 1 | 1 | 1 |  |  |  |  |  |  |  |
| V3 |  | 1 |  |  | 1 | 1 | 1 |  |  |  |  |
| V4 |  |  | 1 |  | 1 |  |  | 1 |  |  |  |
| V5 |  |  |  |  |  | 1 |  |  | 1 | 1 | 1 |
| V6 |  |  |  | 1 |  |  | 1 |  | 1 |  |  |
| V7 | 1 |  |  |  |  |  |  | 1 |  | 1 | 1 |
| Вес Wi | 16 | 16 | 13 | 17 | 28 | 16 | 28 | 25 | 30 | 11 | 14 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 | e11 | e12 |
| V1 | 1 | 1 |  |  |  |  |  |  |  |  |  |  |
| V2 |  |  | 1 | 1 | 1 |  |  |  |  |  |  |  |
| V3 | 1 |  |  |  |  | 1 | 1 |  |  |  |  |  |
| V4 |  | 1 | 1 |  |  |  |  | 1 | 1 |  |  |  |
| V5 |  |  |  | 1 |  |  |  | 1 |  | 1 | 1 |  |
| V6 |  |  |  |  |  |  | 1 |  |  | 1 |  | 1 |
| V7 |  |  |  |  | 1 |  |  |  | 1 |  | 1 |  |
| V8 |  |  |  |  |  | 1 |  |  |  |  |  | 1 |
| Вес Wi | 11 | 19 | 10 | 22 | 30 | 21 | 18 | 13 | 11 | 15 | 30 | 21 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 |
| V1 | 1 | 1 |  |  |  |  |  |  |  |  |
| V2 | 1 |  | 1 | 1 |  |  |  |  |  |  |
| V3 |  |  | 1 |  | 1 | 1 |  |  |  |  |
| V4 |  |  |  | 1 |  |  | 1 | 1 |  |  |
| V5 |  | 1 |  |  |  | 1 |  |  | 1 |  |
| V6 |  |  |  |  |  |  | 1 |  | 1 | 1 |
| V7 |  |  |  |  | 1 |  |  | 1 |  | 1 |
| Вес Wi | 24 | 42 | 37 | 33 | 47 | 18 | 19 | 15 | 37 | 32 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 |
| V1 | 1 | 1 | 1 |  |  |  |  |  |  |  |
| V2 | 1 |  |  | 1 |  |  |  |  |  |  |
| V3 |  | 1 |  | 1 | 1 | 1 | 1 |  |  |  |
| V4 |  |  | 1 |  | 1 |  |  | 1 | 1 | 1 |
| V5 |  |  |  |  |  | 1 |  | 1 |  |  |
| V6 |  |  |  |  |  |  | 1 |  | 1 | 1 |
| Вес Wi | 40 | 57 | 54 | 33 | 43 | 44 | 42 | 57 | 40 | 41 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 | e11 |
| V1 | 1 | 1 |  |  |  |  |  |  |  |  |  |
| V2 |  |  | 1 | 1 |  |  |  |  |  |  |  |
| V3 |  |  | 1 |  | 1 | 1 | 1 |  |  |  |  |
| V4 | 1 |  |  |  | 1 |  |  | 1 | 1 |  |  |
| V5 |  | 1 |  |  |  |  |  | 1 |  | 1 |  |
| V6 |  |  |  |  |  | 1 |  |  | 1 |  | 1 |
| V7 |  |  |  | 1 |  |  | 1 |  |  | 1 | 1 |
| Вес Wi | 20 | 26 | 34 | 28 | 22 | 25 | 25 | 27 | 37 | 27 | 40 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 | e11 |
| V1 | 1 | 1 | 1 |  |  |  |  |  |  |  |  |
| V2 | 1 |  |  | 1 | 1 |  |  |  |  |  |  |
| V3 |  | 1 |  |  |  | 1 | 1 |  |  |  |  |
| V4 |  |  |  |  |  | 1 |  | 1 | 1 | 1 |  |
| V5 |  |  |  | 1 |  |  | 1 | 1 |  |  | 1 |
| V6 |  |  | 1 |  |  |  |  |  | 1 |  | 1 |
| V7 |  |  |  |  | 1 |  |  |  |  | 1 |  |
| Вес Wi | 7 | 27 | 29 | 4 | 30 | 24 | 40 | 25 | 14 | 4 | 34 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 | e11 |
| V1 | 1 | 1 |  |  |  |  |  |  |  |  |  |
| V2 | 1 |  | 1 | 1 | 1 |  |  |  |  |  |  |
| V3 |  |  |  |  |  | 1 | 1 |  |  |  |  |
| V4 |  |  | 1 |  |  | 1 |  | 1 | 1 |  |  |
| V5 |  |  |  | 1 |  |  |  | 1 |  | 1 | 1 |
| V6 |  |  |  |  |  |  | 1 |  |  | 1 |  |
| V7 |  |  |  |  | 1 |  |  |  |  |  | 1 |
| V8 |  | 1 |  |  |  |  |  |  | 1 |  |  |
| Вес Wi | 16 | 40 | 18 | 30 | 14 | 8 | 11 | 33 | 7 | 9 | 40 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 | e11 | e12 |
