KOLEJ YAYASAN PELAJARAN JOHOR
FINAL EXAMINATION

COURSE NAME	:	**INDUSTRIAL ELECTRONICS**
COURSE CODE	:	**DKE 3043**
SESSION	:	**JANUARY 2024**
DURATION	:	**2 HOURS 30 MINUTES**

INSTRUCTION TO CANDIDATES /
ARAHAN KEPADA CALON

1. This examination paper consists of **TWO (2)** parts: / PART A (20 Marks) / PART B (80 Marks) /
   *Kertas soalan ini mengandungi **DUA (2)** bahagian:* *BAHAGIAN A (20 Markah)* *BAHAGIAN B (80 Markah)*

2. Candidates are not allowed to bring any material to examination room except with the permission from the invigilator. /
   Calon tidak dibenarkan untuk membawa sebarang bahan/nota ke bilik peperiksaan tanpa kebenaran daripada pengawas.

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 **15** printed pages including front page
*Kertas soalan ini mengandungi **15** halaman bercetak termasuk kulit hadapan*

PART A/ *BAHAGIAN A*

This part consists of **FOUR (4)** questions. Answer **ALL** the questions in an answering booklet.

*Bahagian ini mengandungi **EMPAT (4)** soalan. Jawab **SEMUA** soalan dalam buku jawapan.*

QUESTION 1/ *SOALAN 1*

Figure Q1 shows a block diagram of a direct current power supply. Illustrate the output waveform of each block in the diagram.

(5 marks/ *markah*)

***Rajah Q1** menunjukkan satu rajah blok bekalan kuasa arus terus. Ilustrasikan bentuk gelombang keluaran bagi setiap blok dalam rajah itu.*

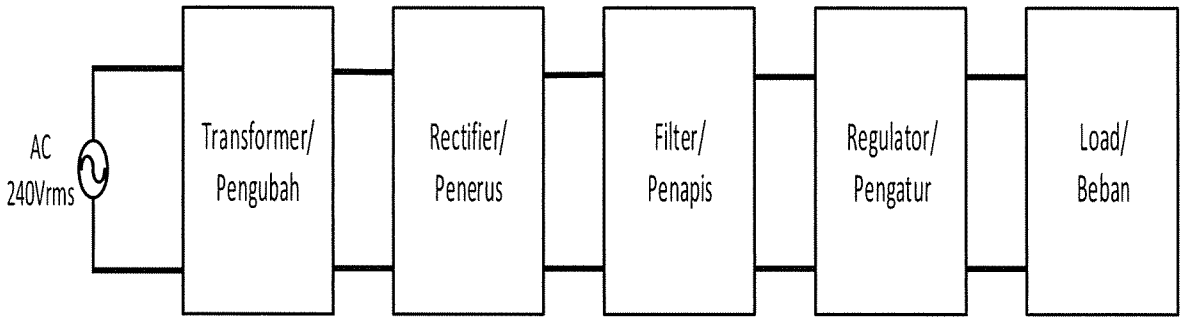

Figure Q1/ *Rajah Q1*

QUESTION 2/ *SOALAN 2*

Compare between a monostable multivibrator and an astable multivibrator.

(5 marks/ *markah*)

Bandingkan antara pemberbilang getar monostabil dengan pemberbilang getar tak stabil.

QUESTION 3/ *SOALAN 3*

Express completely I-V characteristic curve of triac.

(5 marks/ *markah*)

Nyatakan dengan lengkap lengkung cirian I-V bagi triak.

QUESTION 4/ *SOALAN 4*

Based on the circuit in **Figure Q4**, find the value of resistor, R_C if the maximum current, $I_{C(max)}$ flowing through the light emitted diode (LED) is 40mA.

