INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**SATELLITE COMMUNICATION**				
Course Code	AEC522				
Programme	B.Tech				
Semester	VI	ECE			
Course Type	Professional Elective				
Regulation	R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Practicals**	**Credits**
	3	-	3	-	-
Chief Coordinator	Dr. V Sivanagaraju, Professor, ECE				
Course Faculty	Dr. V Sivanagaraju, Professor, ECE				

COURSE OBJECTIVES:

The course should enable the students to:	
I	Understand the communication space craft and orbits.
II	Interpret the access systems in communication satellites.
III	Understand the VSAT system technologies.
IV	Interpret packet communications in satellite.

COURSE OUTCOMES (COs):

CO 1	Discuss the satellite subsystems, spacecraft and orbits.
CO 2	Analyze the design of Satellite link budget and discuss the satellite subsystems like telemetry, tracking and command system
CO 3	Discuss the significance of different types of multiple access techniques in communication satellites
CO 4	Analyze the earth station technology and constellation of NGSO
CO 5	Evaluate the future satellite communication systems and error control coding for digital satellite links

COURSE LEARNING OUTCOMES (CLOs):

CLO 1	Discuss the different satellite systems like Low earth orbit (LEO), Medium earth orbit (MEO) and Geo synchronous earth orbit (GEO).
CLO 2	Understand how the satellite is locating with respect to earth and orbital perturbations due to earth's oblateness, moon and sun.
CLO 3	Understand the satellite sub systems like Telemetry, tracking and command system, power system, satellite antenna equipment, communications subsystem and transponders
CLO 4	Analyze the design of satellite links for a specified C/N with and without frequency Re-use and link budget.
CLO 5	Discuss the propagation effects like atmospheric absorption, cloud attenuation, troposphere and ionospeheric scintillation and low angle fading.
CLO 6	Discuss the effects of rain, rain induced attenuation, rain induced cross polarization and interference.
CLO 7	Analyze the various multiple access techniques used in communication satellites like FDMA, TDMA and CDMA.
CLO 8	Analyze the concept of demand assignment multiple access (DAMA), types of demand assignment and characteristics.
CLO 9	Understand the significance of Spread Spectrum Multiple Access (SSMA), Direct sequence CDMA (DS-CDMA) or DS spread spectrum transmission and reception.
CLO 10	Understand and analyze the Earth Station technology transmitters, receivers, antennas, tracking systems, terrestrial interface, power test methods and lower orbit considerations
CLO 11	Analyze the Very Small Aperture Terminal (VSAT) network architecture, access control and multiple access selection.
CLO 12	Analyze the constellation design of Non Geostationary Orbit (NGSO) coverage, frequency bands, delay and throughput.
CLO 13	Understand the message transmission by FDMA using M/G/1 queue and message transmission by TDMA using pure aloha.
CLO 14	Apply the error control coding for digital satellite links like block codes and convolution codes.
CLO 15	Evaluate the future satellite communication systems and introduction to satellite laser communication.
CLO 16	Apply the concept of satellite communication to understand and analyze real time applications.
CLO 17	Acquire the knowledge and develop capability to succeed national and international level competitive examinations.

