**UTM**
UNIVERSITI TEKNOLOGI MALAYSIA

DDPB

# FINAL EXAMINATION / PEPERIKSAAN AKHIR
## SEMESTER 2 – SESSION 2015 / 2016
## PROGRAM KERJASAMA

| | | |
|---|---|---|
| COURSE CODE<br>*KOD KURSUS* | : | DDPE 1142 |
| COURSE NAME<br>*NAMA KURSUS* | : | INSTRUMENTATION / *INSTRUMENTASI* |
| YEAR / PROGRAMME<br>*TAHUN / PROGRAM* | : | 1DDPE / K / P |
| DURATION<br>*TEMPOH* | : | 2 HOURS / 2 JAM |
| DATE<br>*TARIKH* | : | APRIL 2016 |

INSTRUCTION :
*ARAHAN*

1. This question paper consist of **FIVE (5)** questions.
   *Kertas soalan ini mengandungi **LIMA (5)** soalan.*

2. Answer **ALL** questions.
   *Jawab **SEMUA** soalan.*

( You are required to write your name and your lecturer's name on your answer script )
*( Pelajar dikehendaki tuliskan nama dan nama pensyarah pada skrip jawapan )*

| | | |
|---|---|---|
| STUDENT'S NAME /<br>*NAMA PELAJAR* | : | ................................................ |
| I.C NO. / NO. *K/PENGENALAN* | : | ................................................ |
| YEAR / COURSE<br>*TAHUN / KURSUS* | : | ................................................ |
| LECTURER'S NAME | | |

Q1.    (a)    Explain briefly three (3) classifications of a transducer.

*Terangkan secara ringkas tiga (3) pengkelasan transduser.*

(6 marks/*markah*)

(b)    Figure Q1(b), shows the LVDT and its specification.

(i)    Explain briefly the operation principle of the LVDT.

(ii)   Calculate the displacement if the output voltage is 2.5 mV.

(iii)  Sketch the graph of output voltage versus displacement if the output of LVDT is at the range of – 4 mV to + 2.5 mV.

*Rajah Q1(b), menunjukkan LVDT dan spesifikasinya.*

*(i)    Terangkan dengan ringkas prinsip pengendalian LVDT.*

*(ii)   Kirakan anjakan jika voltan keluaran ialah 2.5 mV*

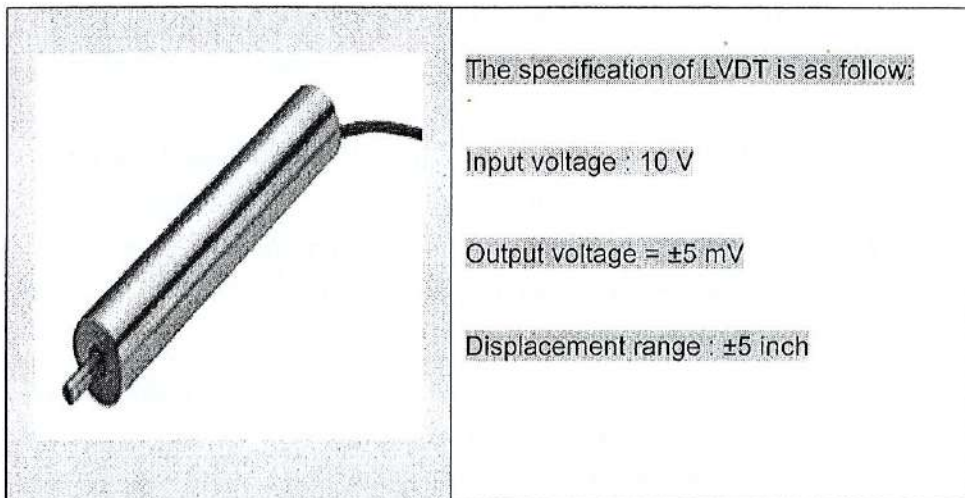*(iii)  Lakarkan graf voltan keluaran melawan anjakan jika keluaran LVDT pada julat – 4 mV hingga + 2.5 mV.*



The specification of LVDT is as follow:

Input voltage : 10 V

Output voltage = ±5 mV

Displacement range : ±5 inch

Figure Q1(b) / *Rajah Q1(b)*

(14 marks/*markah*)

Q2.    (a)    Describe the operation principle of one (1) of the following transducers. Illustrate your answer with the aid of appropriate diagrams.

        (i)      Multiplier phototube.

        (ii)     Shaft encoder.

