KOLEJ YAYASAN PELAJARAN JOHOR
FINAL EXAMINATION

COURSE NAME	:	**INDUSTRIAL ELECTRONICS**
COURSE CODE	:	**DEE 2203**
EXAMINATION	:	**JUNE 2024**
DURATION	:	**2 HOURS 30 MINUTES**

INSTRUCTION TO CANDIDATES /
ARAHAN KEPADA CALON

1. This examination paper consists of **ONE (1)** part: / PART A (100 Marks) /
*Kertas soalan ini mengandungi **SATU (1)** bahagian: BAHAGIAN A (100 Markah)*

2. Candidates are not allowed to bring any material to examination room except with the permission from the invigilator. The formula was attached at the back question paper. /
Calon tidak dibenarkan untuk membawa sebarang bahan/nota ke bilik peperiksaan tanpa kebenaran daripada pengawas. Rumus dilampirkan di belakang kertas soalan peperiksaan.

3. Please check to make sure that this examination pack consists of: /
Pastikan kertas soalan peperiksaan ini mengandungi:
   i. Question Paper /
   Kertas Soalan.
   ii. Answering Booklet /
   Buku Jawapan.
   iii. Attachment /
   Lampiran.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO /
JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU

This examination paper consists of 14 printed pages including front page
Kertas soalan ini mengandungi 14 halaman bercetak termasuk kulit hadapan

PART A/ *BAHAGIAN A*

This part consists of **FIVE (5)** questions. Answer **ALL** the questions in an answering booklet.

*Bahagian ini mengandungi **LIMA (5)** soalan. Jawab **SEMUA** soalan dalam buku jawapan.*

QUESTION 1/ *SOALAN 1*

Referring to the circuit in **Figure Q1**. Given P_{zmax}=0.5W and I_{zmin}=2mA. Calculate:

a. the output voltage, Vo range by changing the value of resistor, R_1.

(8 marks/ *markah*)

b. the maximum power dissipated by the transistor, Q_1 if resistor, R_1 is set at maximum value.

(6 marks/ *markah*)

c. the range of allowable resistor, R_S to ensure the Zener diode is always in the breakdown region.

(6 marks/ *markah*)

*Berdasarkan litar dalam **Rajah Q1**. Diberi P_{zmaks}=0.5W dan I_{zmin}=2mA. Kirakan:*

a. julat voltan keluaran, V_O dengan menukar nilai perintang, R_1.

b. kuasa maksimum yang dilesapkan oleh transistor, Q_1 jika perintang, R_1 ditetapkan pada nilai maksimum.

c. julat perintang, R_S yang dibenarkan untuk memastikan diod Zener sentiasa berada dalam kawasan pecah tebat.

