INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

TUTORIAL QUESTION BANK

Course Name	:	SATELLITE COMMUNICATIONS
Course Code	:	A80452-R15
Class	:	IV - B. Tech IIsem
Branch	:	Electronics and Communications Engineering
Year	:	2018 – 2019
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OBJECTIVE

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

UNIT-I COMMUNICATION SATELLITE			
PART – A (Short Answer Questions)			
S. No	**Questions**	**Blooms Taxonomy Level**	**Course Outcome**
1.	Distinguish direct and retrograde orbits?	Understand	1
2.	Explain how a satellite is located with respect to earth?	Understand	1
3.	Discuss the advantages and disadvantages of satellite communications?	Understand	1
4.	Explain What is meant by apogee and perigee heights?	Understand	1
5.	Define Kepler's law and universal time?	Remember	1
6.	List out the frequency bands used for satellite services?	Understand	1
7.	List any three applications with respect to satellite communications?	Understand	1
8.	Explain the frequency allocation for satellite with respect to International Telecommunication Union (ITU)?	Understand	1
9.	Show the importance of 6/4 GHz system?	Remember	1
10.	Write about Fixed satellite service (FSS)?	Understand	1
11.	Classify two segments of basic satellite communication?	Understand	1

12.	Differentiate between active and passive satellites?	Understand	1
13.	Explain need for space communication?	Understand	1
14.	List the names of all Indian satellites?	Understand	1
15.	Specify the components used for satellite communication?	Remember	1
16.	Differentiate between Geo-stationary and Geo-synchronous orbit?	Remember	2
17.	Compare satellite and terrestrial communication system?	Remember	2
18.	State the advantages and disadvantages of Geo stationary orbits?	Remember	2
19.	Geo stationary orbit is always geo synchronous but the reverse is not true? Explain?	Understand	2
20.	State the name of regional Russian satellite and why is it made highly.	Remember	2

PART - B (Long Answer Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1.	Explain a brief account of Theory and application of geocentric equatorial coordinate systems. Orbital elements and orbital plane	Understand	1
2.	Discuss the elements of satellite communication systems? Explain each with a suitable block diagram?	Understand	1
3.	Explain the basic differences between an active and passive satellite. Whether a passive satellite can be used for communication? If yes explain in brief?	Understand	1
4.	Explain the historical background on satellite communication?	Understand	1
5.	Illustrate the advantages of digital satellite communication over its analog satellite communication?	Remember	1
6.	Describe different frequency bands which are allocated for satellite communication and explain the uses of these frequencies?	Understand	1
7.	Illustrate the effect of eclipse on orbital motion of satellite in brief?	Remember	2
8.	Describe in brief about Azimuth and Elevation angles in satellite communication?	Remember	2
9.	Explain the coverage angle and slant range of satellite communication?	Understand	2
10.	Discuss the orbital aspects, which are of importance in synchronous satellite communications. Explain these aspects in brief?	Understand	2
11.	Examine the term first point of ARIES and what is its importance in the determination of position of satellite in space?	Understand	2
12.	State the name of regional Russian satellite and why is it made highlyInclined and what is its angle of inclination and which particular law of Kepler supports its requirement?	Remember	2
13.	Give reasons for choosing the downlink frequency lower than the uplink frequency and state the frequencies used for uplink and downlink?	Understand	1
14.	Discuss various modes of propagation of radio waves and specify the frequencies used for each radio wave propagation?	Understand	1

15.	Determine the Apogee and Perigee distance, semi major and semi minor axis of the elliptical orbit are 20,000km and 16,000km respectively?	Remember	2
16.	State the various steps involved in placing the satellite in its own orbit and explain it with diagram?	Remember	1
17.	Explain about the two forces acting on a moving satellite in its orbital space by deriving the equation for both the forces?	Understand	1
18.	Explain the Cartesian coordinate system and write about sidereal day in satellite communications?	Understand	2
19.	Discuss about the solar eclipse with diagram and show the graphical representation of eclipse in one day duration?	Understand	2
20.	Discuss about orbital perturbations and the satellite acquisition with diagram?	Understand	2