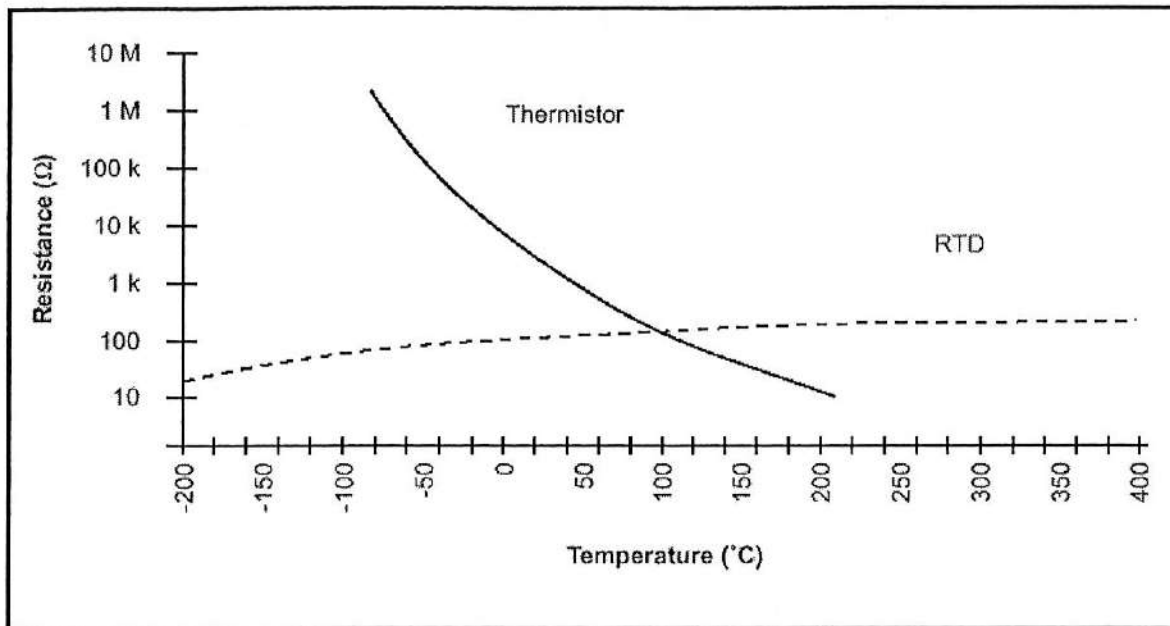*Huraikan prinsip pengendalian satu (1) daripada transduser berikut. Jelaskan jawapan*

Figure Q2(b) / *Rajah Q2(b)*

(14 marks/*markah*)

Q3.  (a)  Two categories of signal conditioners in instrumentation systems are bridges and filters. Explain the role of any device in those two categories.

*Dua kategori penyesuai isyarat dalam sistem pengalatan ialah titi dan penapis. Terangkan peranan setiap peranti dalam dua kategori tersebut.*

(6 marks/*markah*)

(b)  Figure Q3(b) shows the circuit of a Wheatstone bridge. Given that $E = 20$ V, $R_1 = 5$ kΩ, $R_2 = 10$ kΩ, $R_3 = 15$ kΩ.

(i)  Calculate $R_x$ when the bridge is in a balanced condition.

(ii)  By using sensitivity analysis, calculate the required sensitivity of the galvanometer G if its displacement is 5 mm when $R_x$ changes to 10 kΩ. Given the internal resistance of the galvanometer, $R_g = 100$ Ω.

DDPE 1142

*Rajah Q3(b) menunjukkan litar titi Wheatstone. Diberi E = 20 V, $R_1$ = 5 kΩ, $R_2$ = 10 kΩ, $R_3$ = 15 kΩ.*

(i)   *Kirakan $R_x$ ketika titi tersebut berada dalam keadaan terimbang.*

(ii)  *Dengan menggunakan analisis kepekaan, kirakan kepekaan meter galvani G jika anjakannya ialah 5 mm ketika $R_x$ berubah ke 10 kΩ. Diberi rintangan dalam meter galvani, $R_g$ = 100 Ω.*
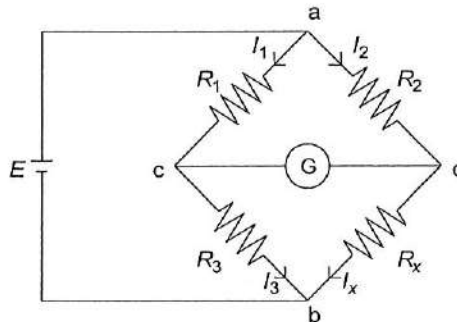


Figure Q3(b) / *Rajah Q3(b)*

(14 marks/*markah*)

Q4.   (a)   Figure Q4(a) shows a Maxwell bridge. When in the null condition,   $R_1$ = 1.2 kΩ, $R_2$ = 2.4 kΩ, $R_3$ = 400 Ω and $C_1$ = 1 µF.