(5 marks/ *markah*)

*Berdasarkan litar dalam **Rajah Q4**, cari nilai perintang, R_C jika arus maksimum, $I_{C(maks)}$ yang mengalir melalui diod pemancar cahaya (LED) ialah 40mA.*

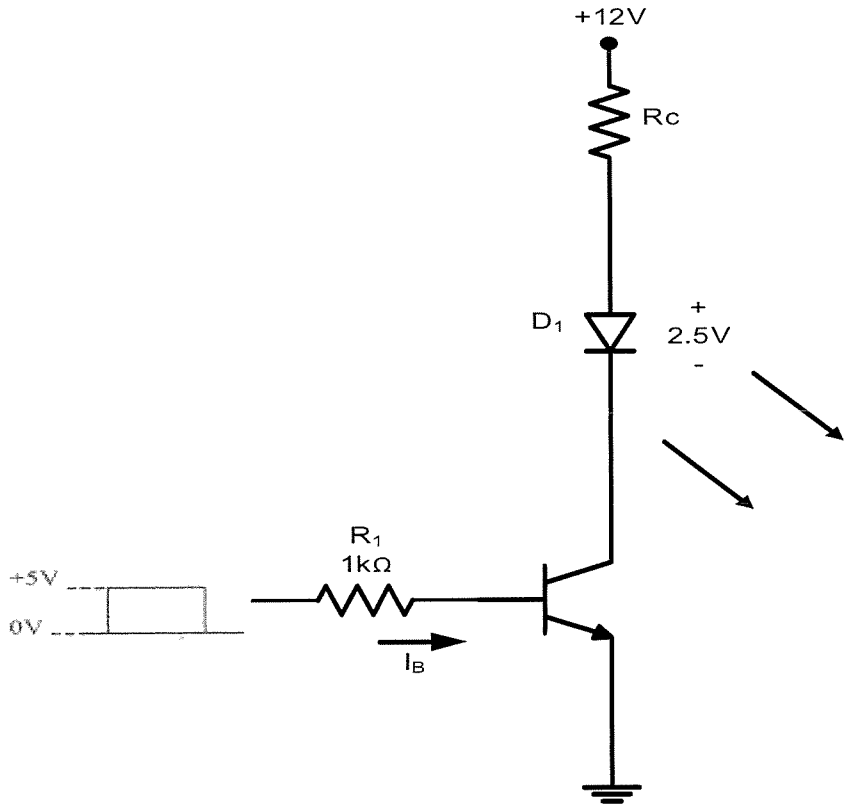

Figure Q4/ *Rajah Q4*

PART B / *BAHAGIAN B*

This part consists of **FOUR (4)** questions. Answer **ALL** the questions in an answering booklet.

*Bahagian ini mengandungi **EMPAT (4)** soalan. Jawab **SEMUA** soalan dalam buku jawapan.*

QUESTION 5/ *SOALAN 5*

Referring to the circuit in **Figure Q5**. 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 Q5**. 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.*

