2011 Paper 7 Question 11

Principles of Communications

(a) Consider a Graph G, with bi-directional equal weight edges, defined by:

$$
\begin{aligned}
G &= V, E \\
V &= 1, 2, 3, 4, 5, 6, 7 \\
E &= (2, 1), (2, 3), (2, 4)(3, 4)(5, 2), (6, 2), (7, 1), (7, 5), (7, 6)
\end{aligned}
$$

(i)   Draw the graph.   [2 marks]

(ii) Define a spanning tree of G using an incidence matrix.   [3 marks]

(iii) Explain the Distance Vector (D–V) routing algorithm, illustrating it operating in terms of messages sent and received by node 7 in G. Show what happens in terms of D–V messages exchanged by node 7, if the edge $(1, 7)$ breaks, and then later, when edge $(1, 7)$ is repaired.   [10 marks]

(b) Suppose that your college has 1000 members; and that Cambridge has a population of 100,000; and that the Earth's total population is ten thousand million. Assuming that each of these social networks is a random graph with $p = 0.01$, then for each network, what is the average degree and average path length?   [5 marks]