PART - C   (Analytical Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1.	Summarize the maximum and minimum range in kilometer from an earth station to geo-Synchronous satellite. To what round trip propagation times do these correspond?	Understand	1
2.	A satellite is in 322-km high circular orbit Estimate. i. Orbital angular velocity. ii. Orbital period. iii. Orbital linear velocity.	Understand	2
3.	Explain how Kepler's and Newton's laws are useful to describe the orbit. A) A satellite is moving in a highly eccentric Malniya orbit having the farthest and the closest points as 3500km and 500km and 500km respectively from earth surface. Determine the orbital time period time period time period and the velocity at apogee and perigee points. (Assume earth's radius = 6360km). B) The semi-major axis and the semi-minor axis of an elliptical satellite orbit are 20,000km and 16,000km respectively. Determine the apogee and perigee distances.	Understand	2
4.	A satellite is orbiting in the equatorial plane with a period from perigee to perigee of 12hours. Given that the eccentricity is 0.002, calculate the semi-major axis. The earth's equatorial radius is	Remember	2
5.	Explain the interpretation of kepler's laws. Satellite is orbiting in a geosynchronous orbit of radius 42500km. find the velocity and time of orbit. What will be the change in velocity if the radius reduces to 36000km.if go=398600.5Km3s2.	Understand	2

S. No	Questions	Blooms Taxonomy Level	Course Outcome
6.	If a satellite has an orbiting time of 23 hrs 56 min. calculate orbiting distance. Assume suitable data if required. A satellite is orbiting round the earth at 4212km. The earth station is looking at this satellite at an elevation angle of 35degree. Calculate slant range. Make suitable assumption.	Remember	1
7.	The orbital period of satellite is 650min, Determine the semi major axis of the elliptical orbit given g=6.67x10-11 and M=5.98x1024kg?	Remember	2
8.	Apogee and perigee of a elliptical satellite orbit are 3000km and 200km, Determine the eccentricity semi major axis and the semi minor axis?	Understand	2
9.	A satellite is moving in an elliptical orbit with apogee and perigee at a distance of 35000km and 500km respectively from the surface of earth. If the radius of earth is 6370km. Determine the velocity of satellite at any point in its orbit?	Remember	2
10.	Two satellites are moving in an elliptical eccentric angle with the same perigee but different apogee distances. Satellite one is having orbital period of 5hr and semi major access 20,000km while the orbital period of satellite two is 2hr 50min. Determine the semi major axis of the satellite path?	Understand	2

UNIT-II
SATELLITE SUB-SYSTEMS

PART – A (Short Answer Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1.	Quote what do you mean by space qualification?	Remember	3
2.	Explain different method for stabilizing a satellite?	Understand	3
3.	Define the terms roll, pitch and yaw?	Remember	3
4.	Explain the meaning of term frequency reuse and payload of the satellite?	Understand	3
5.	Describe the spin stabilized satellites?	Understand	3
6.	Write short notes on satellite's solar power system?	Understand	3
7.	Calculate the dimension of each side of a square aperture horn antenna having power gain 60?	Remember	3
8.	Discuss in detail the factors that affect the link design of a satellite?	Understand	3
9.	State what is the system noise temperature?	Remember	3
10.	Discuss the affect of C/N and G/T ratios?	Understand	4
11.	Explain what is meant by noise factor for what source temperature is noise factor defined?	Understand	4
12.	Explain what do you understand by G/T ratio ?	Understand	4
13.	Discuss about thermal noice?	Understand	4
14.	Give the free space loss equation?	Understand	4
15.	State the relation between EIRP and power received at the ground?	Remember	4
16.	State about carrier to noise ratio?	Remember	4

S. No	Questions	Blooms Taxonomy Level	Course Outcome
17.	Quote the equation for equivalent noise temperature?	Understand	4
18.	Discuss about low angle fading?	Understand	4
19.	State the purpose of telemetry tracking and command?	Understand	4
20.	Explain about atmospheric drag?	Understand	4

