2018/2019 SEMESTER TWO EXAMINATION

Diploma in Aerospace Electronics (DASE) 1st Year FT

Diploma in Computer Engineering (DCPE) 1st Year FT

Diploma in Electrical & Electronic Engineering (DEEE) 1st Year FT

Diploma in Engineering Systems (DES) 1st Year FT

Diploma in Energy Systems and Management (DESM) 1st Year FT

Common Engineering Programme (DCEP) 1st Year FT

Diploma in Engineering with Business (DEB) 2nd Year FT

# PRINCIPLES OF ELECTRICAL & ELECTRONIC ENGINEERING II

# Time Allowed: 2 Hours

## Instructions to Candidates

1. The examination rules set out on the last page of the answer booklet are to be complied with.

2. This paper consists of **TWO** sections:

Section A - 10 Multiple Choice Questions, 2 marks each.

Section B - 8 Short Questions, 10 marks each.

3. **ALL** questions are **COMPULSORY**.

4**.** All questions are to be answered in the answer booklet.

5. Start each question in Section B on a new page.

6. Fill in the Question Numbers, in the order that they were answered, in the boxes found on the front cover of the answer booklet under the column “Questions Answered”.

7. This paper contains 10 pages, inclusive of formulae sheets.

#### SECTION A

**MULTIPLE CHOICE QUESTIONS** **(20 marks)**

1. Please **tick** your answers in the **MCQ box** on the inside of the front cover of the answer booklet.

2. No marks will be deducted for incorrect answers.

A1. Which one of the following statements is not true for a P-type semiconductor?

1. It is doped with a trivalent impurity.
2. Holes are the majority carriers.
3. It is positively charged.
4. Electrons are the minority carriers.

A2. The purpose of adding pentavalent impurity to silicon is to

1. increase the number of free electrons.
2. increase the number of holes.
3. reduce the number of holes.
4. reduce the number of free electrons.

A3. The average value of a full-wave rectified voltage with a peak output voltage of 35 V is

(a) 11.14 V

(b) 17.5 V

(c) 22.28 V

(d) 70 V

A4. Which one of the following IC voltage regulators gives a DC output voltage of +24 V?

1. 7812
2. 7824
3. 7912
4. 7924

A5. A Zener diode has an impedance of 7  and a maximum voltage of 6.85 V at a maximum current of 75 mA. If the Zener diode is operating at a current of 35 mA, its operating voltage is equal to

1. 6.150 V
2. 6.325 V
3. 6.570 V
4. 6.605 V

A6. For the circuit shown in Figure A6 assuming that the 4 LEDs are identical, the voltage drop across each LED is equal to

680  W

8 V

680  W

12 mA

1. 4 V
2. 3.92 V
3. 2.98 V
4. 1.96 V

Figure A6 mA

A7. Assuming that the transistor shown in Figure A7 is biased in the active region with VCE = 2.5 V, the collector current IC is equal to

1. 0.11 mA

IC

## RC

## 270 

1. 9.26 mA

## RB

## 30 k

1. 22.22 mA

VCC

10 V

1. 27.78 mA

IB

4 V

Figure A7

A8. For the transistor circuit shown in Figure A7, the base current IB is equal to

1. 0.11 mA
2. 0.133 mA
3. 0.167 mA
4. 0.177 mA

A9.An averaging amplifier has 5 inputs. The ratio of the resistors, Rf/Ri is equal to

1. 0.2
2. 0.4
3. 5
4. 10

A10. For the operational amplifier circuit shown in Figure A10, the output voltage,Vo is equal to

V+

5 k

1 V(p)

+

-

Vo

V–

20 k

+15V

–15V

1. 4 V(p)
2. -4 V(p)
3. 5 V(p)
4. -5 V(p)

Figure A10

#### SECTION B

**SHORT QUESTIONS (80 marks)**

B1. For the circuit shown in Figure B1,

1. name the circuit and explain how it works. (6 marks)
2. Vcc = 12 V, coil resistance of relay = 1 kVCE(sat) = 0.2 V and βDC = 220

find the minimum base current, IB to saturate the transistor. (4 marks)

ThermistorRTH

Relay

Diode

R2

VCC

Electric Bell

R1

Figure B1

B2. For the circuit shown in Figure B2,

1. sketch the output voltage waveform across diode D1. (5 marks)
2. sketch the output voltage waveform across the resistor RL. (5 marks)

Indicate the maximum and minimum values of the waveforms. The circuit uses silicon diodes.

Figure B2

10 V(p-p)

RL

3 k

2 k

D1 k

D2 k

B3. For the circuit shown in Figure B3 if Vin1 = 0.4 V and Vin2 = 0.6 V,

1. calculate the output voltage Vout1;  (3 marks)
2. calculate the output voltage Vout2; (4 marks)
3. draw a circuit to be connected to Vout2 such that its output is inverted.(3 marks)

R2

12 kΩ

R5

15 kΩ

R1

5 kΩ

R3

10 kΩ

*V*out1

***–***

*V*in1

***+***

***–***

R4

5 kΩ

***+***

*V*out2

*V*in2

Figure B3

B4. For the circuit shown in Figure B4,

1. calculate the reference voltage Vref1 and Vref2; (4 marks)
2. determine the output voltage Vout1 and Vout2; (4 marks)
3. state whether LED1 and LED2 are “ON” or “OFF”. (2 marks)

