



MALAYSIAN INSTITUTE OF INFORMATION TECHNOLOGY

FINAL EXAMINATION
JANUARY 2106 SEMESTER

SUBJECT CODE : INB33103
SUBJECT TITLE : TELECOMMUNICATIONS
LEVEL : BACHELOR
TIME / DURATION : 2.00 PM – 4.00 PM
(2 HOURS)
DATE : 26 MAY 2016

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consists of TWO (2) sections only: Section A and Section B.
4. Answer all questions in Section A and TWO (2) questions from Section B.
5. Formulas and references are provided on the last page (Appendix).
6. Please write your answers on the answer booklet provided.
7. Answer all questions in English.

THERE ARE 11 PAGES OF QUESTIONS, INCLUDING THIS PAGE AND APPENDIX

SECTION A (Total: 50 marks)**INSTRUCTION: Answer ALL questions.****Please use the answer booklet provided.****Question 1**

a) These days, businesses must move data and voice information within locations and between locations. To rationalize this, telecommunication systems become one of the most important aspects. The systems are required to be available, reliable, flexible and scalable.

i. Telecommunication systems can reduce the effect of geography. Support this statement with THREE (3) capabilities of telecommunication systems.

(6 marks)

ii. To ensure availability, information must be ready and operating whenever needed. Explain how time zone affects the availability of a system.

(4 marks)

iii. Describe MTTR in the context of reliability of a telecommunication system.

(3 marks)

b) Konakiri Communications (M) Berhad is offering a new telephone service. 2400 calls are offered to a channel and 12 calls are lost. Average duration of an individual call is 4 minutes. Find:

i. Offered traffic intensity, A

ii. Carried traffic

iii. Lost traffic

iv. Grade of Service, B

v. Congestion time

vi. Call intensity, λ

(12 marks)

[25 marks]

Question 2

a) Within a cellular system, call can take place between a landline party and a mobile phone or between two mobile phones.

i. Elaborate the process of establishing a mobile-to-mobile call, assuming both sides are connected to the same mobile switching center (MSC).

(8 marks)

ii. Determine the additional requirement needed in order to allow long distance mobile-to-mobile communication.

(2 marks)

b) Fiber optic is defined as a branch of optics that deals with the transmission of light through ultrapure fibers of glass, plastic, or some other form of transparent media.

i. Determine the speed of light travelling in a glass fiber.

(3 marks)

ii. Calculate the time taken for the light to travel via glass fiber from Kuala Lumpur, Malaysia to Kathmandu, Nepal. The distance between these two cities is approximately 3221 km. (Hint: Speed is equals to distance over time)

(3 marks)

iii. Light travelling through the glass fiber reached the end of the fiber and exits into the air in Kathmandu, Nepal. If the angle of incidence on the end of the fiber is 30° , calculate the angle of refraction outside the fiber using Snell's Law.

(3 marks)

iv. Assume that the fiber system is going to be replaced with satellite network. Provide THREE (3) benefits of using satellite system in allowing communication between the two cities.

(6 marks)

[25 marks]

SECTION B (Total: 50 marks)

INSTRUCTION: Answer TWO (2) questions ONLY.

Please use the answer booklet provided.

Question 1

- a) A communications satellite is a satellite that has been stationed in space for the purpose of providing telecommunications. Communications satellites are artificial satellites that relay receive signals from an earth station and then retransmit the signal to other earth stations. Read the newspaper clip published by NetIndian News Network, shown in Figure 1, about the currently launched communication satellites, and answer the questions given.

India's communication satellite GSAT-15 to be launched on Wednesday morning

*NetIndian News Network
New Delhi, November 10, 2015*

GSAT-15, India's latest communication satellite, will be scheduled to be launched into orbit by an Ariane 5 launcher of Arianespace from the European spaceport at Kourou in French Guiana in the early hours of Wednesday.

The satellite, built by the Indian Space Research Organisation (ISRO) and designed to deliver telecommunications services as well as dedicated navigation aid and emergency services for India, will be launched on board Ariane 5 flight VA 227 during a 43-minute window that opens at 6.34 pm local time on November 10 in French Guiana (0304 hours on November 11 IST).