PART – B (Long Answer Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1.	Explain the different types of noise to be considered in the design of satellite communication system? Explain the calculation of combined uplink and downlink C/N ratio?	Understand	4
2.	Discuss with a neat diagram the Anik-E C band transponder. Explain the attitude control of a satellite with necessary diagrams.	Understand	4
3.	State how does the system noise temperature affect the performance? Derive the expression for overall system noise temperature at the receiving earth station?	Remember	3
4.	Estimate link power budget equation and explain about the downlink and uplink rain fade margin.	Remember	3
5.	Formulate general link equation. Find out an expression for C/N and G/T ratios. Explain the importance of these ratios on satellite link design?	Understand	4
6.	Explain how the uplink design is different from downlink design? Why design of downlink is more critical than of uplink? In what conditions a complete satellite link became downlink limited?	Remember	3
7.	Explain the functions and characteristics of satellites and various sub- systems of satellites?	Understand	4
8.	Discuss the attitude and orbit control subsystems? Explain how they perform their functions?	Understand	4
9.	Explain telemetry, tracking and command (TT&C) subsystem of a satellite With the help of block diagram?	Understand	3
10.	Discuss reliability and redundancy? Explain how reliability increases through redundancy?	Understand	4
11.	Explain satellite stabilization? Explain the importance of stabilization. Make a comparative study between spin stabilization and three axes body stabilization?	Understand	4
12.	Explain how the capacity of a satellite can be increased by reusing the same frequency in satellite communication?	Understand	4
13.	Explain what do understand by G/T ratio? Prove that the figure of merit shows the performance of the receiver circuitry?	Understand	4
14.	Prove that C/N at the input of a detector in the receiver is proportional to the G/T ratio?	Remember	4
15.	For an equivalent noise bandwidth of 10Mhz and total noise power of 0.0276 PW. Determine the noise density and equivalent noise temperature?	Understand	4
16.	A receiver system has antenna noise temperature 600K and receiver noise figure is 9dB. Calculate the system noise temperature when T0 is 290?	Remember	4

| 17. | Carrier to noise density ratio of 90dB hz is required at a receiver having G/T ratio of 12 dB. Given that the total loss in the link is 196dB. Calculate the required EIRP? | Remember | 4 |
| 18. | Explain what is the attitude control as applicable to satellite with the help of a diagram, spin stabilization of satellites? | Understand | 4 |

PART – C   (Analytical Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1.	A satellite TV signals occupies the full transponder bandwidth of 36 MHz, and it must provide a C/N ratio of 22 dB the destination losses are 200 dB and the destination earth station G/T ratio is 31dB/K, Calculate the satellite required.	Remember	4
2.	Discuss about near geostationary orbits Determine the limits of visibility for an earth station situated at mean sea level, at latitude 48.42 degree north and longitude 89.26 degree west. Assume a minimum angle of elevation of M5.9 degree. Discuss about sun transit outage?	Understand	4
3.	Consider the receiver side of an earth station. The antenna gain is 65 dB and it noise contribution in 60 K. The wave guide Ions is 0.5 dB. Sketch the equivalent noise temperature of LNA assuming that the noise contribution by the down converter is negligible and earth station G/T is 40 dB. K. (To=300K).	Remember	4
4.	Explain the following: input back off, output back off, earth station HPA and combined uplink and downlink. C/N ratio.For a satellite circuit the individual link carrier-to-noise spectral density ratios are: uplink 100 dB Hz; Downlink: 87 dB Hz. Calculate the combined uplink and downlink.	Understand	3
5.	State the limits of visibility for an earth station situated at mean sea level, at latitude 48.42 degrees north and longitude 89.26 degrees West. Assume a minimum angle of elevation of 5 degrees?	Remember	4
6.	A Geo stationary satellite is located at a distance of 3000km with an operating frequency of 14.25Ghz.Gain of the transmitting and receiving antennas are 15 and 20 respectively. If the transmitting power is 200kW. Calculate the power received by the receiving antennas?	Understand	4
7.	Determine the power received by the satellite located at 40,000km from the surface of the earth, satellite operating at 11Ghz and has EIRP as 21dBW. Gain of the receiving antenna is 50.5dB.	Remember	3
8.	The antenna design is matched into a receiver. The noise temperature of antenna and receiver are 40K and 100K respectively. If the received BW is 36Mhz. Determine its noise power?	Remember	4
9.	A satellite at distance of 40,000km from the point on the surface of the earth radiates the power of 200W from an antenna with gain of 17dB in the direction of observer. Calculate the flux density at receiver point and the power received by an antenna with an effective area of 10m2.	Understand	4
10.	Determine the C/N density ratio for a receiver with a 80dBW carrier power and equivalent noise temperature of 240K and BW of 10Mhz.	Remember	4