TUTORIAL QUESTION BANK

S. No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcome
UNIT-I COMMUNICATIONS SPACECRAFT AND ORBITS				
PART-A (SHORT ANSWER QUESTIONS)				
1	Elucidate how a satellite is located with respect to earth.	Remember	CO 1	AEC522.01
2	Explore the present trends of satellite communications.	Understand	CO 1	AEC522.01
3	Define sun transit outage.	Understand	CO 1	AEC522.01
4	Describe the effect of solar eclipse.	Remember	CO 1	AEC522.01
5	Define Doppler shift.	Understand	CO 1	AEC522.01
6	Define Kepler's first law for planetary motion.	Remember	CO 1	AEC522.01
7	Describe the first point of Aries.	Understand	CO 1	AEC522.02
8	Define coverage angle.	Remember	CO 1	AEC522.01
9	Define an orbit.	Understand	CO 1	AEC522.01
10	Describe the meant by slant range.	Remember	CO 1	AEC522.01
11	List out the different types of orbits.	Understand	CO 1	AEC522.01
12	Describe the steps involved in launching a satellite.	Remember	CO 1	AEC522.02
13	Distinguish the difference between a geosynchronous and a geostationary satellite.	Understand	CO 1	AEC522.01
14	Compare the difference between active and passive satellites.	Remember	CO 1	AEC522.01
15	State the meaning of apogee and perigee.	Remember	CO 1	AEC522.01
PART-B (LONG ANSWER QUESTIONS)				
1	Explain the historical background of satellite communication.	Understand	CO 1	AEC522.01
2	Describe different frequency bands which are allocated for satellite Communication and explain the uses of these frequencies.	Remember	CO 1	AEC522.01
3	Demonstrate the orbital aspects, which are of importance in synchronous satellite communications. Explain these aspects in brief.	Understand	CO 1	AEC522.02
4	State the various steps involved in placing the satellite in geostationary orbit and explain it with diagram.	Remember	CO 1	AEC522.02
5	Examine the term first point of ARIES and what is its importance in the determination of position of satellite in space.	Understand	CO 1	AEC522.02
6	Give the mathematical formulation of Kepler's third law for planetary motion. Express the importance of perigee and apogee in determining the orbit of a satellite in space.	Remember	CO 1	AEC522.01
7	Elucidate the importance of inclined orbits in satellite communication.	Remember	CO 1	AEC522.01

S. No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcome
8	Give an overview of present and future trends of satellite communications.	Understand	CO 1	AEC522.02
9	Elucidate the following terms: (i) LEO (ii) MEO (iii) GEO	Remember	CO 1	AEC522.01
10	Examine the steps involved locating the satellite with respect to the earth.	Understand	CO 1	AEC522.02
PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)				
1	The earth rotates once per sidereal day of 23h 56min 4s, show that the radius of the GEO is 42,164.1 km.	Remember	CO 1	AEC522.01
2	A low earth orbit satellite orbits at an altitude of 250km above the earth's surface, the mean earth's radius is approximately 6378.14km, calculate the period of the satellite orbit when the altitude is 250km and the orbit is circular. Find the velocity of the satellite along its orbit.	Understand	CO 1	AEC522.01
3	A satellite is in an elliptical with a perigee of 1000km and an apogee of 4000km using a mean earth radius of 6378.14km. Find the period and the eccentricity of the orbit.	Remember	CO 1	AEC522.02
4	A quasi-GEO satellite is in a circular orbit close to geosynchronous altitude; its orbital period is exactly 24h. Calculate the radius of the orbit and the rate of drift.	Remember	CO 1	AEC522.02
5	A low earth orbit satellite is in a circular polar orbit with an altitude of 1000 km. a transmitter on the satellite has a frequency of 2.65 GHz. Find the velocity of the satellite and Doppler shift of the received signal.	Understand	CO 1	AEC522.01
6	Obtain the expression for coverage angle and slant range to the geostationary satellite.	Understand	CO 1	AEC522.01
7	A satellite is moving in an elliptical orbit with the semi major axis equals to 24571 Km. If the perigee distance is 6978 Km, find the apogee height and orbit eccentricity	Remember	CO 1	AEC522.01
8	Calculate the slant range of a geostationary satellite orbiting at 42200 km from an earth station making an elevation angle of 25°. Also find the viewing of the satellite.	Remember	CO 1	AEC522.01
9	A satellite is in 322-km high circular orbit Estimate i. Orbital angular velocity. ii. Orbital period & Orbital linear velocity.	Understand	CO 1	AEC522.02
10	Apogee and perigee of a elliptical satellite orbit are 3000km and 200km, Determine the eccentricity semi major axis and the semi minor axis	Understand	CO 1	AEC522.02
UNIT-II SPACE SEGMENT				
PART-A (SHORT ANSWER QUESTIONS)				
1	List out the types of satellite subsystems.	Remember	CO 2	AEC522.03
2	Elucidate the importance of Telemetry and monitoring	Understand	CO 2	AEC522.06