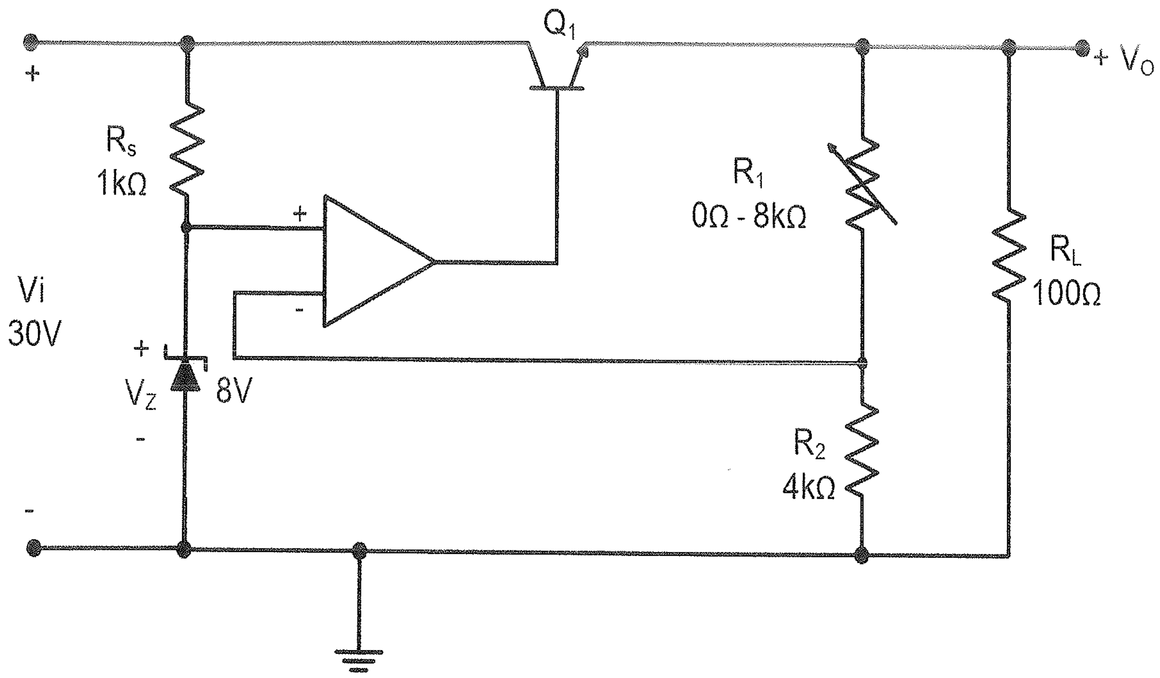

Figure Q1/ *Rajah Q1*

QUESTION 2/ *SOALAN 2*

Referring to the voltage-shunt feedback connection in **Figure Q2.**

a. Prove that closed loop gain with feedback, A_f is equal to:

$$A_f = \frac{V_O}{I_s} = \frac{A}{(1 + A\beta)}$$

(8 marks/ markah)

b. Determine the gain value, A_f

(2 marks/ markah)

c. Calculate the value of input impedance, Z_{iF} and the value of output impedance, Z_{oF}.

(10 marks/ markah)

Given the gain value, A=100 and the feedback network, β=0.1.

Merujuk sambungan suapbalik voltan-pirau dalam ***Rajah Q2****.*

a. *Buktikan bahawa gandaan gelung tertutup dengan suapbalik, A_f adalah sama dengan:*

$$A_f = \frac{V_O}{I_s} = \frac{A}{(1 + A\beta)}$$

b. *Tentukan nilai gandaan, A_f.*

c. *Kira nilai galangan masukan, Z_{iF} dan nilai galangan keluaran, Z_{oF}.*

Diberi nilai gandaan, A=100 dan rangkaian suapbalik, β=0.1.

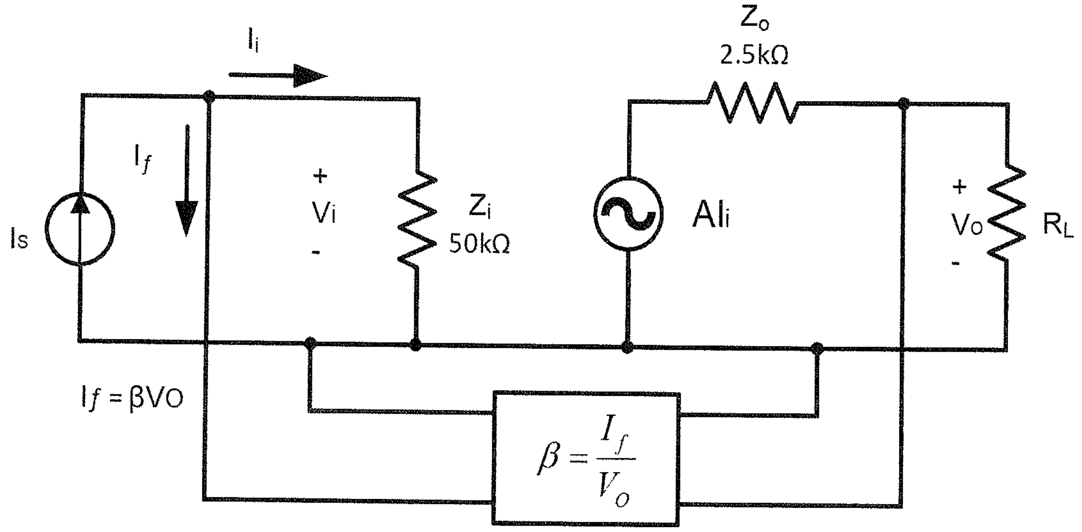

Figure Q2/ ***Rajah Q2***

QUESTION 3 / *SOALAN 3*

Referring to **Figure Q3.**

a. Show that oscillation frequency for oscillator is:

