Department of Medical Engineering

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN MEDICAL ENGINEERING

EBL 4501: TELE-MEDICINE

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2024

TIME:2HOURS

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of FIVE questions; Answer Question ONE (Compulsory) any other TWO questions.

Question ONE (Compulsory 20 marks)

a) State the reasons for using **modulation** in Communication systems **(4 marks)**

b) Draw the block diagram of an AM receiver **(2marks)**

c) A broadcast AM receiver has a tuning range of 530kHz to 1640kHz and an IF of 455kHz. The loaded Q of the coupling circuit is 80. Calculate the image frequency rejection in dB at 1MHz **(3 marks)**

d) For an FM system, the maximum frequency deviation is 75kHz and maximum modulating frequency is 15kHz.Calculate the modulation index **(2marks)**

e) With the aid of diagrams, describe the following satellite multiple access methods

i) Frequency Division Multiple access (FDMA)

ii) Time Division Multiple access (TDMA)

(6 marks)

f) Explain THREE advantages of Optical fiber as a medium of transmission compared to copper wires **(3 marks)**

Question TWO

(a) Describe any THREE radio Frequency Spectrum, and in each state its frequency range, mode of propagation and its application in communication

(10 marks)

(b) A Sinusoidal modulating signal, $m(t)=4\cos 2\pi 4\times 10^{3}t$ is applied to an FM modulation that has a frequency deviation constant gain of 10kHz/V. Compute:

i) The peak frequency deviation
ii) The modulation index

(4 marks)

(c) A 880 MHz carrier signal is frequency modulated using a 100kHz sinusoidal modulating waveform. The peak deviation of the FM signal is 500kHz. If this FM signal is received by a super heterodyne receiver having an IF frequency of 5kHz, determine the IF bandwidth necessary to pass the signal. **(6 marks)**

Question THREE

(a) With the aid of diagrams and equations describe how FM modulation is achieved using:

i) Direct method
ii) Indirect method

(10 marks)

(b) With the aid of diagram and equations explain how FM is detected using:

i) Slope detector
ii) Zero-crossing detector

(10 marks)

QUESTION FOUR

a) Draw a well labelled simplified block diagram of C band(6GHz/4GHz) communication satellite transponder and briefly explain its operation

(6 marks)

b) A satellite earth station transmitter has an output power P_T and an aerial gain G_T.The receiving aerial on the satellite distant D meters has a power gain G_R.If the gain of an aerial is $\frac{4\pi}{D^2}$ times its effective aperture, derive an expression for the received power P_R at the satellite.

(4 marks)

c) A satellite operating at 6GHz at a distance of 40000km from a point on the earth's surface radiates a power of 2W from an antenna with a gain of 17dB.Determine

i) the maximum isotropic radiated power EIRP

ii) Power density at the receiving point

iii) the path loss in dB

iii) the power received by an antenna with effective area of $10m^2$.

(10 marks)

Question FIVE

(a) i) With the aid of a diagram and appropriate equations describe Amplitude modulation.

ii) Define the term modulation index.

iii) Derive an expression and illustrate for AM bandwidth.

(14 marks)

(a) A sinusoidal message is applied to a transmitter that radiates an AM signal with 10kW power.

i) Compute the carrier power if the modulation index is 0.6.

ii) Determine % of the total power in the carrier.

iii) Calculate the power in each sideband. **(6 marks)**