S. No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcome
3	Describe the attitude and orbit control system (AOCS)	Remember	CO 2	AEC522.05
4	List out the types of antennas are used on satellites	Remember	CO 2	AEC522.02
5	Illustrate the term of housekeeping in satellite communication	Understand	CO 2	AEC522.06
6	Describe the link outage	Remember	CO 2	AEC522.04
7	Analyze the term low angle fading	Analyze	CO 2	AEC522.04
8	Explore the different frequency bands which are allocated for satellite communication	Understand	CO 2	AEC522.06
9	Describe the EIRP.	Remember	CO 2	AEC522.03
10	Describe the tracking and command.	Understand	CO 2	AEC522.05
11	Enumerate the propagation effects	Understand	CO 2	AEC522.03
12	Discuss the affect of C/N and G/T ratios	Remember	CO 2	AEC522.03
13	Illustrate path loss in satellite communication	Understand	CO 2	AEC522.03
14	Describe the rain effects at Ku band	Understand	CO 2	AEC522.03
15	Classify the types of transponder used in satellite	Remember	CO 2	AEC522.03
PART-B (LONG ANSWER QUESTIONS)				
1	Formulate general link equation using basic transmission theory.	Remember	CO 2	AEC522.06
2	Elucidate telemetry, tracking and command (TT&C) subsystem of a satellite with the help of block diagram	Remember	CO 2	AEC522.06
3	Analyze the travelling wave tube amplifier operation.	Analyze	CO 2	AEC522.05
4	Elucidate the working operation of transponder with the help of block diagram for both single and double conversion	Understand	CO 2	AEC522.06
5	State how the system noise temperature affects the performance. Derive the expression for overall system noise temperature at the receiving earth station.	Remember	CO 2	AEC522.06
6	Elucidate in detail satellite communication link design procedure	Understand	CO 2	AEC522.06
7	Find out an expression for C/N and G/T ratios. Explain the importance of these ratios on satellite link design	Remember	CO 2	AEC522.02
8	Elucidate the functions and characteristics of satellites and various sub- systems of satellites	Understand	CO 2	AEC522.04
9	Elucidate the G/T ratio. Prove that the figure of merit shows the performance of the receiver circuitry	Remember	CO 2	AEC522.04
10	Discuss the propagation effects like atmospheric absorption, cloud attenuation and troposphere scintillation	Remember	CO 2	AEC522.06
PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)				
1	A satellite at a distance of 40000 km from a point on the earth's surface radiates a power of 10W from an antenna with a gain of 17 dB in the direction of the observer. Find the flux density at the receiving point and the power received by an antenna at this point with an effective area of 10 meters square	Understand	CO 2	AEC522.04