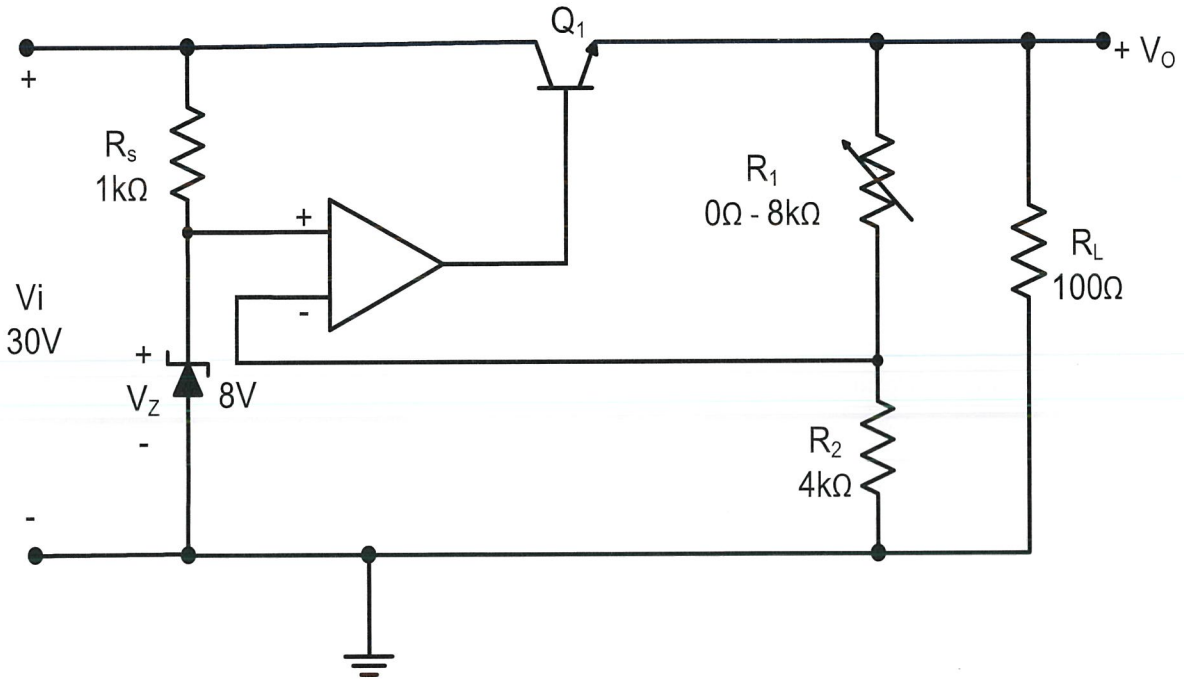

Figure Q5/ *Rajah Q5*

QUESTION 6/ *SOALAN 6*

Referring to **Figure Q6** is astable multivibrator circuit using 555 timers that operates at 5kHz. Calculate:

a. the capacitor value, C if resistor, R_A=1kΩ and resistor, R_B=3.3kΩ.

(6 marks/ *markah)*

b. the duty cycle of the timer circuit.

(6 marks/ *markah)*

c. the high period, T_{high} and low period, T_{low} of the generated output waveform.

(8 marks/ *markah)*

*Berdasarkan **Rajah Q6** yang menunjukkan litar jenis pemberbilang getar tak stabil dengan menggunakan pemasa 555 yang beroperasi pada 5kHz. Kirakan:*

a. *nilai pemuat, C jika perintang, R_A=1kΩ dan perintang, R_B=3.3kΩ.*

b. *kitaran tugas litar pemasa.*

c. *tempoh tinggi, T_{tinggi} dan tempoh rendah, T_{rendah} bagi gelombang keluaran yang dijana.*

