

5. (a) (i) Describe the operation of the MAC protocol used in classic Ethernet, and explain the purpose and operation of the binary exponential back-off algorithm. [6]
- (ii) Why is it not possible to use the MAC protocol used in Ethernet for a wireless local area network? [2]
- (b) A 100 Mbps CSMA/CD local area network (not Ethernet) has equally spaced nodes and a total length of 2km. The signal propagation speed in the cable is 2×10^8 m/s. There are no repeaters.
- (i) If two stations start to transmit at exactly the same time, what will be the mean time for them to detect a collision? [3]
- (ii) Given the above parameters, what minimum frame length (in bits) is required for correct operation of the CSMA/CD protocol? [3]
- (c) (i) Describe the basic architecture of a Bluetooth personal area network and briefly explain how Bluetooth-enabled devices communicate with each other. [4]
- (ii) Why does a Bluetooth frame contain redundant information and how is the redundancy utilised? [2]
- (iii) Bluetooth uses frequency hopping spread spectrum with a hop rate of 1600 hops/s. What is the length of a time slot in bits, given that the bandwidth is 1 MHz and information is coded at the rate of 1 bit/Hz? [2]
- (iv) In each slot of the Bluetooth system described in (c)(iii) above, $259 \mu\text{s}$ is needed for hopping and control mechanisms. Packets can be of 1, 3 or 5 slots in length. How long does the frame last in each type of packet? [3]