$$f_o = \frac{1}{2\pi\sqrt{L\left(\frac{C_1 C_2}{C_1 + C_2}\right)}}$$

(8 marks / *markah*)

b. Prove the equation of an amplifier gain is:

$$A = \frac{V_O}{V_f} = -\frac{C_1}{C_2}$$

when oscillation occurs.

(6 marks / *markah*)

c. Calculate the oscillation frequency, f_O, the amplifier gain, A and the feedback gain, β while the oscillation is maintained.

(6 marks / *markah*)

Merujuk pada ***Rajah Q3.***

a. Tunjukkan bahawa frekuensi ayunan bagi pengayun adalah:

$$f_o = \frac{1}{2\pi\sqrt{L\left(\frac{C_1 C_2}{C_1 + C_2}\right)}}$$

b. Buktikan persamaan gandaan penguat adalah:

$$A = \frac{V_O}{V_f} = -\frac{C_1}{C_2}$$

ketika ayunan berlaku.

c. *Kira frekuensi ayunan, f_O, gandaan penguat, A dan gandaan suapbalik, β semasa pengayunan dikekalkan.*

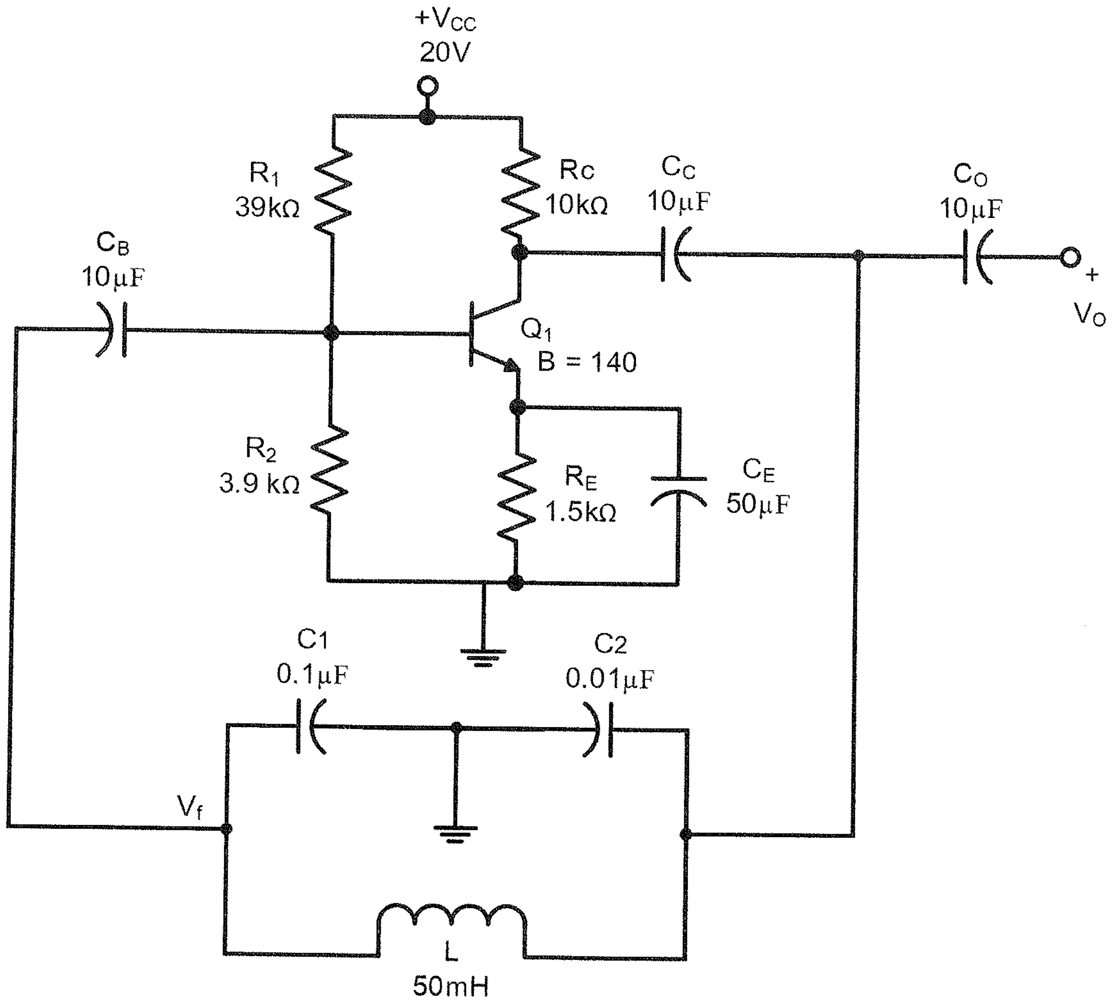

Figure Q3/ *Rajah Q3*

QUESTION 4/ *SOALAN 4*

Referring to **Figure Q4** is astable multivibrator circuit using 555 timers which generates a square wave frequency, f = 2kHz and the duty cycle is 66%. Given the supply voltage, $+V_{CC}$ = +18V and $I_{C\,(min)}$ = 1mA. Determine:

