UNIVERSITY OF GLASGOW

Degrees of MEng, BEng, MSc and BSc in Engineering

Communication Systems 3 (ENG3014)

Wednesday 7th December 2022
09:30 – 11:00AM

Attempt all questions

TOTAL MARKS AVAILABLE
50

The numbers in square brackets in the right-hand margin indicate the marks allotted to the part of the question against which the mark is shown. These marks are for guidance only.

An electronic calculator may be used provided that it does not have a facility for either textual storage or display, or for graphical display.

Continued overleaf

Q1 Electrical filtering is a critical component in communication systems.

(a) State the types of filters used in a Super-heterodyne radio receiver and explain their purpose. [4]

(b) Explain the mathematical method that can be used to calculate the expected time varying output from a filter if you are given a time varying input signal with the function $f(t) = A(t)\sin(\Omega t)$. [4]

(c) Explain the difference between synchronous and asynchronous frequency shift keying. Discuss the similarities and differences between these systems and Super-heterodyne radio receivers. [6]

(d) In a digital system, the received radio signal will be sampled when measured. State any requirements that must be met for sampling data. [1]

(e) Discuss the effect sample time and number of samples has on the frequencies one can measure from sampled data. [3]

(f) Discuss how a synchronous or coherent receiver can be used to create high order modulation formats such as PSK, QPSK or QAM. Using a constellation diagram, with appropriate axes, show an example of each of these modulation formats. [4]

(g) Draw the transmitter and receiver architecture for a communication system implementing one of the modulation formats of question (f) and explain the mathematical principles that can be used to calculate the function of the key components that enable the system to operate. [6]

Continued overleaf

Q2 Fibre optical communications is widely used for cabled communication systems.

(a) Explain the advantages and disadvantages of fibre optical communication systems compared to other cabled communication systems. [2]

(b) Explain what Passive Optical Networking (PON) is and how it is used to connect residential properties to the internet. Include a diagram that shows how PON is integrated into the larger metro area network, [6]

(c) Describe the best networking protocol to use for PON and how does this protocol support the transfer of information across networks. [4]

(d) Explain what limits the maximum amount of information that can be transmitted over a single mode fibre optical communication link and the physical reason for this limit. [4]

(e) Explain the issues that might lead to transmission errors in both single mode and multi-mode optical fibres. [2]

(f) High-capacity low costs interconnects that support up to 100 Gbps are required for a data centre network with fibre spans that are a maximum of 100m in length. Explain what fibre optical components you would use for this application and the reasons for this choice. [4]

End of question paper