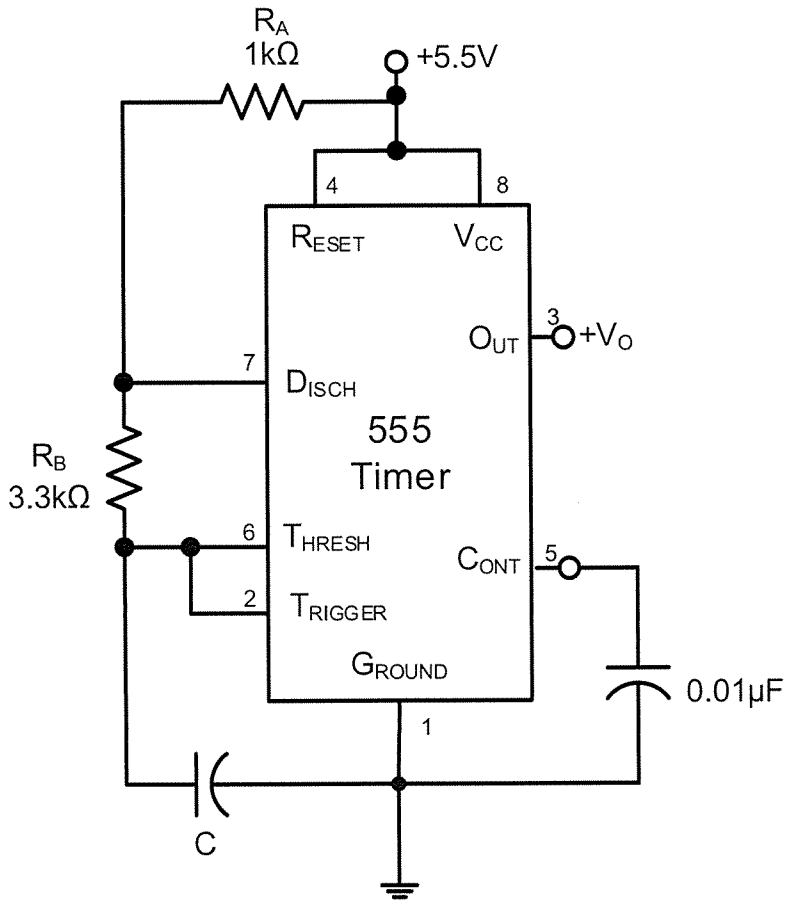

Figure Q6/ *Rajah Q6*

QUESTION 7/ *SOALAN 7*

Referring to **Figure Q7**, given peak input voltage, $V_{i(peak)}$=60V, load resistance, R_L=10Ω, resistance, R_1=47kΩ, R_2=10kΩ, R_3=4.7kΩ, gate trigger current, I_{GT}=15μA and gate trigger voltage, V_{GT}=1V. Calculate:

a. the trigger voltage enters the gate, V_T.

(4 marks/ *markah)*

b. the maximum firing angles, Θ_{max}.

(8 marks/ *markah)*

c. the minimum firing angles,Θ_{min}.

(8 marks/ *markah)*

*Berdasarkan **Rajah Q7**, diberi voltan masukan puncak, $V_{i(puncak)}$=60V, rintangan beban, R_L=10Ω, rintangan, R_1=47kΩ, R_2=10kΩ, R_3=4.7kΩ, arus picuan get, I_{GT}=15μA dan voltan picuan get, V_{GT}=1V. Kirakan:*

a. *voltan picuan masuk ke get, V_T.*

b. *sudut tembak maksimum,Θ_{maks}.*

c. *sudut tembak minimum, Θ_{min}.*

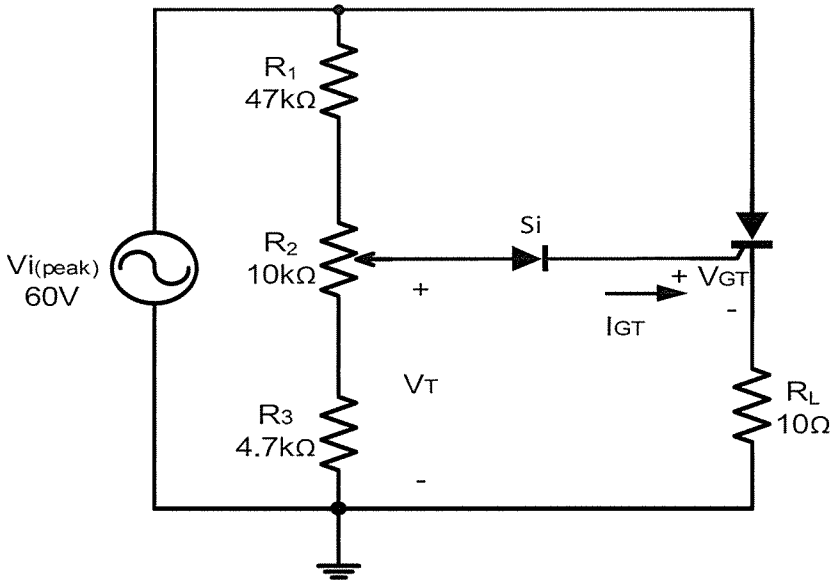

Figure Q7/ *Rajah Q7*

QUESTION 8/ *SOALAN 8*

Referring to **Figure Q8**, 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 Q8**, tentukan nilai berikut:*

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

b. voltan, V_{CE}.

c. Kuasa yang dilesapkan oleh transistor, Q.

