

19

**SULIT**



**BAHAGIAN PEPERIKSAAN DAN PENILAIAN  
JABATAN PENDIDIKAN POLITEKNIK  
KEMENTERIAN PENDIDIKAN TINGGI**

**JABATAN KEJURUTERAAN ELEKTRIK**

**PEPERIKSAAN AKHIR  
SESI JUN 2017**

**DEP 5313: FIBER OPTIC COMMUNICATION SYSTEM**

---

**TARIKH : 24 OKTOBER 2017  
MASA : 8.30 PAGI – 10.30 PAGI (2 JAM)**

---

Kertas ini mengandungi **SEMBILAN (9)** halaman bercetak.

Bahagian A: Struktur (4 soalan)

Bahagian B: Esei (2 soalan)

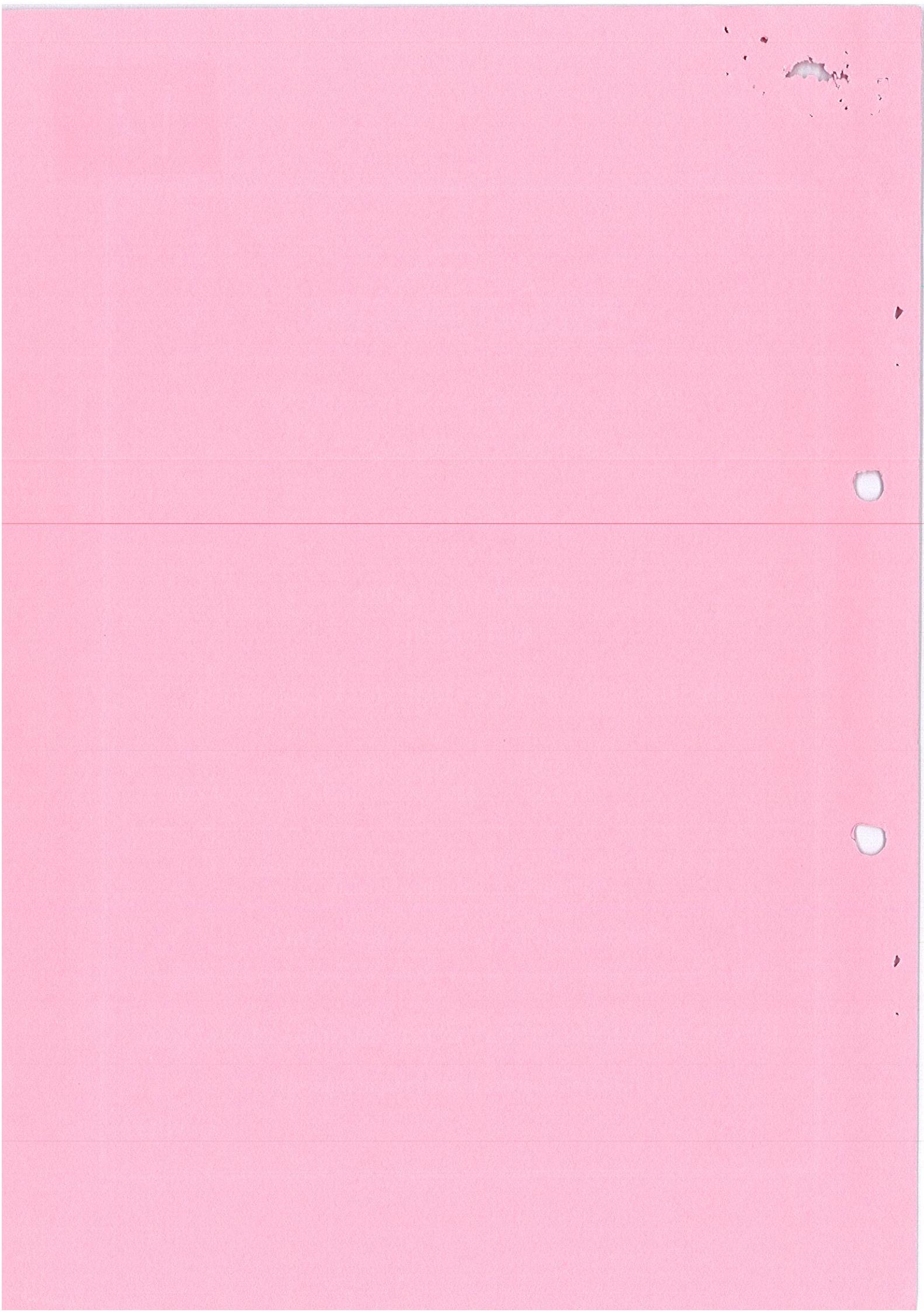
Dokumen sokongan yang disertakan : TIADA