The launcher rolled out today from the spaceport's Final Assembly Building for Ariane 5 to the ELA-3 launch zone on Monday. Flight VA 227 will lift off with a pair of telecommunications satellites: GSAT-15 and Arabsat-6B (Badr-7).

GSAT-15 is a high power satellite that will be inducted into India's INSAT/GSAT system, ISRO sources said. Weighing 3164 kg at lift-off, GSAT-15 carries a total of 24 communication transponders in Ku-band as well as a GPS Aided GEO Augmented Navigation (GAGAN) payload operating in L1 and L5 bands.

GSAT-15 will be the third satellite to carry GAGAN payload after GAST-8 and GSAT-10, which are already providing navigation services from orbit. GSAT-15, carries a Ku-band beacon as well to help in accurately pointing ground antennas towards the satellite.

Ariane 5 VA 227 is expected to launch GSAT-15 into a geosynchronous transfer orbit (GTO), following which ISRO's Master Control Facility (MCF) at Hassan will take control of the satellite and perform the initial orbit raising maneuvers using its Liquid Apogee Motor (LAM), placing it in circular geostationary orbit.

Figure 1: Article from NetIndian News Network

- i. Based on the position of where GSAT-15 satellite is to be placed, estimate the distance between the satellite and the Earth surface.
(1 mark)
- ii. Define payload in this context.
(4 marks)
- iii. Despite the capability of Ku-band to support high frequency, explain the disadvantage of the band, which is being selected to be used by GSAT-15.
(2 marks)
- iv. Besides Ku-Band, other frequency bands that are commonly used for communication satellites are C-Band and Ka-Band. Briefly explain both.
(4 marks)
- v. Look angle is the coordinate to which an Earth Station must point to communicate with a satellite. The coordinate is determined by TWO (2) different angles. Explain both.
(6 marks)

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a) Figure 2 illustrates the architecture of a simple telephone system. Study the figure and answer the following questions.

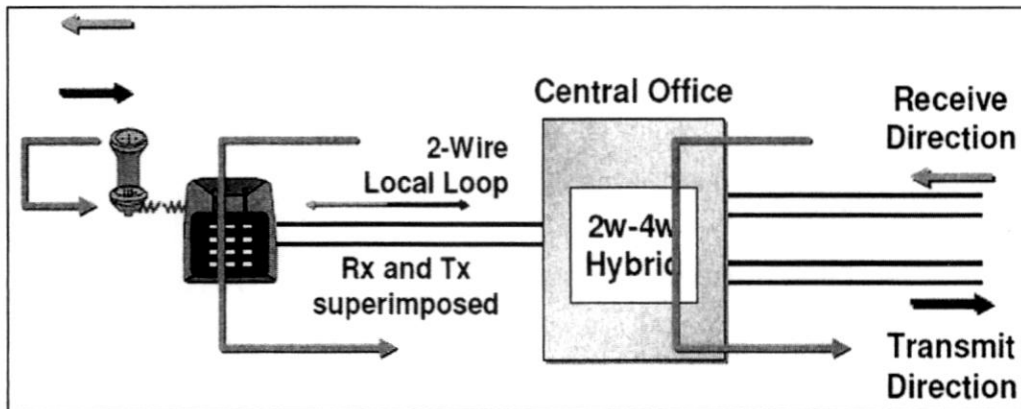


Figure 2: Simple Telephone System

- i. The use of wires in this system causes impedance mismatched. Explain the effect of impedance mismatch in the system.

(2 marks)

- ii. Suggest TWO (2) solutions that can be taken to handle the effect of impedance mismatch mentioned in a)i. above.

(6 marks)

[25 marks]

Question 2

a) Nowadays, the mobile phone has become the favorite way for communication. The telecommunications industry is mainly driven by the cellular segment.

- i. One of the basic elements of cellular system is the radio base transceiver station (BTS), which is the cell site with the antenna system. Describe BTS.

(6 marks)

- ii. As adjacent areas do not use the same radio channels, a call must either be dropped or transferred from one radio channel to another when a user crosses the line between adjacent cells. Assume a mobile unit is moving out of one cell into a neighboring cell.

- a. Determine the process needed to ensure that the connection will not be disrupted or disconnected.

(1 mark)

- b. Explain the process.

(5 marks)

b) A communications satellite is an artificial satellite stationed in space for the purposes of telecommunications using radio at microwave frequencies.

i. Explain the concept of Uplink and Downlink in satellite communications.

