

- (a) (i) Explain the term *bandwidth*, and differentiate between *baseband* and *bandpass* signals. Use diagrams to illustrate your answer. [4]
- (ii) What maximum sampling period (in μs) is necessary for all information to be captured in a digitised 4 kHz telephone channel? [2]
- (b) (i) With the aid of diagrams, explain the terms (1) *Frequency Division Multiplexing* (FDM) and (2) *Time Division Multiplexing* (TDM). [4]
- (ii) Explain the term *Asymmetric Digital Subscriber Line* (ADSL). [4]
- (iii) How are FDM and TDM utilised in the GSM mobile phone system? [3]
- (c) (i) Give two advantages and one disadvantage of using a *packet-switching* network over a *circuit-switching* network. [3]
- (ii) Three packet-switching networks each contain n nodes. The first network has a star topology with a central switch node, the second is a bi-directional ring, and the third is fully interconnected, with a wire from each node to every other node. What are the best-, average-, and worst-case transmission paths in hops? [3]
- (d) Chip sequences used in Code Division Multiple Access (CDMA) are pair-wise orthogonal. In other words, the normalised inner product ($S \bullet T$) of any two distinct sequences, S and T, is zero.

$$S \bullet T = \frac{1}{m} \sum_{i=1}^m S_i T_i = 0$$

What can you conclude about the number of corresponding chips that must match in any two distinct chip sequences? [2]