---

**JANGAN BUKA KERTAS SOALANINI SEHINGGA DIARAHKAN**

(CLO yang tertera hanya sebagai rujukan)

**SULIT**



**SECTION A : 60 MARKS**  
**BAHAGIAN A : 60 MARKAH****INSTRUCTION:**

This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

**ARAHAN:**

Bahagian ini mengandungi **EMPAT (4)** soalan berstruktur. Jawab **SEMUA** soalan.

**QUESTION 1****SOALAN 1**CLO1  
C2

- (a) Describe the Snell's law.

*Terangkan istilah "Snell's law".*

[3 marks]

[3 markah]

CLO1  
C3

- (b) Use the Snell's Law equation to prove the critical angle equation is

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

*Gunakan persamaan Snell's Law untuk membuktikan persamaan**Sudut kritikal adalah  $\Theta_c = \sin^{-1} (n_2 / n_1)$ .*

[6 marks]

[6markah]

CLO2  
C3

- (c) Illustrate the propagation of light in single mode fiber and step index multimode fiber.

*Gambarkan pergerakan cahaya dalam gentian mod tunggal dan gentian mod pelbagai langkah tunggal.*

[6 marks]

[6 markah]

**QUESTION 2**  
**SOALAN 2**

CLO1

C2

- (a) Identify the blocks A, B and C by referring to Figure 2 (a): Fiber Optic Communication System.

*Kenalpastikan blok A, B dan C dengan merujuk kepada Rajah 2(a): Sistem Komunikasi Gentian Optik.*

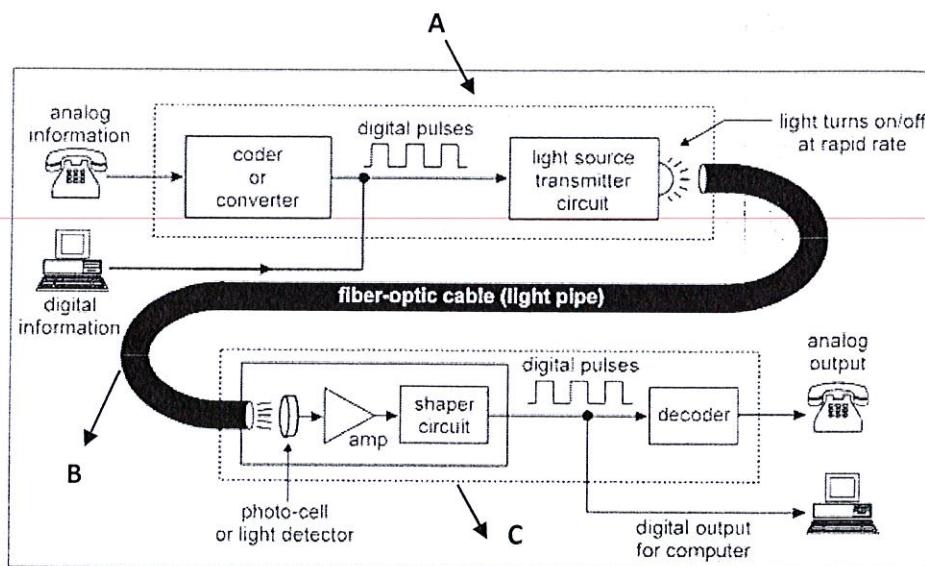


Figure 2 (a) : Fiber Optic Communication System  
Rajah 2(a) : Sistem Komunikasi Gentian Optik

[3 marks]  
[3 markah]

CLO1  
C3

- (b) List the processes of performing an arc fusion splicing.