S. No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcome
2	A satellite at a distance of 20000 km from a point on the earth's surface radiates a power of 10W from an antenna with a gain of 17 dB in the direction of the observer and operates at a frequency of 11GHz. The receiving antenna has a gain of 52.3 dB, find the received power.	Remember	CO 2	AEC522.06
3	Suppose we have a 4GHz receiver with the following gains and noise temperatures, T_{in}=25K , T_{RF} =50K , T_{IF} =1000K , T_m= 500K , G_{RF}= 23 dB, G_{IF}= 30dB , Calculate the system noise temperature assuming that the mixer has a gain $G_{m = 0dB.}$	Understand	CO 2	AEC522.04
4	An earth station antenna has a diameter of 30m, has an overall efficiency of 68%, and is used to receive a signal at 4150MHz. At this frequency, the system noise temperature is 79K when the antenna points at the satellite at an elevation angle of 28 degrees. What is the earth station G/T ratio under these conditions, if heavy rain causes the sky temperature to increase so that the system noise temperature rises to 88K, what is the new G/T ratio?	Understand	CO 2	AEC522.04
5	An earth station transmits at 5.62 GHz from an antenna of 6m. The transmitter generates an output of 8KW. The satellite is 39920 km from the earth station. The efficiency of transmitting antenna being 0.7. Calculate path loss, transmitting antenna gain, transmitter power in dBW, EIRP and received power at the satellite.	Remember	CO 2	AEC522.06
6	In a satellite receiving system, the input equivalent noise temperature to RF antenna is 20K. The receiving system has following characteristics $T_{RF}=15^0$ K, G_{RF}= 20dB, $T_m= 40^0$K, G_m= -2dB, $T_{IF}= 150^0$ K, G_{IF}= 100dB, Calculate the system noise temperature and noise power produced by this receiver, if receiver BW is 10MHz.	Remember	CO 2	AEC522.06
7	A satellite orbiting at 38000km transmits signal at 11.7 GHz. The output power of the satellite transmitter is 250 mW fed to an antenna of directive gain 18.9 dB. The earth station antenna being 4m dish with efficiency 60%. Find the G/T ratio of the earth station of bandwidth 36MHz if C/N equal 40dB.	Remember	CO 2	AEC522.02
8	A constellation of low earth orbit satellites has an altitude of 1000 km. each satellite has two multiple beam antennas that generate 16 beams. One antenna is used to transmit at 2.4 GHz and the other antenna receives at 1.6 GHz. Find the coverage angle of the satellite antenna when the lowest elevation angle for an earth station is 10 degrees.	Understand	CO 2	AEC522.06
9	A satellite at geo stationary orbit from a point on the earth's surface operates at a frequency of 14GHz. The receiving antenna has a gain of 44 dB, find the received power.	Understand	CO 2	AEC522.02
10	Thermal noise in an earth station receiver results in a $(C/N)_{dn}$ ratio of 20 dB. A signal is received from a bent pipe transponder with a carrier to noise ratio $(C/N)_{up}$ is 20 dB. What is the overall $(C/N)_o$ at the earth station? If the transponder introduces intermodulation products with (C/I) ratio is 24dB, what is the overall (C/N) ratio at the	Understand	CO 2	AEC522.03

S. No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcome
	receiving earth station.			
UNIT-III COMMUNICATION SATTELLITE ACCESS SYSTEMS				
PART-A (SHORT ANSWER QUESTIONS)				
1	Define multiple accesses.	Remember	CO 3	AEC522.07
2	Enumerate the advantages of time division multiple access	Remember	CO 3	AEC522.07
3	Describe the pre assigned access	Understand	CO 3	AEC522.07
4	Illustrate the frequency division multiple access	Understand	CO 3	AEC522.07
5	Describe the code division multiple access	Remember	CO 3	AEC522.08
6	Name and classify the modes of multiple access	Understand	CO 3	AEC522.08
7	Express the features of FDMA scheme.	Remember	CO 3	AEC522.07
8	Define preamble	Remember	CO 3	AEC522.08
9	State any two types of spread spectrum techniques	Understand	CO 3	AEC522.08
10	Elucidate the function of various controls in DAMA system	Remember	CO 3	AEC522.08
11	Discriminate multiplexing with multiple access	Remember	CO 3	AEC522.08
12	List out the applications of spread spectrum techniques.	Understand	CO 3	AEC522.08
13	Describe CBTR in TDMA system	Understand	CO 3	AEC522.08
14	Recall the expression for calculation of C/N with intermodulation	Remember	CO 3	AEC522.08
15	Define burst? Elucidate the method of control burst plan	Understand	CO 3	AEC522.07
1	Describe the time division multiple access	Understand	CO 3	AEC522.07
2	Elucidate pre assigned and demand assigned TDMA systems	Remember	CO 3	AEC522.07
3	Describe the demand assignment multiple access	Understand	CO 3	AEC522.08
4	List out the limitations of frequency division multiple access	Remember	CO 3	AEC522.07
5	List Out the benefits of satellite diversity	Remember	CO 3	AEC522.09
6	Illustrate the disadvantages of time division multiple access	Understand	CO 3	AEC522.08
7	Summarize the guard time and mention its role in TDMA efficiency	Remember	CO 3	AEC522.07
8	Describe the single channel per carrier	Remember	CO 3	AEC522.08
9	Define SPADE	Understand	CO 3	AEC522.08
10	Describe the multiple channels per carrier	Understand	CO 3	AEC522.08
11	Discuss the direct sequence spread spectrum	Understand	CO 3	AEC522.09