a. period T, high duration, T_H, low duration, T_L and pulse width, P_W.

(8 marks/ *markah)*

b. capacitor value, C_A.

(6 marks/ *markah*)

c. resistor value, R_A and R_B.

(6 marks/ *markah*)

*Berdasarkan **Rajah Q4** ialah litar pemberbilang getar tak stabil dengan menggunakan pemasa 555 yang menghasilkan gelombang segiempat yang berfrekuensi, f = 2kHz dan kitar tugas ialah 66%. Diberi voltan bekalan, $+V_{CC} = +18V$ dan $I_{C(min)} = 1mA$. Tentukan:*

a. tempoh, T, tempoh tinggi, T_H, tempoh rendah, T_L dan lebar denyut, P_W.

b. nilai pemuat, C_A.

c. nilai perintang, R_A dan R_B.

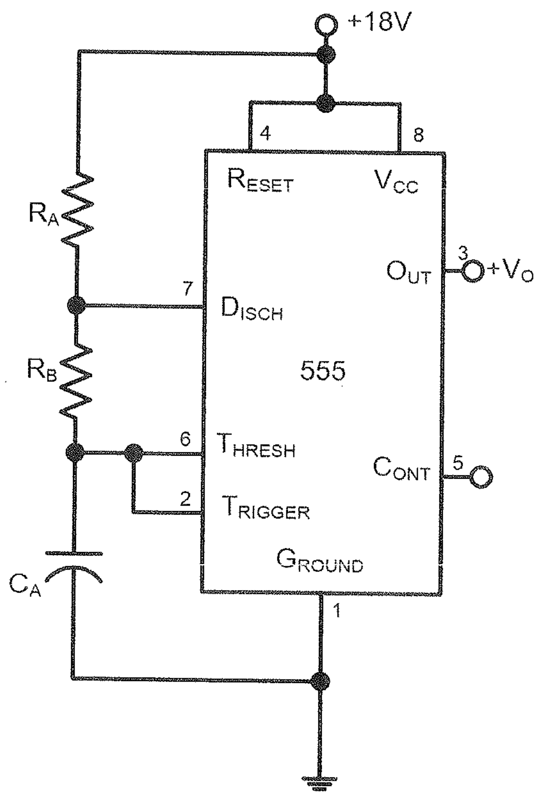

Figure Q4/ *Rajah Q4*

QUESTION 5/ *SOALAN 5*

Referring to **Figure Q5**, determine the following values:

a. current I_1, I_2 and I_{LED}.

(12 marks/ *markah)*

b. voltage, V_{CE}.

(*3 marks/ *markah)

c. power dissipated by the transistor, Q.