UNIT-III
PROPAGATION EFFECTS

PART – A (Short Answer Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1.	Explain Boltzmann's concept for performance of earth space links?	Understand	5
2.	Discuss the effects of propagation in atmosphere?	Understand	5
3.	Define what is cloud attenuation?	Remember	5
4.	Explain the concept of rain induced cross polarization interference?	Remember	5
5.	List the disturbances created by Ionosphere and its irregularities?	Understand	5
6.	Name and define the modes of multiple access?	Understand	5
7.	Explain what is guard time? Mention its role in TDMA efficiency?	Understand	5
8.	Define burst? Explain the method of control burst plan?	Remember	5
9.	Distinguish the drawback of SDMA/FDMA technique?	Understand	5
10.	Explain the function of various controls in DAMA system?	Understand	5
11.	Define polling technique? What is binary tree search technique?	Remember	5
12.	Differentiate between multiplexing and multiple access?	Remember	6
13.	Compare any three multiple access techniques?	Remember	6
14.	State the advantages and disadvantages of CDMA?	Remember	6
15.	Define multipath fading?	Remember	6
16.	State any two types of spread spectrum techniques?	Remember	6
17.	State two types of codes used for transmitting the signals from satellites?	Remember	6
18.	Define spread spectrum technique?	Remember	6
19.	State what are the limitations of FDMA-satellite access?	Understand	6
20.	Write about demand assigned TDMA satellite access.	Understand	6

PART – B (Long Answer Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1	Classify the difference between the pre-assignment and demand assignment multiple access systems. Also make a comparative study of advantages and disadvantages between them?	Understand	5
2	Explain the DA-TDMA brust structure. Make a comparative study between DA-TDMA and DA FDMA system?	Remember	5
3	Develop various techniques for improving throughputs of ALOHA system/Discuss about reservation ALOHA system?	Remember	5
4	Explain pre assigned and demand assigned TDMA systems and Discuss the operation of SPADE communication system?	Understand	5
5	Explain the principle behind spectrum spreading and dispreading and how this issued to minimize interference in a CDMA system. Also determine the throughput efficiency of the system?	Understand	5
6	With the help of structure define the TDMA super frame and explain how if differs from a simple TDMA frame?	Remember	5

7	Define the C/N ratio relationship of FDM-FM-FDMA demodulator circuit and list all the parameters incorporated into the relationship?	Remember	5
8	Compare similarities and differences in the fundamental concepts of direct sequence spread spectrum system verses a frequency hopping spread spectrum system?	Remember	5
9	Explain the concept of Ionosphere Scintillation along with the pattern occurrence of Ionospheric Scintillation and low angle fading?	Understand	5
10	Explain transionospheric propagation predictions and corrections? Give the relationship between water vapor pressure and density?	Understand	5
11	Describe attenuation? Explain the several statistical models of attenuation due to rain?	Understand	5
12	Discuss about troposphere Scintillation and low angle fading with the help of stratified layers and turbulent mixing by using satellite phenomena?	Remember	6
13	Explain about the several phenomena that lead to signal loss on transmission through the earth atmosphere?	Remember	6
14	Discuss about the various losses occurring at antennas with the help of diagram at both transmitter and receiver side?	Remember	6
15	Explain with an example the type of traffic route where single access is used in satellite communications?	Remember	6
16	Explain in detail the operation of the spade system of demand assignment. What is the function of the common signaling channel?	Remember	6
17	Explain atmospheric losses and ionosphere losses for satellite communication with diagrams?	Understand	6
18	Explain the principle behind spectrum spreading and dispreading and how this is used to minimize interference in a CDMA system. Also determine the throughput efficiency of the system	Understand	6