| V1 | 1 | 1 | 1 |  |  |  |  |  |  |  |  |  |
| V2 |  |  |  | 1 | 1 | 1 |  |  |  |  |  |  |
| V3 |  |  |  | 1 |  |  | 1 | 1 |  |  |  |  |
| V4 |  |  |  |  |  |  | 1 |  | 1 | 1 |  |  |
| V5 | 1 |  |  |  | 1 |  |  | 1 |  |  | 1 |  |
| V6 |  | 1 |  |  |  | 1 |  |  | 1 |  |  | 1 |
| V7 |  |  | 1 |  |  |  |  |  |  | 1 | 1 | 1 |
| Вес Wi | 42 | 53 | 46 | 78 | 70 | 37 | 66 | 63 | 75 | 31 | 74 | 55 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 | e11 |
| V1 | 1 |  |  |  |  |  |  |  |  |  |  |
| V2 |  | 1 |  |  |  |  |  |  |  |  |  |
| V3 |  |  | 1 | 1 | 1 | 1 |  |  |  |  |  |
| V4 | 1 |  | 1 |  |  |  | 1 | 1 |  |  |  |
| V5 |  |  |  | 1 |  |  | 1 |  | 1 | 1 |  |
| V6 |  | 1 |  |  | 1 |  |  | 1 | 1 |  | 1 |
| V7 |  |  |  |  |  | 1 |  |  |  | 1 | 1 |
| Вес Wi | 50 | 64 | 54 | 78 | 43 | 55 | 43 | 43 | 64 | 49 | 70 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 |
| V1 | 1 |  |  |  |  |  |  |  |  |
| V2 |  | 1 |  |  |  |  |  |  |  |
| V3 |  |  | 1 | 1 | 1 | 1 |  |  |  |
| V4 | 1 |  | 1 |  |  |  | 1 | 1 |  |
| V5 |  |  |  | 1 |  |  | 1 |  | 1 |
| V6 |  | 1 |  |  | 1 |  |  | 1 | 1 |
| Вес Wi | 50 | 64 | 54 | 78 | 43 | 55 | 43 | 43 | 64 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 | e11 | e12 |
| V1 | 1 |  |  |  |  |  |  |  |  |  |  |  |
| V2 |  | 1 |  |  |  |  |  |  |  |  |  |  |
| V3 |  |  | 1 | 1 | 1 | 1 |  |  |  |  |  |  |
| V4 | 1 |  | 1 |  |  |  | 1 | 1 |  |  |  |  |
| V5 |  |  |  | 1 |  |  | 1 |  | 1 | 1 |  |  |
| V6 |  | 1 |  |  | 1 |  |  | 1 | 1 |  | 1 |  |
| V7 |  |  |  |  |  | 1 |  |  |  | 1 | 1 | 1 |
| V8 |  |  |  |  |  |  |  |  |  |  |  | 1 |
| Вес Wi | 50 | 64 | 54 | 78 | 43 | 55 | 43 | 43 | 64 | 49 | 70 | 19 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 |
| V1 | 1 | 1 | 1 |  |  |  |  |  |  |  |
| V2 | 1 |  |  | 1 | 1 |  |  |  |  |  |
| V3 |  | 1 |  |  |  | 1 | 1 |  |  |  |
| V4 |  |  |  |  |  | 1 |  | 1 | 1 |  |
| V5 |  |  |  | 1 |  |  |  | 1 |  | 1 |
| V6 |  |  | 1 |  |  |  | 1 |  |  |  |
| V7 |  |  |  |  | 1 |  |  |  | 1 | 1 |
| Вес Wi | 26 | 13 | 41 | 9 | 22 | 15 | 7 | 16 | 25 | 33 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 | e11 |
| V1 | 1 |  |  |  |  |  |  |  |  |  |  |
| V2 | 1 | 1 | 1 | 1 | 1 |  |  |  |  |  |  |
| V3 |  | 1 |  |  |  | 1 | 1 |  |  |  |  |
| V4 |  |  | 1 |  |  | 1 |  | 1 | 1 |  |  |
| V5 |  |  |  | 1 |  |  |  |  |  | 1 | 1 |
| V6 |  |  |  |  |  |  |  | 1 |  |  |  |
| V7 |  |  |  |  |  |  |  |  | 1 | 1 |  |
| V8 |  |  |  |  | 1 |  | 1 |  |  |  | 1 |
| Вес Wi | 21 | 13 | 46 | 10 | 18 | 34 | 16 | 20 | 20 | 11 | 10 |

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| Ребро  Вершина | e1 | e2 | e3 | e4 | e5 | e6 | e7 | e8 | e9 | e10 | e11 | e12 |
| V1 | 1 | 1 | 1 |  |  |  |  |  |  |  |  |  |
| V2 | 1 |  |  | 1 | 1 | 1 |  |  |  |  |  |  |
| V3 |  | 1 |  | 1 |  |  | 1 | 1 | 1 |  |  |  |
| V4 |  |  |  |  | 1 |  | 1 |  |  | 1 | 1 |  |
| V5 |  |  | 1 |  |  | 1 |  | 1 |  | 1 |  | 1 |
| V6 |  |  |  |  |  |  |  |  | 1 |  | 1 | 1 |
| Вес Wi | 6 | 8 | 4 | 2 | 9 | 11 | 3 | 8 | 12 | 5 | 7 | 4 |