Level 7 Post Graduate Diploma in Engineering

Data communication

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	You should have the following for this examination	**No additional data is attached**
	• one answer book	
	• non-programmable calculator	
	• pen, pencil, ruler	

General instructions

• This paper consists of **eight** questions over two **sections A and B**.
• Answer **five** questions including at least **3 questions** from section A and
 **2 questions** from section B

Section A

1 a) Briefly explain how Digital Subscriber Line (DSL) works. (3 marks)
   b) Draw a typical frequency spectrum for Asymmetric Digital Subscriber Line (ADSL) showing frequency bands for voice, uplink and downlink data? (4 marks)
   c) State four differences between ADSL and SDSL (Symmetric Digital Subscriber Line). (5 marks)
   d) Illustrate the ADSL architecture and briefly explain the functions of the three main entities. (8 marks)

2 a) What are typical characteristics of a wireless channel which make the transport of data more difficult in comparison to a wired connection? (3 marks)
   b) i) Specify the equation for free space path loss in a wireless channel and clearly define its parameters. (3 marks)
      ii) Calculate the free space loss in dB for a distance of 10 meter for ISM (Industrial, Scientific and Medical) systems such as WLAN IEEE 802.11b. (3 marks)
      iii) What is the received power in dBm. The scenario is (ii) above If the IEEE 802.11b wireless data card is transmitting with 100 mW. (3 marks)
   c) Why is hybrid ARQ more effective than legacy ARQ schemes? (4 marks)
   d) What is the basic feature which allows QoS support in WiMAX? (4 marks)

3 a) Briefly describe a Metro Ethernet network. (4 marks)
   b) Discuss the basic carrier Metro Ethernet services under following key categories.
      i) Point to point services (2 marks)
      ii) Point to Multi Point Services (2 marks)
      iii) Multi-point to Multi-point Services (2 marks)
   c) What are the differences between Ethernet over SDH (Synchronous Digital Hierarchy) and Ethernet over Wavelength-division multiplexing (WDM) used in Metropolitan Area Network (MAN)? (5 marks)
   d) Compare the differences between Dense wavelength division multiplexing (DWDM) and WDM. (5 marks)

4 a) What effect does the choice of modulation scheme have on the transmission rate? (5 marks)
   b) Briefly explain the difference between packet switching and circuit switching communication methods. (5 marks)
   c) Explain the function of the Simple Network Management Protocol (SNMP). (4 marks)
   d) What is Multiprotocol Label Switching (MPLS) networking? (4 marks)
   e) What are key functions of the Network Operation Center (NOC)? (2 marks)

5 a) Optical fibers are composed of fine threads of glass in layers, called the core and cladding. The transmission of light in optical fiber is commonly explained using the principle of total internal reflection. Briefly explain the principle of total internal reflection and the optical fiber signal transmission using an appropriate diagram. (5 marks)

   b) What is difference between a multimode optical fiber and a single-mode optical fiber? (5 marks)

   c) Is it possible to connect a single-mode fiber cable with a multi-mode cable and vise-versa? Justify the answer. (5 marks)

   d) The following figure shows a DWDM schematic for four channels. Each optical channel occupies its own wavelength. Briefly explain the primary function of this DWDM system from signal transmission to signal reception. (5 marks)
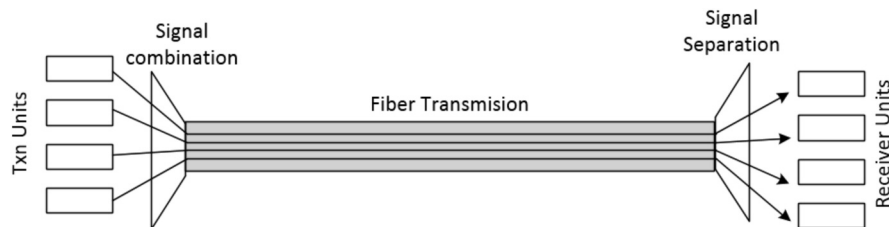
Section B

6 a) i)   Briefly explain the principle of DMT (Discrete Multitone)   (4 marks)
        ii)   What are key advantages of DMT? State four of them.   (4 marks)
    b) Briefly explain the line coding principal used in HDSL Technology.   (3 marks)
    c) What is Power Line Carrier Communication (PLCC)? and briefly highlight three application areas of PLCC.   (6 marks)
    d) What parameters can be used to describe Quality-of-Service (QoS) of a network and briefly explain three of them?   (3 marks)

7 a) What is the maximum transmission speed that can be achieved in a channel of bandwidth 5 MHz with a signal-to-noise ratio = 15?   (3 marks)
    b) Wireless LANs use Carrier Sense Multiple Access/Collision Avoidance (CSMA/CA) instead of Carrier Sense Multiple Access/Collision Detection (CSMA/CD). Why can CSMA/CD not be used in wired networks?   (4 marks)
    c) In IEEE 802.11, the channel is sensed before the transmission starts. Why are collisions still possible despite this?   (3 marks)
    d) Is RTS/CTS useful for all data packet sizes in 802.11b? Explain your answer.   (3 marks)
    e) What are the weaknesses of the legacy WEP encryption? What are the enhancements in WPA and WPA2?   (7 marks)

8 a) Two popular mobile wireless technologies are GSM and UMTS. Briefly explain key differences between these mobile technologies.   (5 marks)
    b) Many broadband wireless technologies use the duplexing and the multiple access techniques. Explain the difference between duplexing and multiple access techniques.   (5 marks)
    c) Why is a transmission using multiple antennas at the transmitter and the receiver (MIMO) faster than one using single antennas?   (4 marks)
    d) Mobile WiMAX offers wireless broadband access for mobile stations. What was the objective to introduce the IEEE 802.20 or Mobile Broadband Wireless Access (MBWA) standard which supports mobile wireless stations as well?   (6 marks)