Assume +Vsat = 13 V and -Vsat = -13 V

2 k

15 V

4 k

2 k

5 V

Vref2

4 k

5 V

2 k

Vref1

LED1

LED2

Vout1

Vout2

Figure B4

B5. For the circuit shown in Figure B5,

1. find the total voltage VT in polar form; (3 marks)
2. find the current I in polar form; (2 marks)
3. write down the time-domain expression for I; (2 marks)
4. draw the phasor diagram for V1, V2, and V3. (3 marks)

I

50 

V1

12∠30o V

V2

10∠0o V

V3

20∠-60o V

Figure B5

B6**.** For the circuit shown in Figure B6, calculate

1. the total impedance Z in polar form; (4 marks)
2. the circuit current I in polar form; (2 marks)
3. the total reactive power; (2 marks)
4. the voltage across the capacitor in polar form. (2 marks)

240∠0o V, 50 Hz

V

60 mH 

I

100 F

30 

Figure B6

B7. For the circuit shown in Figure B7 if the total power of the circuit is 300 W and the power factor is 0.85 lagging, calculate

1. the current I in polar form; (4 marks)
2. the total impedance in polar form; (2 marks)
3. the resistance R; (2 marks)
4. the inductance L. (2 marks)



220∠0o V

50 Hz

L

R

Figure B7

B8. For the circuit shown in Figure B8, calculate

1. the currents IR, IC, IL and IT in polar form: (8 marks)
2. the total admittance YT in polar form. (2 marks)



50 

-j30 

L

R

C

120∠0o V

50 Hz

j60 

Figure B8

* **End of Paper**  -

**Formulae List**

The maximum number of electrons in a shell (band) = 2N2

6.25 x 1018 electrons 🡺1C of negative charge

**Ohm’s Law for ac:**

  

**Capacitors:**



Capacitive reactance, XC = in ohms

**Inductors:**

Inductive reactance, XL = 2π*f*L in ohms

**AC Voltages and Currents:**

Irms = Ip /√ 2 = 0.7071 Ip  Ip-p = 2Ip Iav = 2Ip /π = 0.637Ip

Vrms = Vp /√ 2 = 0.7071 Vp Vp-p = 2Vp Vav = 2Vp /π = 0.637Vp

**AC Impedance/Admittance:**



**AC Power:1**

*S*

*P*

*I*

*V*

*Q*

*I*

*V*

*P*

*Z*

*I*

*I*

*V*

*S*

*S*

*S*

*S*











**

*2X*

*2R*

cos

sin

cos

2

**Diodes:**

Forward voltage drop is 0.7 V for silicon diode and 0.3 V for germanium diode

Zener impedance

**Half-Wave Rectifier:**

****

**Centre-Tapped Full-Wave Rectifier:**

****

**Full-Wave Bridge Rectifier:**

****

**Ripple Factor:**

**** where ****

**Line Regulation =  Load Regulation = **

**Transistors:**

****

**Operational Amplifiers**

Voltage Gain of Inverting Amplifier: 

Voltage Gain of Non-inverting Amplifier: 

Output voltage of summing amplifier:

VO = for “n” inputs

Threshold Voltages for comparator with positive feedback:

Upper Trigger Point (UTP) = 

Lower Trigger Point (LTP) = 

**ANSWERS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| A1 | **c** |  |  | A6 | **d** |
| A2 | **a** |  |  | A7 | **d** |
| A3 | **c** |  |  | A8 | **a** |
| A4 | **b** |  |  | A9 | **a** |
| A5 | **c** |  |  | A10 | **b** |

|  |  |
| --- | --- |
| B1 (a) | Automatic fire alarm circuit  Please refer to the textbook. |
| (b) | IB(min)= 53.64 A |

|  |  |
| --- | --- |
| B2 (a) | 5 V  0  VD1  t  -0.7 V |
| (b) | *v*out  0  -2.58 V  -2.58 V |

|  |  |
| --- | --- |
| B3 (a) | Vout1 = |
| (b)  (c) | Vout2 = -3.84 V  ***+***  Vout2  -Vout2  R  R  ***–*** |

|  |  |
| --- | --- |
| B4  (a) | Vref1 = 9 V  Vref2 = 3 V |
| (b) | Vout1= -Vsat= -13 V (Vref1> 5 V)  Vout2= +Vsat= 13 V (Vref2< 5 V) |
| (c) | LED1 will be “OFF” since it is reverse biased.  LED2 will be “ON” since it is forward biased. |

|  |  |
| --- | --- |
| B5 (a) | = 32.43∠-20.43o  V |
| (b) |  |
| (c) | *i*(*t*) = 0.919sin(*t* – 20.43o) A |
| (d) | V2  300  V1  V3  -60o |

|  |  |
| --- | --- |
| B6 (a) | Z = 32.68∠-23.35o |
| (b) |  |
| (c) | Q = 698.2 VAR |
| (d) | VC = 233.41∠-66.65o V |

|  |  |
| --- | --- |
| B7 (a) | I = 1.6∠-31.79o A |
| (b) |  |
| (c) | = 161.81  |
| (d) | L = 0.831 H |

|  |  |
| --- | --- |
| B8 (a) | ; ; ; IT = |
| (b) |  |