S. No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcome
12	Write the formula for processing gain	Remember	CO 3	AEC522.08
13	Define frame efficiency	Remember	CO 3	AEC522.08
14	List out the types of handover in satellite communication	Understand	CO 3	AEC522.08
15	Compare any three multiple access techniques	Remember	CO 3	AEC522.08
	PART-B (LONG ANSWER QUESTIONS)			
1	Elucidate the principle of FDMA with necessary diagrams	Remember	CO 3	AEC522.07
2	Draw the burst structure of TDMA frame and briefly explain	Understand	CO 3	AEC522.08
3	Elucidate the concept of onboard processing in transponder.	Remember	CO 3	AEC522.08
4	Elucidate the block diagram of typical FDMA satellite systems	Remember	CO 3	AEC522.09
5	Describe the characteristics of demand access multiple access	Understand	CO 3	AEC522.08
1	Describe the term satellite switched TDMA	Understand	CO 3	AEC522.08
2	With a neat sketch explain the frame structure of a TDMA	Understand	CO 3	AEC522.08
3	Mention the types of demand assignment and Explain the demand assignment multiple access (DAMA)	Understand	CO 3	AEC522.08
4	Describe the DS spread spectrum transmission and reception in code division multiple access.	Remember	CO 3	AEC522.08
5	Elucidate the following terms: i) Handover ii) inter modulation iii) satellite diversity	Remember	CO 3	AEC522.08
	PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)			
1	Estimate the buffer requirement of a TDMA switch if the transmitter and receiver are operating at 52.35MHz and 55.5 MHz respectively. While 672,128 symbols are transmitted during a frame period of 15ms.thestability requirement is $25.92*10^5$ seconds and frame transmission rate 54MBps.	Remember	CO 3	AEC522.08
2	A satellite has an EIRP of 24dBW and 8 earth stations each with G/T of 38.3 dB/K share equally the total transponder in FM/FDMA. These links are characterized as : uplink C/N = 27dB, inter modulation C/N =20dB, output back off = 6dB, downlink path loss = 197 dB, RMS frequency deviation of carrier = 260 kHz. Calculate the number of 4 KHz voice channels that each earth station can transmit in order to meet an overall C/N of 16 dB at receiver input. Assuming voice activity advantage of 10dB.	Understand	CO 3	AEC522.08
3	A 14-GHz uplink operates with transmission losses and margins totaling 212 dB and a satellite [G/T] 10 dB/K. The required uplink [Eb/N0] is 12 dB. (a) Assuming FDMA operation and an earth station uplink antenna gain	Understand	CO 3	AEC522.08

