FIJI NATIONAL UNIVERSITY
College of Engineering, Science & Technology

School of Electrical and Electronics Engineering

Bachelor of Engineering (BENG)- Year 4

Electrical and Electronics Engineering

EEB863- Satellite Communication

Semester 2, 2018

(Total Marks: 100 Duration: 3 Hours)

November 2018

Date: As per time table Time: As per time table

Venue: As per exam. Schedule

Instructions to Candidates

1. You will be allowed 10 minutes reading time and **3 hours** to complete this paper.
2. Begin each answer on a fresh page and use both sides of the sheet.
3. Please ensure that **your ID number** is written at the top of each sheet of paper used.
4. Insert all written pages, graph paper, drawing paper etc. in their correct sequences and secure with string.
5. For all sheets of paper on which rough/ draft work has been done, cross it through and you must attach all of them to your answer scripts.
6. Write clearly the numbers of the questions attempted on the top of each sheets.
7. Answer all questions.
8. Use of mobile phones, smart watches or any other electronics devices with electronics storage of data/communication is not allowed during the examination.
9. Use of only non-programmable scientific calculator is allowed.

Total number of pages: 3(three) including this cover page.

(Answer all Questions)

Q1. (a) Comparisons are sometimes made between satellite and optical fiber Communications systems. State briefly the areas of application for which you feel Satellite system is best suited. [10]

(b) In a point-to-point satellite communication system, the carrier signal at the satellite as received over uplink is 40 dB greater than the strength of the interference signal from an interference Earth station. Also, the strength of the signal power received at the desired Earth station over the downlink is 35 dB more than the strength of the interference signal due to an interfering satellite. Determine the total carrier-to- interference ratio of the satellite link. [10]

Q2. (a) A satellite is orbiting in the equatorial plane with a period from perigee to perigee of 12 h. Given that the eccentricity is 0.002, μ is 3.986005X 1014 $\frac{m^3}{cm^2}$, the earth's equatorial radius is 6378.1414 kilo meter (km), i is 0^0, K_1 is 66063.1704km^2. Calculate the semi major axis. [10]

(b) With the aid of a neat sketch, explain what is meant by each of the angles: inclination; argument of perigee; right ascension of the ascending node. Which of these angles would you expect, in general, to change with time? [10]

Q3. (a) State Keplers three laws of planetary motion. Illustrate in each case their relevance to artificial satellites orbiting the earth. [10]

(b) Calculate the apogee and perigee heights of a satellite for the orbital parameters given as eccentricity e is 0.0011501 and semimajor axis a is 7192.335 km. Assume a mean earth radius of 6371 km. [10]

Q4. A satellite at a distance of 50,000 km from the CEST building radiates a power of 30 W from an antenna with a gain of 20 dB in the direction of a Very Small Aperture Terminal (VSAT) system at the CEST building with an effective aperture area of 20$meter^2$.

(a) Calculate the flux density at the CEST building. [8]

(b) Calculate the power received by the Very Small Aperture Terminal (VSAT) antenna located at the CEST building. [6]

(c) Determine the received power. If the satellite operates at a frequency of 11 GHz and the Earth Station (ES) antenna has a gain of 52.3 dB. [6]

Q5. (a) A satellite transponder has a bandwidth of 36 MHz and saturation Equivalent Isotropically Radiated Power (EIRP) of 27 dBW. The earth-station receiver has a [G/T] of 30 dB/K, and the total link losses are 196 dB. The transponder is accessed by Frequency-division Multiple Access (FDMA) carriers each of 3-MHz bandwidth, and 6-dB output backoff is employed. Calculate the downlink carrier-to-noise ratio for single-carrier operation and the number of carriers which can be accommodated in the FDMA system. Compare this with the number which could be accommodated if no backoff were needed. The carrier-to noise ratio

determined for single-carrier operation may be taken as the reference value, and it may be assumed that the uplink noise and intermodulation noise are negligible. [10]

(b) In Satellite communication system the code waveform in a Code-Division Multiple Access (CDMA) system spreads the carriers over the full 36 MHz bandwidth of the channel, and the rolloff factor for the filtering is 0.4. The information bit rate is 64 kb/s, and the system uses BPSK. Calculate the processing gain in decibels. Given that the BER must not exceed 10^{-5}, give an estimate of the maximum number of channels that can access the Satellite system. [10]

All the best.
The END.