*Senaraikan proses-proses untuk melakukan pelakuran arka.*

[6 marks]  
[6 markah]

## APPENDIX A2

## REGISTER 9-2: INTCON2: INTERRUPT CONTROL REGISTER 2

R/W-1	R/W-1	R/W-1	R/W-1	U-0	R/W-1	U-0	R/W-1
RBPU	INTEDG0	INTEDG1	INTEDG2	—	TMROIP	—	RBIP
bit 7	bit 0						

## Legend:

R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared
		x = Bit is unknown

bit 7	<b>RBPU:</b> PORTB Pull-up Enable bit 1 = All PORTB pull-ups are disabled 0 = PORTB pull-ups are enabled by individual port latch values
bit 6	<b>INTEDG0:</b> External Interrupt 0 Edge Select bit 1 = Interrupt on rising edge 0 = Interrupt on falling edge
bit 5	<b>INTEDG1:</b> External Interrupt 1 Edge Select bit 1 = Interrupt on rising edge 0 = Interrupt on falling edge
bit 4	<b>INTEDG2:</b> External Interrupt 2 Edge Select bit 1 = Interrupt on rising edge 0 = Interrupt on falling edge
bit 3	<b>Unimplemented:</b> Read as '0'
bit 2	<b>TMROIP:</b> TMRO Overflow Interrupt Priority bit 1 = High priority 0 = Low priority
bit 1	<b>Unimplemented:</b> Read as '0'
bit 0	<b>RBIP:</b> RB Port Change Interrupt Priority bit 1 = High priority 0 = Low priority