S. No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcome
	of 46 dB, calculate the earth station transmitter power needed for transmission of a T1 baseband signal. (b) If the downlink transmission rate is fixed at 74 dBb/s, calculate the uplink power increase required for TDMA operation.			
4	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 total frame length is equivalent to 40,800 bits, calculate the frame efficiency.	Remember	CO 3	AEC522.08
5	FDMA is used for uplink access in a satellite digital network, with each earth station transmitting at the T1 bit rate of 1.544 Mb/s. Calculate (a) the uplink [C/N0] ratio required to provide a [Eb/N0] 14 dB ratio at the satellite and (b) the earth-station [EIRP] needed to realize the [C/N0] value. The satellite [G/T] value is 8 dB/K, and total uplink losses amount to 210 dB.	Understand	CO 3	AEC522.08
1	The IF bandwidth for a CDMA system is 3 MHz, the roll off factor for the filter being 1. The information bit rate is 2.4 kb/s, and an $[E_b/N_o]$ of 11 dB is required for each channel accessing the CDMA system. Calculate the maximum number of accesses permitted.	Remember	CO 3	AEC522.08
2	In an FDMA link the following data is available: $\left[\frac{C}{N}\right]_{UPLINK} = 22dB, \left[\frac{C}{N}\right]_{DOWNLINNK} = 25dB,$ $\left[\frac{C}{N}\right]_{Intermodulation} = 22dB, \left[\frac{C}{I}\right]_{UPLINK} = 200dB,$ $\left[\frac{C}{I}\right]_{DOWNLINK} = 175dB$, Calculate the overall C/N of the link.	Remember	CO 3	AEC522.08
3	A BPSK TDMA system is to transmit 1000 digital voice channels, each with 4 bits per sample at a 64 kbps rate. The system must accommodate 1000 data bits/slot at a frame efficiency of 90%. i) What is the number of slots in a frame. ii) what is the length of TDMA frame. iii) how many preamble bits can be used. iv) what is the required satellite bandwidth.	Understand	CO 3	AEC522.08
4	Assume that the TDMA system uses a 125 µs frame time. Find the number of channels that each earth station can send within the TDMA frame when a 5 µs preamble is added and 2µs guard band is used.	Understand	CO 3	AEC522.08
5	A transponder has a bandwidth of 56 MHz and an available single carrier to noise density ratio of 96dBHz. It is intended for SCPC service, with expected voice activity of 30%. Using a voice activated system, calculate the number of 64Kbps QPSK channels that can be sustained by this transponder.	Remember	CO 3	AEC522.08

S. No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcome
UNIT-IV EARTH STATION AND VSAT SYSTEMS TECHNOLOGY				
PART-A(SHORT ANSWER QUESTIONS)				
1	Describe the effective isotropic radiated power	Remember	CO 4	AEC522.10
2	State the functions of low noise amplifier, where it is employed	Understand	CO 4	AEC522.10
3	List out the applications of satellite communication	Remember	CO 4	AEC522.11
4	Describe the feed arrangement system in earth stations	Understand	CO 4	AEC522.11
5	Enumerate the types of satellite services	Understand	CO 4	AEC522.11
6	Define earth segment.	Remember	CO 4	AEC522.10
7	Describe the drawbacks of parabolic reflector antenna	Understand	CO 4	AEC522.12
8	Sketch the elements of satellite tracking system	Understand	CO 4	AEC522.11
9	Enumerate the types of tracking techniques used for satellites.	Remember	CO 4	AEC522.11
10	List the design considerations of lower orbit	Remember	CO 4	AEC522.10
11	Determine the frequency band for MEO system	Understand	CO 4	AEC522.10
12	Enumerate the types of VSAT network architectures	Remember	CO 4	AEC522.11
13	Describe the NGSO orbits	Understand	CO 4	AEC522.12
14	Describe the VSAT system	Understand	CO 4	AEC522.11
15	Describe the effective isotropic radiated power	Remember	CO 4	AEC522.10
PART-B (LONG ANSWER QUESTIONS)				
1	Analyze the reason, cassegrain antenna is popular for large earth stations	Analyze	CO 4	AEC522.10
2	In detail, explain the block diagram representation of a typical earth station.	Remember	CO 4	AEC522.10
3	Elucidate the various feed systems employed in an earth station antenna.	Understand	CO 4	AEC522.10
4	Elucidate the working of VSAT network with a neat sketch.	Remember	CO 4	AEC522.11
6	Describe the operation of typical VSAT user set-up giving detail of the outdoor and indoor units.	Understand	CO 4	AEC522.11
7	With the help of block diagram elucidate the tracking system in ground earth station.	Remember	CO 4	AEC522.10
8	Analyze the various important characteristics of a low noise amplifier.	Analyze	CO 4	AEC522.10
9	Illustrate the mesh and star architectures in a VSAT network.	Remember	CO 4	AEC522.11
10	Elucidate the non geo stationary orbit (NGSO) constellation design	Understand	CO 4	AEC522.12
PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)				
1	A satellite downlink at 12 GHz operates with a transmit	Remember	CO 4	AEC522.10