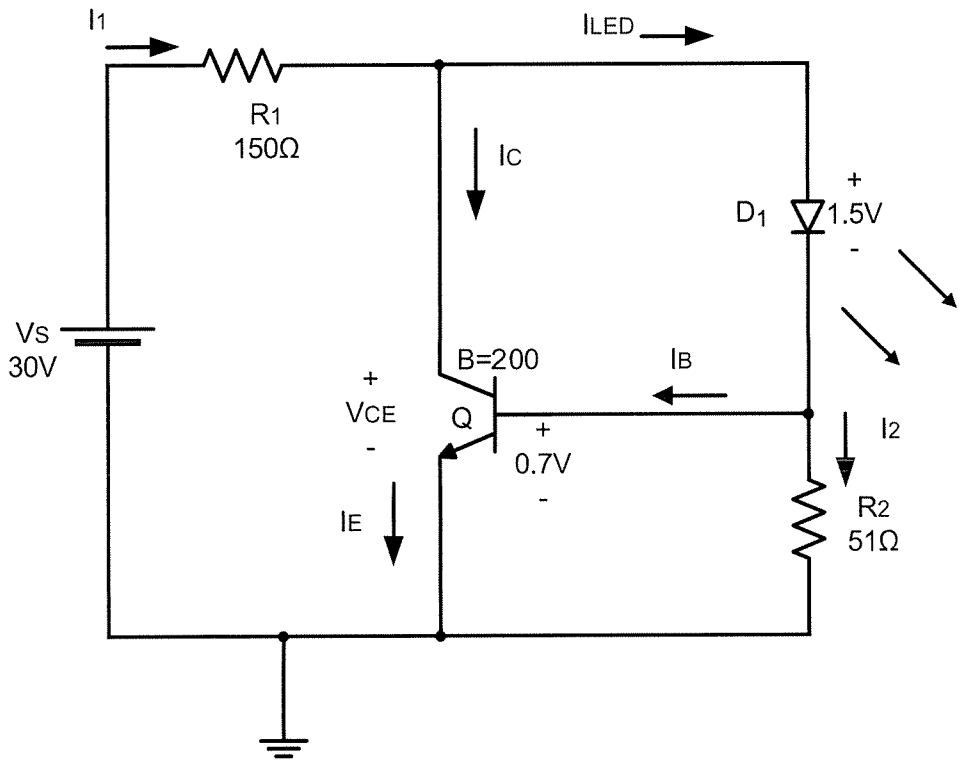

Figure Q8/ *Rajah Q8*

[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.

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

$$T_H = 0.693\left(R_A + R_B\right)C_1$$

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

$$T_L = 0.693\left(R_B\right)C_1$$

$$T = 0.693\left(R_A + 2R_B\right)C_1$$

The oscillation frequency of square wave astable multivibrator.

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

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.

$$f_o = \frac{1}{2\pi\sqrt{(R_1 C_1 R_2 C_2)}}$$

The feedback factor of Wien-bridge Oscillator.

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

Frequency of oscillation of Colpitts Oscillator.

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

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.

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

Firing angle of SCR.

$$\theta f = \alpha$$

Conducting angle of SCR.

$$\theta c = \beta$$

Total angle of SCR

$$\theta f + \theta c = 180°$$

$$\alpha + \beta = 180°$$

Stand-off ratio of UJT

$$\eta = \left(\frac{R_{B1}}{R_{BB}}\right) \text{ where } R_{BB} = R_{B1} + R_{B2}$$

Relation between V_{RB1} and V_{BB} of UJT

$$V_{RB1} = \left(\frac{R_{B1}}{R_{BB}}\right) V_{BB}$$

$$V_{RB1} = \eta V_{BB}$$

Relation between frequency and wave length.

$f = \frac{c}{\lambda}$ where $c = 3 \times 10^8$

Relation between flux luminous and power per meter square.

$1\mathrm{I}m = 1.464 \frac{m\mathrm{W}}{m^2}$