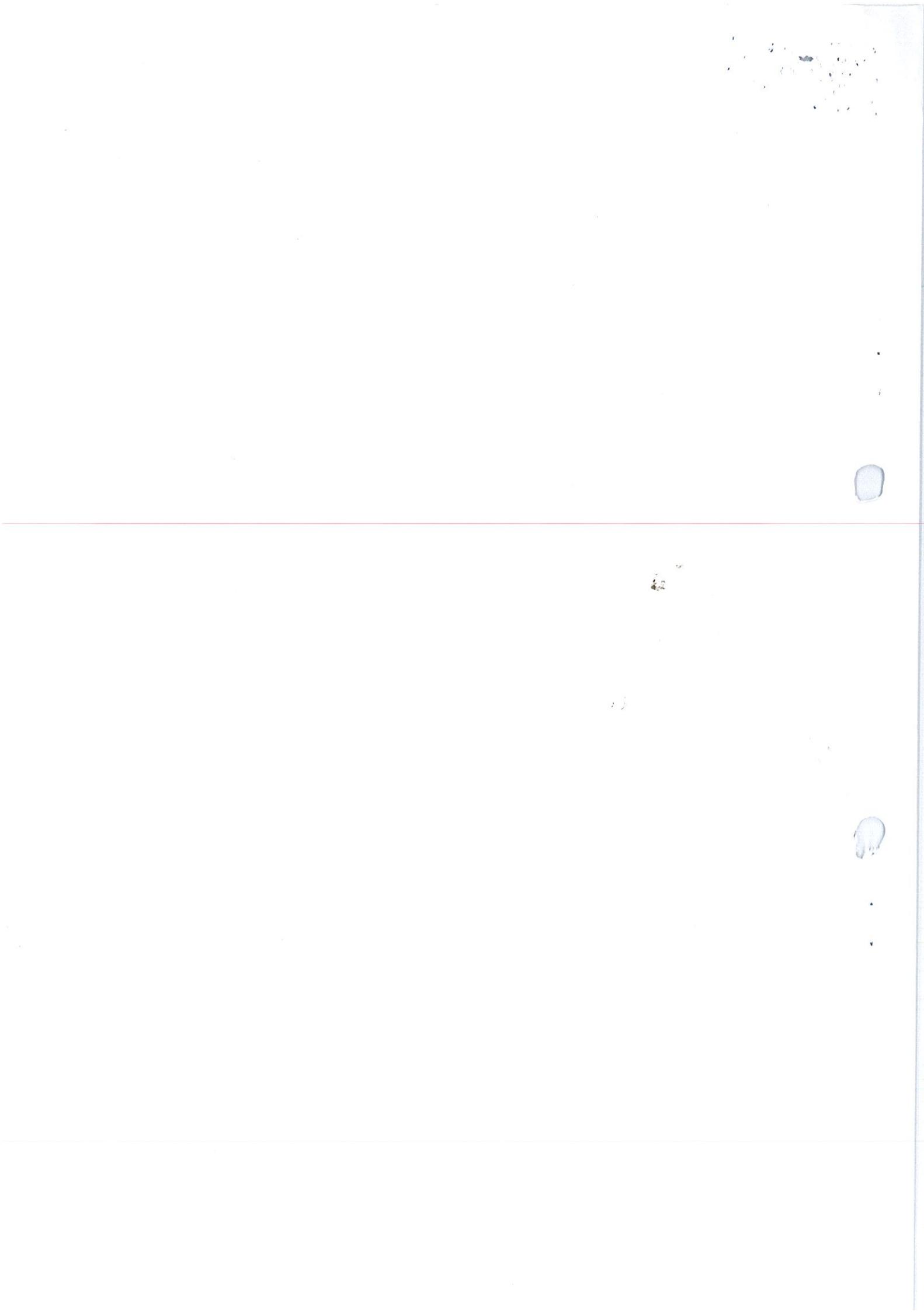
## REGISTER 10-13: IOCB: INTERRUPT-ON-CHANGE PORTB CONTROL REGISTER

R/W-1	R/W-1	R/W-1	R/W-1	U-0	U-0	U-0	U-0
IOCB7	IOCB6	IOCB5	IOCB4	—	—	—	—
bit 7	bit 0						

## Legend:

R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared
		x = Bit is unknown

bit 7-4	<b>IOCB&lt;7:4&gt;:</b> Interrupt-on-Change PORTB control bits 1 = Interrupt-on-change enabled <sup>(1)</sup> 0 = Interrupt-on-change disabled
---------	--



- CLO1 C3 (c) A photodiode incorporated into an optical fiber receiver which is operating at a wavelength of  $1.55\mu\text{m}$  has a dark current of  $500 \text{ nA}$  at its operating temperature. When the incident optical power at this wavelength is  $1\text{mW}$  and the responsivity of the device is  $0.6\text{AW}^{-1}$ , shot noise dominates in the receiver. Calculate the dark current noise and the shot noise when the bandwidth is  $100 \text{ MHz}$ .

*Satu fotodiod dalam penerima gentian optik beroperasi pada panjang gelombang  $1.55\mu\text{m}$  mempunyai arus gelap  $500 \text{ nA}$  pada suhu operasi. Apabila kuasa masukan optik pada panjang gelombang ini adalah  $1\text{mW}$  dan responsivity peranti adalah  $0.6\text{AW}^{-1}$ , shot noise menguasai dalam penerima. Kirakan hingar arus gelap dan shot noise apabila jalur lebar adalah  $100 \text{ MHz}$ .*

[6 marks]  
[6 markah]

**QUESTION 3**  
**SOALAN 3**CLO1  
C1

- (a) Wavelength Division Multiplexing (WDM) is one of the multiplexing techniques that transmits a different optical wavelengths simultaneously to the optical link system. List **THREE (3)** classifications of WDM.