S. No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcome
	power of 6 W and an antenna gain of 48.2 dB. Calculate the EIRP in dBW.			
2	The range between a ground station and a satellite is 42000 km. Calculate the free space loss a frequency of 6 GHz.	Remember	CO 4	AEC522.10
3	Analyze the A satellite in circular orbit with 1000 Km orbital height transmits at 2.65 GHz. A station in the plane of the satellite orbit receives the signal from the satellite when it is rising from horizon. Find the Doppler shift of the received signal.	Understand	CO 4	AEC522.10
4	Determine the visibility arc on earth equator from the satellite located at 87^0E in the geostationary orbit.	Understand	CO 4	AEC522.10
5	An artificial earth satellite is in an elliptical orbit which brings it to an altitude of 250 km at perigee and out to an altitude of 500 km at apogee. Calculate the velocity of the satellite at both perigee and apogee	Remember	CO 4	AEC522.10
6	A satellite in earth orbit passes through its perigee point at an altitude of 200 km above the earth's surface and at a velocity of 7,850 m/s. Calculate the apogee altitude of the satellite.	Understand	CO 4	AEC522.10
7	A satellite in earth orbit has a semi-major axis of 6,700 km and an eccentricity of 0.01. Calculate the satellite's altitude at both perigee and apogee.	Remember	CO 4	AEC522.12
8	Calculate the escape velocity of a spacecraft launched from the surface of the earth. Likewise, calculate the escape velocity from the surface of the moon where the mass of the moon is 0.0123 times the mass of the earth and the moon's radius is 2,160 miles.	Remember	CO 4	AEC522.12
9	A spacecraft weighing 50,000 lb (including fuel) is drifting in gravity-free space. Its engine is fired for 3 minutes. During the burn, mass is ejected at a rate of 70 lb/s with an exhaust velocity of 10,000 ft/s. Calculate the spacecraft's thrust and acceleration as a function of time during the burn.	Remember	CO 4	AEC522.12
10	A satellite is in a circular equatorial orbit moving in the same direction as of earth rotation with a period 24 hours exactly. Determine the rate of drift of sub-satellite point around the equator in degrees per solar day.	Remember	CO 4	AEC522.12
UNIT-V **SATELLITE PACKET COMMUNICATION**				
PART-A(SHORT ANSWER QUESTIONS)				
1	State the throughput of a satellite.	Understand	CO 5	AEC522.14
2	Describe the types of mobile satellite services.	Understand	CO 5	AEC522.14
3	Enumerate the applications of satellites	Understand	CO 5	AEC522.14
4	Describe the architecture of DRSS satellite	Remember	CO 5	AEC522.14
5	Interpret the function of the error control code	Remember	CO 5	AEC522.14
6	Illustrate the response time of a queue	Understand	CO 5	AEC522.14