(4 marks)

ii. Most communications satellites, particularly the broadcast satellites like AfriStar, Intelsat, PanAmSat, Eutelsat and ASTRA, use geosynchronous earth orbits (GEOs) although some recent systems use low Earth-orbiting satellites.

a. Elaborate GEO satellites.

(6 marks)

b. List THREE (3) disadvantages of GEO satellite implementation.

(3 marks)

[25 marks]

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Question 3

- a) Kassim Baba and his team are currently working on an installation of a small fiber optic network project. The project aimed to connect the networks of Aloya Corporation that are located in two separate buildings, which are only 1.2 km apart. Each building is occupied by 500 staff. Continuous and secure connection is needed between these two building for business activities, such as file sharing, multimedia streaming, network monitoring, video and audio conferencing, email, etc.

Figure 3 illustrates their plan for the fiber optic communication link. Study the plan and answer the following questions.

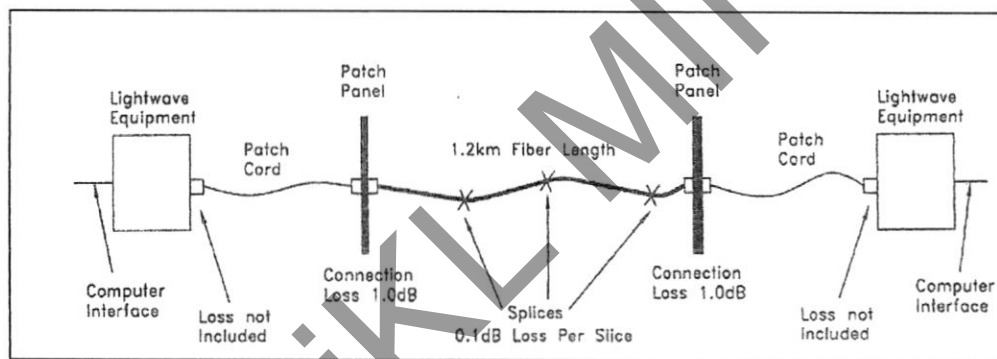


Figure 3: Fiber Optic Communication Link

- i. Optical modules consist of the light source, which generates the light at the transmitter, and the light detector that capture light at the receiver. These modules are parts of the Lightwave Equipment. Considering the high amount of traffic, the limited operational budget and the distance, suggest the most suitable optical modules to be used as the light source and the light detector for Aloya Corporation's network. (2 marks)

- ii. Explain about the light source and the light detector suggested in a(i). (6 marks)

- iii. Splices are being marked with X on the cable. Describe splice. (2 marks)

b) Once, a microwave link frequently is used to transmit signals in instances in which it would be impractical to run cables. However, with the development of satellite and cellular technologies, microwave has become less widely used in current telecommunications industry.

i. Explain THREE (3) minimum requirements of a terrestrial microwave transmission system.

(6 marks)

ii. Rationalize the requirement of having microwave stations (repeaters/relay towers) approximately 30 miles apart.

(3 marks)

iii. Discuss THREE (3) impairments, which degrade the quality of transmitted microwave signals.

(6 marks)

[25 marks]

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END OF EXAMINATION PAPER

APPENDIXErlang:

$$A = CH / T$$

$$B = \text{Number of calls lost} / \text{Number of calls offered}$$

$$\text{Traffic loss} / \text{Traffic offered}$$

$$\lambda = A / s$$

Snell's law:

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$\theta_c = \sin^{-1} (n_2 / n_1)$$

Index of Refraction:

$$n = c / v$$

$$(c = 2.99792458 \times 10^8 \text{ m/s})$$

Index of Refraction of Common Materials:

Material	Index
Vacuum	1.00000
Air at STP (Standard Temperature & Pressure)	1.00029
Ice	1.31
Water at 20 C	1.33
Acetone	1.36
Ethyl alcohol	1.36
Sugar solution (30%)	1.38
Fluorite	1.433
Silica	1.44
Fused quartz	1.46
Vegetable oil	1.47
Sugar solution (80%)	1.49
Glycerin	1.473
Glass	1.52
Sodium chloride	1.54
Carbon disulfide	1.63
Diamond	2.42