*Wavelength Division Multiplexing (WDM) adalah salah satu teknik pemultipleksan yang menghantar panjang gelombang optik yang berbeza pada masa yang sama untuk sistem pautan optik. Senaraikan TIGA (3) klasifikasi WDM.*

[3 marks]

[3 markah]

CLO1  
C2

- (b) Erbium Doped Fiber Amplifier (EDFA) is one of the main components used in DWDM system to boost the optical signal and compensate the loss in optical link. Explain the characteristics of EDFA.

*Erbium Doped Fiber Amplifier (EDFA) merupakan salah satu komponen utama yang digunakan dalam sistem DWDM untuk meningkatkan isyarat optik dan mengimbangi kehilangan di dalam pautan optik. Terangkan ciri-ciri EDFA.*

[5 marks]

[5 markah]

CLO1  
C3

- (c) Fiber-In-The Loop (FITL) is an application of optical fiber transmission in access networks. There are four types of FITL. Illustrate the Fiber-to-the-Home (FTTH) and Fiber-to-the-Curb (FTTC).

*Fiber-In-The Loop (FITL) adalah sebuah aplikasi penghantaran gentian optik dalam rangkaian akses. Terdapat empat jenis FITL. Gambarkan Fiber-to-the-Home (FTTH) dan Fiber-to-the-Curb (FTTC).*

[7 marks]

[7 markah]

**QUESTION 4**  
**SOALAN 4**CLO1  
C2

- (a) Identify the types of fiber optic measurement in optic communication system.

*Kenalpasti jenis pengukuran gentian optik dalam sistem perhubungan optik.*

[3 marks]

[3 markah]

CLO1  
C3

- (b) Fiber continuity testing is also called fiber optic continuity checker. It is the simplest visual test of a fiber optic cable link. Interpret the procedures to perform the fiber continuity test.

*Ujian kesinambungan fiber juga dikenali sebagai pemeriksa kesinambungan gentian optik. Ia adalah ujian visual yang paling mudah untuk pautan kabel gentian optik. Tafsirkan langkah-langkah untuk melaksanakan ujian serat kesinambungan.*

[6 marks]

[6 markah]

CLO1  
C3

- (c) Figure 4 (c) shows the information in the Optical Time Domain Reflectometer (OTDR) Trace. Complete the information in the OTDR trace which is labelled as 1, 2, 3, 4, 5 and 6.

*Rajah 4(c) menunjukkan maklumat yang dipaparkan di dalam Optical Time Domain Reflectometer (OTDR). Lengkapkan maklumat yang berlabel 1,2,3,4,5 dan 6 di paparan OTDR tersebut.*

[6 marks]

[6 markah ]