(i)    State the main use of a Maxwell bridge.

(ii)   Show that in null condition, $R_x$ and $L_x$ are given by

$$R_x = \frac{R_2 R_3}{R_1} \qquad L_x = C_1 R_2 R_3$$

(iii)  Calculate $R_x$ and $L_x$.

*Rajah Q4(a) menunjukkan titi Maxwell. Apabila dalam keadaan nol,   $R_1$ = 1.2 kΩ, $R_2$ = 2.4 kΩ, $R_3$ = 400 Ω dan $C_1$ = 1 µF.*

(i)    *Nyatakan kegunaan utama titi Maxwell.*

(ii)   *Tunjukkan bahawa dalam keadaan nol, $R_x$ dan $L_x$ diberikan oleh*

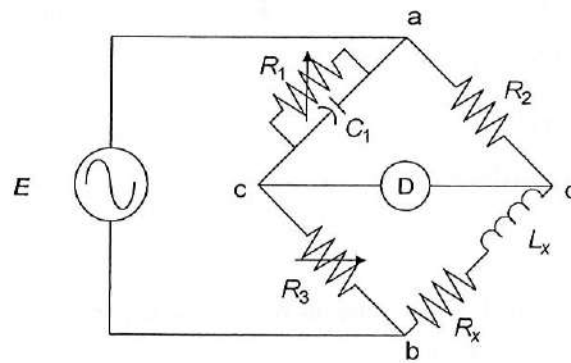$$R_x = \frac{R_2 R_3}{R_1} \qquad L_x = C_1 R_2 R_3$$

(iii)  *Kirakan $R_x$ dan $L_x$.*

DDPE 1142



Figure Q4(a)/*Rajah Q4(a)*

(8 marks/*markah*)

(b) Figure Q4(b) shows a passive filter circuit with $R = 700\,\Omega$ and $C = 2.5\,\mu F$. The frequency of the measurement signal is 100 Hz and the noise frequency is 30 Hz.

(i) State the filter type.

(ii) Calculate the cut-off frequency.

(iii) Calculate the percentage of measured signal that passes through the filter.

(iv) Calculate the percentage of noise signal that passes through the filter.

*Rajah Q4(b) menunjukkan litar penapis pasif dengan $R = 700\,\Omega$ dan $C = 2.5\,\mu F$.*
*Frekuensi isyarat ukuran ialah 100 Hz dan frekuensi hingar ialah 30 Hz.*

*(i) Nyatakan jenis penapis tersebut.*

*(ii) Kirakan frekuensi potong penapis tersebut.*

*(iii) Kirakan peratus isyarat ukuran yang melepasi penapis tersebut.*

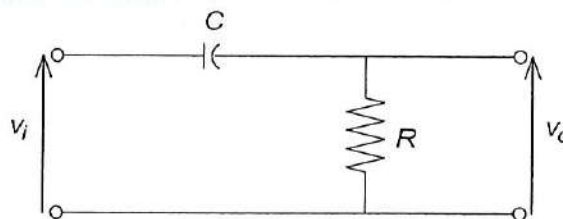*(iv) Kirakan peratus isyarat hingar yang melepasi penapis tersebut.*



Figure Q4(b)/*Rajah Q4(b)*

(12 marks/*markah*)

DDPE 1142

Q5 (a) State two (2) advantages of a digital instrumentation system compared to an analogue instrumentation system.

*Nyatakan dua (2) kelebihan sistem instrumentasi digit berbanding dengan sistem instrumentasi analog.*

( 2 marks / *markah* )

(b) State four (4) components of a data acquisition system. Explain briefly the function of each component.

*Nyatakan empat (4) komponen sistem perolehan data. Terangkan dengan ringkas fungsi setiap komponen.*

( 7 marks / *markah* )

(c) The RS232 bus is an interface commonly used in digital systems. Explain briefly the characteristics of the bus.

*Bas RS 232 ialah pengantaramuka yang lazim digunakan dalam sistem digit. Terangkan dengan ringkas ciri-ciri bas tersebut.*

( 5 marks / *markah* )

d) The IEEE 488 bus is commonly used in data acquisition system. With the aid of an appropriate diagram, explain the principle operation of the bus.

*Bas IEEE 488 lazim digunakan dalam sistem perolehan data. Dengan bantuan gambar rajah yang sesuai huraikan prinsip kendalian bas tersebut.*

( 6 marks / *markah* )