PART – B (Long Answer Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1	Discuss in detail about direct sequence spread spectrum? In a TDMA network the reference burst and the preamble each requires 560 bits and the nominal guard interval between bursts is equivalent to 120 bits. Given that there are eight traffic bursts and one reference burst per frame and the frame length is equivalent to 40800 bits, calculate the frame efficiency?	Understand	5
2	Explain what is meant by asymmetric channels. Describe how asymmetric channels may be incorporated in internet connections via satellites? For a 24 MHz bandwidth transponder and allowing for a roll off factor of 0.2, what is symbol rate?	Understand	5
3	A communication satellite is used for voice signal transmission with a bit rate of 60.8 Kb/s. If the earth station transmit TDMA with an efficiency of 90% and if transmission line bit is 130 Mb/s, Calculate the number of channels?	Remember	5

4	Explain the concept of RMA? The EIRP of a 240 W transponder is 57 dBW. Calculate the approximate gain of the antenna. Suppose if this transponder is Switched to 120 W. What will be the new EIRP, given the same antenna is used?	Understand	5
5	Explain What is intermodulation noise? A satellite downlink at 12 GHz operates with a transmit power of 6 W and an antenna gainof 48.2 dB. Calculate the EIRP in dBW.	Understand	5
6	List the earth station parameters affecting the C/N ratio? What is the relationship between EIRP and antenna gain?	Understand	5

UNIT-IV
EARTH STATION TECHNOLOGY

PART – A (Short Answer Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1	Explain the types of earth stations?	Understand	6
2	Write a short notes on different subsystems of earth station?	Understand	6
3	Write down the requirements for the design of an earth station?	Understand	6
4	Write a short notes on GPS system?	Understand	6
5	Explain What are the components of GIS?	Understand	6
6	Explain the applications of satellite navigation system?	Understand	6
7	Summarize the advantages and disadvantages of forward error correction?	Understand	6
8	Identify various compressions standards used in satellite applications?	Remember	6
9	Differentiate How MATV differs from CATV system?	Understand	6
10	State some of the typical applications of VSAT?	Remember	6
11	Define C0-ordination distance?	Remember	6
12	Elaborate the silent features of GPS?	Remember	6
13	Compare the three segments present in GPS?	Remember	6
14	Give the difference between KU-band and the C-band receive only systems.	Remember	6
15	Define earth segment and what is mean by ODU and IDU?	Remember	6
16	State the types of antenna losses?	Remember	6
17	Define noise factor and what is an antenna loss?	Remember	6
18	Define S/N ratio and explain what is noise weighting?	Understand	6
19	Explain what is an inter modulation noise?	Understand	6

PART – B (Long Answer Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1	Explain with a block diagram the working of receiver part of earth station?	Understand	6
2	Quote a brief account of MPEG compression standards. Write a block diagram explain home receiver indoor unit.	Remember	6
3	Explain the objectives, principles and applications of Orbcomm and GPS system.	Understand	6

4	i. Discuss in detail about global positioning satellite system. ii. Write brief notes on the advantages and disadvantages of using satellite in LEOs, MEOs and GEOs for mobile satellite	Understand	6
5	Explain in detail about TVRO systems and explain how the gain of large antenna can be optimized?	Understand	6
6	Explain with the neat diagram the indoor and outdoor units of DBS home receiver and Discuss the satellite mobile services?	Understand	6
7	Explain what do you mean by the direct broadcast satellite service. How does it differ from the home reception of satellite TV signals in the C-band, which is common place today?	Understand	6
8	Explain with the help of a block diagram; briefly describe the functioning of indoor receiving unit of a satellite TV receiving system intended for home reception?	Understand	6
9	Define frequency co-ordination, co-ordination area andcounter? Differentiate small earth station and a large earth station?	Remember	6
10	Explain the power test methods and lower orbit considerations of earth station technology in satellite communications?	Understand	6
11	Explain the concept of GPS receiver and GPS C/A code Accuracy? Explain the location principles of satellite navigation and global Polling systems?	Understand	6
12	An antenna has a noise temperature of 35 K and it is matched into a receiver which has a noise temperature of 100 K. Calculate the noise power density and the noise power for a BW of 36 MHz.	Understand	6
13	A satellite downlink at 12 GHz operates with a transmit power of 6 W and an antenna gain of 48.2 dB. Calculate the EIRP in dBW.	Understand	6
14	The range between a ground station and a satellite is 42000 km. Calculate the free space loss a frequency of 6 GHz.	Understand	6
15	Describe and compare the MATV and CATV systems	Remember	6
16	Explain the classifications of system noise temperature and also Explain uplink satellite circuit	Remember	6
17	Describe briefly about the rains effects Explain about inter-satellite link.	Remember	6