S. No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcome
7	Describe the automatic repeat request (ARQ).	Remember	CO 5	AEC522.14
8	Interpret the satellite packet switching	Understand	CO 5	AEC522.14
9	Describe which queuing system is used in FDMA	Understand	CO 5	AEC522.15
10	Describe the meant by forward error correction code.	Remember	CO 5	AEC522.15
11	Interpret the burst code word	Remember	CO 5	AEC522.15
12	Express the delay analysis of TDMA	Understand	CO 5	AEC522.15
13	Explain the slotted aloha	Understand	CO 5	AEC522.15
14	Illustrate the packet reservation?	Remember	CO 5	AEC522.15
15	List out the advantages of convolution codes over the other codes.	Understand	CO 5	AEC522.15
PART-B (LONG ANSWER QUESTIONS)				
1	Differentiate pure ALOHA satellite packet switching with slotted ALOHA packet switching.	Remember	CO 5	AEC522.13
2	Elucidate the message transmission in FDMA by using M/G/1 Queue.	Remember	CO 5	AEC522.13
3	Elucidate the packet collision and how it is resolved in pure and slotted ALOHA with the help of tree algorithm.	Understand	CO 5	AEC522.13
4	Analyze the collision resolution protocol using tree algorithm.	Analyze	CO 5	AEC522.14
5	Express in detail about the message transmission by using TDMA technique	Remember	CO 5	AEC522.13
6	Demonstrate the preliminaries in packet communications	Understand	CO 5	AEC522.14
7	Analyze the pure aloha packet switching in satellite packet communication.	Analyze	CO 5	AEC522.13
8	Explain the concept of Dynamic allocation of satellite capacity through packet reservation	Remember	CO 5	AEC522.15
9	Elucidate the packet reservation multiple access with the help of traffic load	Understand	CO 5	AEC522.15
10	Summarize the overview of future satellite communication systems.	Remember	CO 5	AEC522.14
PART-C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)				
1.	A (6, 3) block code has a minimum distance of two. a) How many errors can be detected in a codeword? b) How many errors can be corrected in a codeword?	Remember	CO 5	AEC522.14
2.	Consider a TDMA channel with a capacity of 250 Kbps serving an earth station population of 100. Assume that messages arriving at the earth station are two types: single packet and 10 packets. A packet has a fixed length of 1000 bits. Find the average message delay when the traffic intensity is 0.8. Assume 80% of the messages are the single packet type.	Understand	CO 5	AEC522.14
3.	Find the average packet delay for a 50 Kbps aloha satellite channel operating at a throughput of 8 Kbps with 1000-bit packets. The average satellite roundtrip delay is 13 packets, and the randomized retransmission interval is 10	Understand	CO 5	AEC522.14

S. No	QUESTION	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcome
	packet lengths. If the average throughput over time is 1 packet/2 min, estimate the number of users the channel could support.			
4.	Analyze the instability of aloha protocol can be resolved by using tree algorithm	Understand	CO 5	AEC522.13
5.	Consider a (7,4) cyclic code with $g(x) = 1 + x + x^3$, i) let data word d =(1010) find the corresponding code word. ii) Let the code word c = (1100101) find the corresponding data word.	Understand	CO 5	AEC522.15
6.	An aloha satellite channel serves a community of 4000 users, each with an average throughput of 2 bps. The channel capacity is 50 Kbps, and the packet length is 1000 bits. Find the average packet delay if the randomized retransmission interval is 20 packet lengths. The average satellite roundtrip is 12.5 packets.	Understand	CO 5	AEC522.13
7.	Consider a FDMA system of 200 users sharing a satellite channel with a capacity of R = 12.8 Mbps. Assume that each user generates a constant- length message of 10^4 bits according to the Poisson process at the rate of three messages per second.	Understand	CO 5	AEC522.13
8.	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.Calculate what is the maximum value of N?	Understand	CO 5	AEC522.15
9.	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?	Understand	CO 5	AEC522.13
10.	Consider a slotted aloha system in which a guard time of 125 bits is used between slots to account for satellite movement. The channel bit rate is 56 Kbps and the packet length is 25 ms. The channel has a bit error probability of p. Find the throughput of the channel.	Remember	CO 5	AEC522.13

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