ET0153 Revision Paper (2 hours)

Section A (15 MCQ, 2 marks each)

A1. Graded index multimode fiber will
(a) reduce modal dispersion.
(b) reduce material dispersion.
(c) remove modal dispersion.
(d) remove material dispersion.

A2. Which one of the following statements is incorrect?
(a) A laser diode has a longer life than an LED
(b) A laser diode has a higher output power than an LED
(c) A laser diode is more expensive than an LED
(d) A laser diode is more temperature sensitive than an LED

A3. Light is guided in the **core** of multimode step-index fibers by:
(a) Total internal reflection.
(b) refraction.
(c) reflection.
(d) total internal reflection & refraction.

A4. One of the advantages that an APD has over PIN is that:
(a) it costs less.
(b) the circuitry is simpler.
(c) it produces less noise.
(d) it is more sensitive

A5. Which one of the following factors does not affect the bandwidth of an optical communication link?
(a) Fiber material dispersion.
(b) Fiber loss.
(c) Fiber modal dispersion.
(d) Optical transmitter rise time.

A6. Rayleigh scattering loss is the lowest at:
(a) 1550 nm wavelength.
(b) 1310 nm wavelength.
(c) 980 nm wavelength.
(d) 850 nm wavelength.

A7. Laser light is produced by :
(a) spontaneous emission of photons.
(b) stimulated emission of photons.
(c) absorption of photons.
(d) scattering of photons.

A8. An optical time domain reflectometer (OTDR) is useful for :
(a) measuring losses & location of faults in fiber & estimating a fiber link length.
(b) location of cable faults and measuring of losses in optical fiber.
(c) fiber link length estimation, location of couplers and fiber end in the optical fiber.
(d) measuring losses in couplers, measuring of deadzone and locating fiber end.

A9. It is possible for optical fiber to have no dispersion if:
(a) optical fiber is operating at 850nm, 1310nm and 1550nm wavelengths.
(b) multimode fiber is operated at 1310nm wavelength only.
(c) monomode fiber is operated at 1310nm wavelength only.
(d) optical fiber is operated at 1310nm wavelength only.

A10. Three axis stabilized satellites are kept in a stable position by :
(a) Spinning the body of the satellite.
(b) Momentum wheels inside the satellite body.
(c) Reaction wheels inside the satellite body.
(d) Both momentum wheels and reaction wheels inside the satellite body.

A11. The satellite subsystem that converts uplink to downlink frequencies is the :
(a) Transponder subsystem.
(b) Power supply subsystem.
(c) Command, telemetry and control subsystem.
(d) Antenna subsystem

A12. Which of the following component is not part of a transponder subsystem :
(a) LNA.
(b) Mixer.
(c) Modulator.
(d) HPA.

A13. Under which of the following situations, satellites need to use battery power :
(a) The vernal equinox.
(b) The satellite goes into an eclipse.
(c) The solar cell panels not properly positioned to the sun.
(d) All of the above.

A14. The function of TWTA in the satellites earth stations is :

(a) To translate the signal frequencies.
(b) To reduce the system noise.
(c) To boost the signal to a sufficient high power.
(d) To modulate the baseband signals.

A15. For dual conversion Down Converters in earth satellite station, the two IF frequencies are :

(a) 6/4 GHz.
(b) 6/4 MHz.
(c) 70/770 MHz.
(d) 12/14 GHz.

Section B (15 or 20 marks)

B1**.** It is desired to transmit a 10 Mbps (RZ) digital signal at a BER of 10^{-9} through an optical fiber link, which has the following system specifications:

Transmitter	Receiver
Output Power= 100 μW	Sensitivity at 10^{-9} BER = -48 dBm
Source rise time = 15 ns	Detector rise time = 14 ns
Connector loss = l dB	Connector loss = 1 dB

Fiber

Modal dispersion rise time = 10 ns/km; Material dispersion rise time = 4 ns/km
Attenuation = 3 dB/km; Splice loss is negligible
A safety margin of 6 dB is to be reserved.

(a) Determine the maximum link distance using power budget. (10km)
(b) Determine the maximum link distance using risetime budget. (2.26km)
(c) Is the system power or rise time limited? (risetime limited)

B2. An optical fiber system has the following system parameters:

ILD transmitter power :	-3 dBm
Fiber loss : .	2 dB/km
Connector loss at each end of the link :	l dB
Sensitivity of the PIN receiver :	-50 dBm (at 140 Mbs, NRZ and 10^{-9} BER)
Required safety margin :	3 dB
ILD transmitter rise time :	2 ns
Fiber dispersion :	5 ns/km
PIN receiver rise time :	1 ns

(a) Estimate the maximum permissible link length, without repeater, when operating at 140 Mbps NRZ (BER = 10^{-9}). (0.792km)

(b) If the ILD transmitter power is increased to 0dBm, can the transmission distance be increased without degrading the system performance ? Why? (If the ILD power is increased to 0 dBm from -3 dBm, the maximum link length will **NOT** be increased as the system is still **risetime limited.**)

(c) If the optical fiber system is to operate over a link length of 50 km, determine the total number of repeaters required. (63)

(d) State the advantage of using WDM devices in an optical communication link.
(it greatly expand the information carrying capacity of an optical fiber)

B3. i) An ILD material has a band gap of 1.3eV : Find the wavelength and frequency of peak emission and the band gap energy in Joules. (954nm, 3.15×10^{14} Hz, 2.084×10^{-19} (J)

ii) A photodiode operates at λ = 1510 nm and has a quantum efficiency of 65%. If the incident optical power to the photodiode is -35 dBm, determine the energy of each photon in eV. (0.821eV)

iii) A fiber has a specified NA of 0.22 and n_{core} = 1.4. Find the time difference between the fastest and slowest modes arriving at the end of a 500 m length fiber. (28.7ns)

iv) Given n1 = 1.479, n2 = 1.457 and L = 1km, find the bandwidth of a step index multimode fiber and a graded multimode fiber. (16.67MHz, 2.246 GHz)

B4. A Ku band satellite has the following parameters:

	Uplink	Downlink
EIRP	98 dBw	41 dBw
G/T	-5.3 dBK^{-1}	38 dBK^{-1}
FSPL	208 dB	206 dB
Other losses	7.6 dB	1.0 dB

(a) Calculate the round trip echo delay in ms. (550.5ms)
(b) Determine the earth satellite station transmitter output power in kw, if the antenna gain is 64 dB. (2.51 Kw)
(c) Determine the overall carrier to noise ratio C/N for a 36MHz bandwidth signal. (23.87dB)
(d) Without changing the link distance, suggest a way to reduce the FSPL of this link. (Use C band instead of Ku band as lower frequency has lower FSPL.)

MCQ

A1. - (a)	A11 – a
A2. - (a)	A12 – d
A3. - (a)	A13 – d
A4. - (d)	A14 – c
A5. - (b)	A15 – c
A6. - (a)	
A7. - (b)	
A8. - (a)	
A9. - (c)	
A10. - (d)	