(*5 marks/ *markah)

*Merujuk kepada **Rajah Q5**, tentukan nilai berikut:*

a. arus, I_1, I_2 dan I_{LED}.

b. voltan, V_{CE}.

c. Kuasa yang dilesapkan oleh transistor, Q.

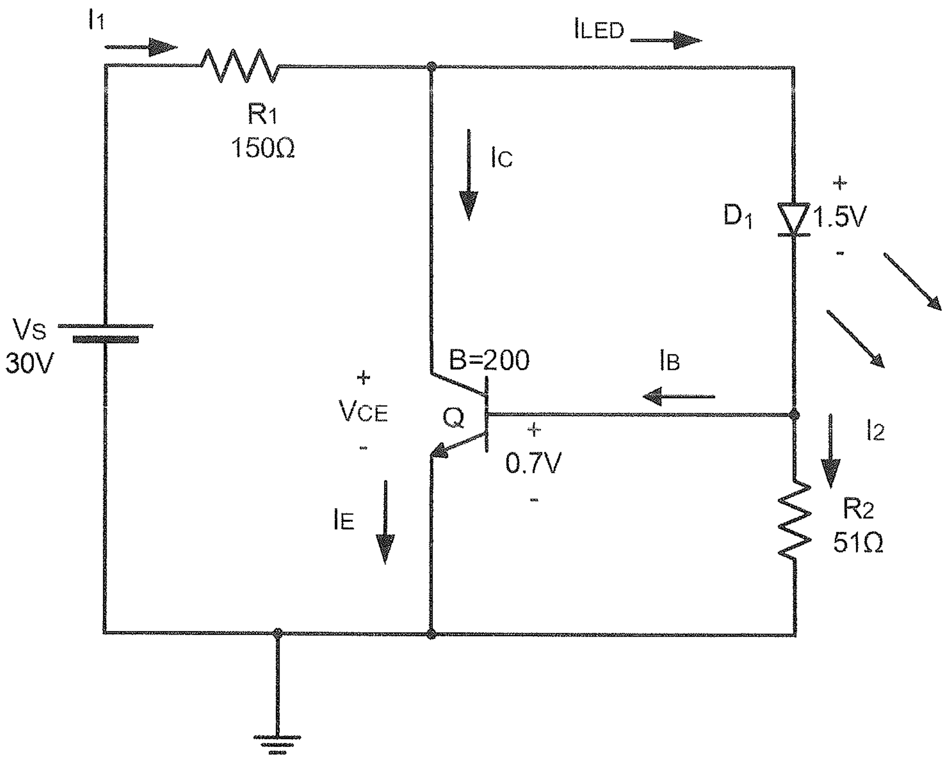

Figure Q5/ *Rajah Q5*

[100 MARKS/ *100 MARKAH*]

END OF QUESTION PAPER/ *KERTAS SOALAN TAMAT*

Attachment/ *Lampiran*

Ripple factor of rectifier.

$$r = \frac{\text{rms value of ac component of signal}}{\text{average value of signal}}$$

$$r = \frac{V_r(rms)}{V_{dc}}$$

Root mean square (rms) value of the total voltage rectified signal.

$$V_r(rms) = 0.385V_m \text{(half-wave)}$$

$$V_r(rms) = 0.308V_m \text{(full-wave)}$$

Ripple voltage of capacitor filter section.

$$V_{dc} = V_m - \frac{V_r(p-p)}{2}$$

Ripple factor of filter section.

$$r = \frac{1}{2\sqrt{3}R_L fC} \text{(half-wave)}$$

$$r = \frac{1}{4\sqrt{3}R_L fC} \text{(full-wave)}$$

DC operation of RC filter section.

$$V'_{dc} = \frac{R_L}{R + R_L} V_{dc}$$

AC operation of RC filter section.

$$V'_r(rms) = \frac{X_{c2}}{R + X_{c2}} V_r(rms)$$

Load regulation.

$$\%L.R = \frac{\frac{V_{o(NL)} - V_{o(FL)}}{V_{o(FL)}} \times 100\%}{I_{L(FL)} - I_{L(NL)}}$$

Line regulation.

