Answer three questions out of five. Calculators are permitted.

Question 1

You are a climber/reporter in the latest Everest expedition. A national TV station is sponsoring your place in the expedition, and in return you must report live every day using a multimedia satellite phone from camps along the route. As the team climbs, you are also contracted to record video sequences of the views, (such as the Khumbu ice fall), which can be uploaded later. Before the expedition, you need to specify just the remote systems the TV station needs to purchase, as you have your own special light-weight IP-based equipment to use on the mountain.

a) Draw high-level host application software block diagram of the multimedia satellite phone (draw the diagram just for the audio) and the remote video file receiver. [10 marks]

b) Calculate the approximate (but reasonably accurate, state any assumptions you make) bandwidth required from the satellite connection for the satellite phone (audio and video) [23 marks]

Assume:

Satellite phone audio: ADPCM codec (sampling frequency = 8kHz), which produces 4 bits per codeword. Assume that 160 bytes of codewords are sent in their own RTP/UDP/IP packet.

Satellite phone video: H.261 frame intra-coded video codec (with no inter-frame coding), which operates at 2 frames per second, and codes Y (352 x 288 pixels),U (176 x 144 pixels) and V (176 x 144 pixels) frames. Each pixel is coded using 8 bits per pixel. H.261 coding gives 20:1 compression. Assume that a maximum of 1024 bytes can be sent in each RTP/UDP/IP packet.

RTP/UDP/IP header: 40 bytes

Question 2

'Kovac' store images on a CD using JPEG. You have been asked to write a report, which includes:

a) A background section on the JPEG compression algorithm. [15 marks]

b) What effect the quantisation of coefficients has on image quality [2 marks]

c) Ball-park figures for the number of images that can be stored on a CD using JPEG [16 marks]

Assuming:

A CD-ROM can store 650 Mbytes of information, that image sizes are roughly 640 pixels per line by 480 lines, that sub-sampling is in the ratio 4:1:1, and that JPEG provides a compression advantage of 20:1 to 25:1, depending upon the complexity of the image.

Question 3

'PlasmaCCD' makes digital cameras and plasma displays for the home market. Write a document for the customer that explains:

a) *How CCD cameras work. The principles of colour and the YUV standard for video. Why was YUV chosen for video instead of RGB?* *[15 marks]*

b) *How Plasma TV systems work, and contrast your answer with Cathode ray tube TV screens.* *[10 marks]*

c) *Ball-park figures for the amount of network capacity required to transmit HDTV. Assume that wide-screen HDTV has a resolution of 1920 samples per line and 1080 lines per frame. It has 50 frames per second, 24 bits per pixel, and sub-sampling in the ratio 4:2:2. Assume the use of M-PEG2 compression, which gives a compression advantage of 100:1* *[8 marks]*

Question 4

You have been asked to design a world-wide-web server that will provide audio-on-demand. Write a report putting forward your design, and in your report include the following:

a) *Background information on URL, HTTP, HTML. Improvements to a simple client / server model can be made using proxy clients and servers, and server caches. Identify how the improvements help in the situation considered in the question, such as: retrieval of frequently accessed albums, retrieval of information by browsers from behind a fire-wall, and how (proxy-server and client) caches are used to restrict the traffic on the wide area network* *[10 marks]*

b) *What the purpose of MIME would be for the audio on demand server* *[2 marks]*

c) *Produce a design for the system, and identify any pieces of software required. Include in your design the following :-*
   - *The use of pictures of album covers, and an MPEG-2 compressed video clip of each of the bands*
   - *20 albums, each of 8 tracks*
   - *The ability for fans to e-mail fan clubs to get more information about bands*

   [10 marks]

d) *Calculate the total storage requirements for your audio on demand web server, assuming:*
   - *Still image is compressed using JPEG, and has 640 lines, 488 samples per line, sub-sampling in the ration 4:2:2, and a compression advantage of 25:1*
   - *60 minutes of audio per track, compressed using MPEG-1 at a bit-rate of 192 kbps/channel, and two channels*
   - *Moving video clips are 30 seconds long and consist of a studio quality TV image equivalent to PAL quality (720 samples per line, 480 lines per frame, sub-sampling in the ratio 4:2:2), compressed using MPEG-2, which provides a compression advantage of 100:1* *[11 marks]*

Question 5

You are part of a team producing an on-line dictionary of Multimedia terms.

a) Your first task is to write descriptions of the following, and illustrate each with a specific example:-

- *The purpose of quantisation in some compression algorithms [5 marks]*
- *The rationale behind differential encoding [5 marks]*
- *Why most video compression algorithms use transforms [8 marks]*

a) *Illustrate the principles behind Huffman coding, by showing how to design a sample code. Use the following information: Probability of occurrence pedestrian (0.1), road (0.15), across (0.2), the (0.3), walked (0.25). Show what the stream of bits would be, given you had to send the following message 'the pedestrian walked across the road' [15 marks]*