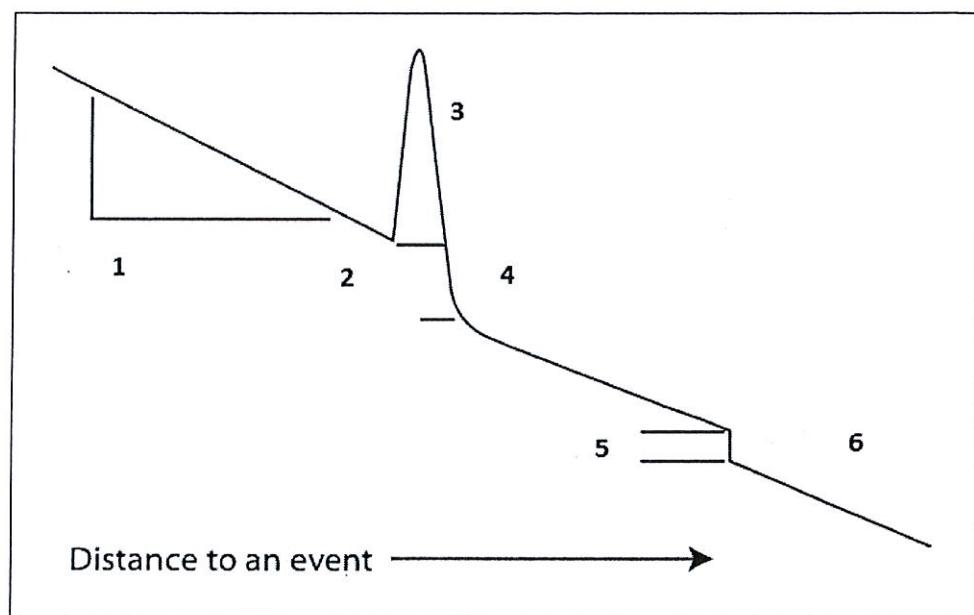


Figure 4 (c): The information in the OTDR Trace

**SECTION B: 40 MARKS**  
**BAHAGIAN B: 40 MARKAH****INSTRUCTION:**

This section consists of **TWO (2)** essay questions. Answer **ALL** questions.

**ARAHAN:**

Bahagian ini mengandungi **DUA (2)** soalan esei. Jawab **SEMUA** soalan.

**QUESTION 1****SOALAN 1**CLO2  
C3

Fiber optic is a medium for carrying information from one point to another in the form of light. The construction of fiber optic cable contains of core, cladding, buffer coated, strengthening fibers and cable jacket. Illustrate the construction of fiber optic cable and the function of every part. Given that the incident angle of the fiber is  $30^\circ$ , the refractive index of material A and material B are 1.50 and 1.48 respectively. Calculate the refraction angle, critical angle at the material A and B interface, the Numerical Aperture and Acceptance Angle.

*Gentian optik adalah satu medium untuk membawa maklumat daripada satu tempat ke tempat lain dalam bentuk cahaya. Binaan kabel gentian optik mengandungi core, cladding, buffer coated, strengthening fibers dan cable jacket. Gambarkan binaan kabel gentian optik dan fungsi setiap bahagian. Diberi sudut tuju bagi gentian adalah  $30^\circ$ , index pembiasan bahan A adalah 1.50 dan bahan B adalah 1.48 masing-masing. Kirakan sudut pembiasan, sudut genting di antara bahan A dan B, bukaan berangka dan sudut penerimaan.*

[20marks]

[20 markah]

**QUESTION 2**  
**SOALAN 2**CLO3  
C5

A transmitter has an output power of 0.1mW, while fiber has two connector insertion loss of 0.2dB and fiber attenuation is 3.5 dB/km for the length of 1 km. The link contain one fiber splice of 0.1dB. The receiver has a minimum acceptable power (sensitivity) of -20dBm. The designer has allowed a 4dB margin. Assuming the design contains Hub (Tx/RX) which is connected to Patch Panel and Wall Outlet by using fiber optic cable as a transmission medium. In addition, Patch Cable is used to connect the Wall Outlet to the PC. Based on the information given, design a fiber optic link loss budget. Evaluate the total loss in the fiber optic link and the total power received. Predict your design based on the evaluation and choose the suitable type of fiber optic as well as the light source that can be used in this system.

*Pemancar mempunyai kuasa 0.1mW manakala gentian optik mempunyai kehilangan dua penyambungan 0.2dB, pelemahan gentian 3.5dB/km untuk jarak 1km. Pautan ini mengandungi satu kehilangan pelakuran 0.1dB. Penerima mempunyai kuasa minimum yang boleh diterima (kepekaan) iaitu -20dBm. Pereka telah membenarkan margin sebanyak 4dB. Anggapkan rekebentuk ini mengandungi Hub (Tx/RX) yang disambungkan ke Patch Panel dan Wall Outlet. Sebagai tambahan, Patch Cable digunakan untuk menyambungkan Wall Outlet ke PC. Berdasarkan kepada maklumat yang diberi reka pautan bajet kehilangan gentian optik. Nilaikan jumlah keseluruhan kehilangan pautan gentian optic dan jumlah kuasa penerima. Jangkakan rekaan anda berdasarkan penilaian yang dibuat dan pilih jenis gentian optik serta sumber cahaya yang boleh digunakan di dalam sistem ini.*

[20marks]  
[20 markah]**SOALAN TAMAT**