$$\%L.R = \frac{\frac{V_{o(ORIGINAL)} - V_{o(NEW)}}{V_{o(ORIGINAL)}} \times 100\%}{V_{i(ORIGINAL)} - V_{i(NEW)}}$$

Percent efficiency of the power supply.

$$\%\eta = \frac{P_L}{P_i} \times 100\%$$

Ideal op-amp.

$$V^+ = V^-$$

$$I^+ = I^- = 0A$$

Upper trigger point of square wave signal generator.

$$V_{UTP} = \frac{R_3}{(R_2 + R_3)} \times (+V_{cc})$$

Lower trigger point of square wave signal generator.

$$V_{LTP} = \frac{R_3}{(R_2 + R_3)} \times (-V_{cc})$$

The time period of square wave signal generator.

$$T_H = R_1 C \ell_n \left(\frac{V_{cc} - V_{LTP}}{V_{cc} - V_{UTP}} \right)$$

$$T_L = R_1 C \ell_n \left(\frac{-V_{cc} - V_{UTP}}{-V_{cc} - V_{LTP}} \right)$$

Output wave frequency of square wave signal generator.

$$f_o = \frac{1}{T_H + T_L}$$

Pulse width of monostable multivibrator.

$$PW = RC\ell_n\left(\frac{V_{CC} - 0}{V_{CC} - \frac{2}{3}V_{CC}}\right)$$

$$PW = 1.1RC$$

The period of the astable multivibrator.

$$T_H = \tau_1\ell_n\left(\frac{V_{CC} - \frac{1}{3}V_{CC}}{V_{CC} - \frac{2}{3}V_{CC}}\right)$$

$$T_H = 0.693(R_A + R_B)C_1$$

$$T_L = \tau_2\ell_n\left(\frac{0 - \frac{2}{3}V_{CC}}{0 - \frac{1}{3}V_{CC}}\right)$$

$$T_L = 0.693(R_B)C_1$$

$$T = 0.693(R_A + 2R_B)C_1$$

The oscillation frequency of square wave astable multivibrator.

$$f_o = \frac{1}{0.693(R_A + 2R_B)C_1}$$

Duty cycle.

$$D = \frac{T_H}{T_H + T_L} \times 100\%$$

$$D = \frac{R_A + R_B}{R_A + 2R_B} \times 100\%$$

Barkhausen criterion of oscillation.

$A\beta = 1$ and $A_f = \infty$

The voltage gain of the amplifier with positive feedback.

$$A_f = \frac{A}{1 - A\beta}$$

Frequency of oscillation of RC Phase Shift Oscillator.

$$f_o = \frac{1}{2\pi RC\sqrt{6}}$$

The feedback factor of Phase Shift Oscillator.

$$\beta = \frac{1}{29}$$

Frequency of oscillation of Wien-bridge Oscillator.

$$f_o = \frac{1}{2\pi\sqrt{(R_1C_1R_2C_2)}}$$

The feedback factor of Wien-bridge Oscillator.

$$\beta = \frac{1}{3}$$

Frequency of oscillation of Colpitts Oscillator.

$$f_o = \frac{1}{2\pi\sqrt{(LC_{eq})}} \quad \text{where;} \quad C_{eq} = \frac{C_1C_2}{C_1 + C_2}$$

The feedback factor of Colpitts Oscillator.

$$\beta = \frac{C_2}{C_1}$$

Frequency of oscillation of Hartley Oscillator.

$$f_o = \frac{1}{2\pi\sqrt{(L_{eq}C)}} \text{ where; } L_{eq} = L_1 + L_2$$

The feedback factor of Hartley Oscillator.

$$\beta = \frac{L_1}{L_2}$$

Frequency of oscillation of Crystal Oscillator.

$$f_o = \frac{1}{2\pi\sqrt{LC_{eq}}} \text{ where; } C_{eq} = C + C_M$$

Relation between frequency and wave length.

$$f = \frac{c}{\lambda} \text{ where } c = 3\times10^8$$

Relation between flux luminous and power per meter square.

$$1\text{l}m = 1.464\frac{m\text{W}}{m^2}$$