PART - C (Analytical Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1	Explain all the types of INTELSAT satellite with respect to basic space craft characteristics and the vehicle type?	Understand	6
2	a) For a 24 MHz bandwidth transponder and allowing for a roll off factor of 0.2, what is the symbol rate? b) The EIRP of a 240W transponder is 57dBW. Calculate the approximate gain of the antennas. Suppose if this transponder is switched to 120W. What will be the new EIRP, Given the same antenna is used?	Remember	6
3	Write note on i. Bit rate for digital television ii. MPEG compression standards.	Remember	6
4	a) Discuss briefly on DAB system. b) With a neat block diagram explain (lie outdoor unit for an OUS home receiver).	Understand	6

	UNIT-V SATELLITE PACKET COMMUNICATIONS		

PART – A (Short Answer Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1	Recognize what is queue in satellite packet communication?	Remember	7
2	Explain FDMA and TDMA concepts?	Understand	7
3	Define satellite packet switching?	Remember	8
4	Explain the algorithm used in satellite packet switching?	Understand	7
5	Define slotted aloha? Explain in brief about slotted aloha?	Remember	8
6	Explain packet reservation?	Understand	7
7	Describe the probability of M/M/I queue?	Remember	8
8	Calculate the response time of a queue?	Understand	8
9	Explain the delay analysis of TDMA?	Understand	7
10	Explain frequency division multiple access in FDMA?	Understand	8
11	State what is Universal time?	Remember	7

PART – B (Long Answer Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1	Describe what satellite communication protocol used in satellite communication?	Understand	8
2	Differentiate pure ALOHA satellite packet switching with slotted ALOHA packet switching?	Understand	7
3	Discuss in brief the message transmission by FDMA by using MI G/I Queue?	Understand	8
4	Describe in detail about the message transmission by using TDMA technique?	Understand	8
5	Explain the design network channel architecture and transmission of ALOHA net?	Remember	7
6	Discuss in brief about packet reservation multiple access with the help of traffic load?	Understand	7
7	Explain the concept of Dynamic allocation of satellite capacity through packet reservation?	Remember	8
8	Explain packet collision and how it is resolved in pure and slotted ALOHA with the help of tree algorithm?	Remember	8
9	Discuss the Stability analysis for communication of voice terminals with packet reservation multiple access protocol?	Understand	7
10	Discuss the preliminaries in packet communications?	Understand	8

PART - C (Analytical Questions)

S. No	Questions	Blooms Taxonomy Level	Course Outcome
1	Consider a slotted ALOHA system in which a Guard time 125 bits is used between slots to account for satellite movement. The channel bit rate is 56 kbps and the packet length is 25ms.the channel has a bit error probability of p.Calculate the throughput of the channel?	Understand	8

2	Design the channel backlog in packets for a slotted ALOHA satellite channel with an infinite population and at equilibrium. The channel input rate is 0.346,the randomized retransmission interval is 60 packet lengths, and the satellite roundtrip propagation delay is taken to be 12 packet slots. What is the average packet delay in packet slots?	Remember	8
3	A community of N earth stations shares a 64-kbps aloha satellite channel. Each earth station sends out a 1000-bit packet on an average of once every 100s.Caluculate what is the maximum value of N?	Remember	7
4	Design the average packet delay for 50-kbps ALOHA satellite channel operating at a throughput of 8kbps with 1000-bit packets. The average satellite roundtrip delay is 13 packets, and the randomized retransmission interval is 10 packet lengths. If the average user throughput over time is 1 packet/2 min, estimate the number of users the channel support?	Remember	7

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