The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical and Computer Engineering

Study Programme	:	Bachelor of Science Honours in Engineering
Name of the Examination	:	Final Examination
Course Code and Title	:	**EEX3351 Electronics I**
Academic Year	:	2024/25
Date	:	22nd February 2026
Time	:	1330-1630h
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Five (5)** questions in **six (6)** pages.
3. Answer **all** questions.
4. All questions carry equal marks.
5. Answer for each question should commence from a new page.
6. This is a Closed Book Test (CBT).

Question 1 **(20 Marks)**

Figure-Q1 shows a single-stage, Si- BJT amplifier circuit. The DC current gain (β) of the amplifier is 50.

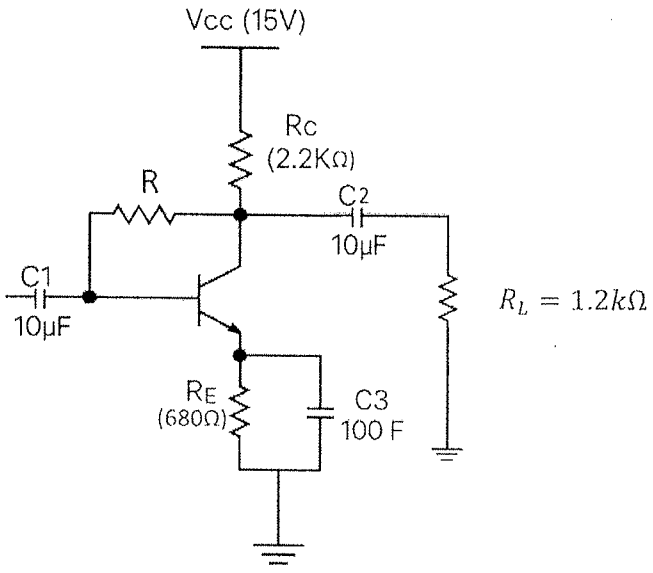


Figure Q1

a) What is the bias configuration of the amplifier? (01 Marks)

b) Find expressions for the collector current (I_c) and the voltage across collector-emitter terminals (V_{CE}) in terms of R. (10 Marks)

c) Draw the DC load line for the above amplifier and mark the Q point. (03 Marks)

d) Hence, find a suitable value for resistor R to produce a maximum peak-to-peak output swing without distortion. State any assumption/s you made. (06 Marks)

Question 2 **(20 Marks)**

Consider the circuit given in *Figure Q2.*

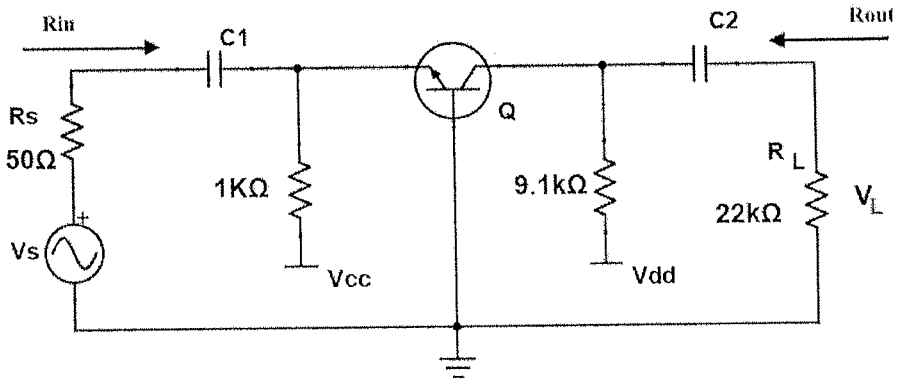


Figure Q2

Let, $h_{fb} = -0.992, h_{ib} = 15\Omega$, $V_{CC} = 10V$ and $V_{dd} = -15V$,

a) What is the configuration of the transistor? (01 Marks)

b) Assume that the effects of h_{rb} and h_{ob} are negligible and draw the AC h parameter equivalent circuit of the circuit arrangement in the above *Figure Q2*. State any assumptions you made. (08 marks)

c) Find the input and output impedances shown by R_{in} and R_{out}. State any assumptions you made. (06 marks)

d) Calculate the voltage gain, $\frac{V_L}{V_s}$. (05 marks)

Question 3 **(20 Marks)**

a) Compare five characteristics of a practical operational amplifier and compare them with the ideal approximations. (05 marks)

b) Derive an expression for the closed loop voltage gain of the non-inverting amplifier shown in the Figure Q3-(a). (05 marks)

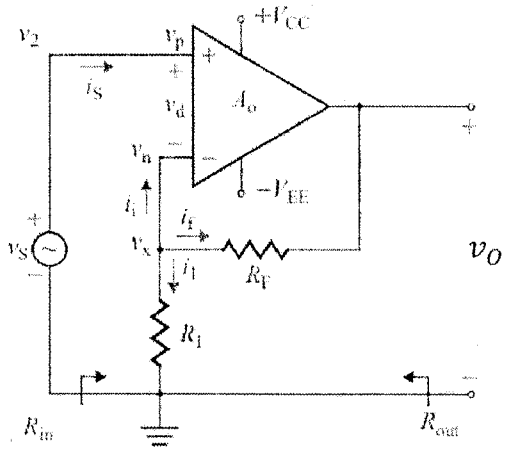


Figure Q3-(a)

c) Find the voltages V_x, V_y and V_o in the given Figure Q3-(b). State any assumptions you made. (10 marks)

$$V_1 = 5V, V_2 = 7V, R_1 = 25\Omega \quad R_2 = 50\Omega \quad R_3 = 100\Omega$$

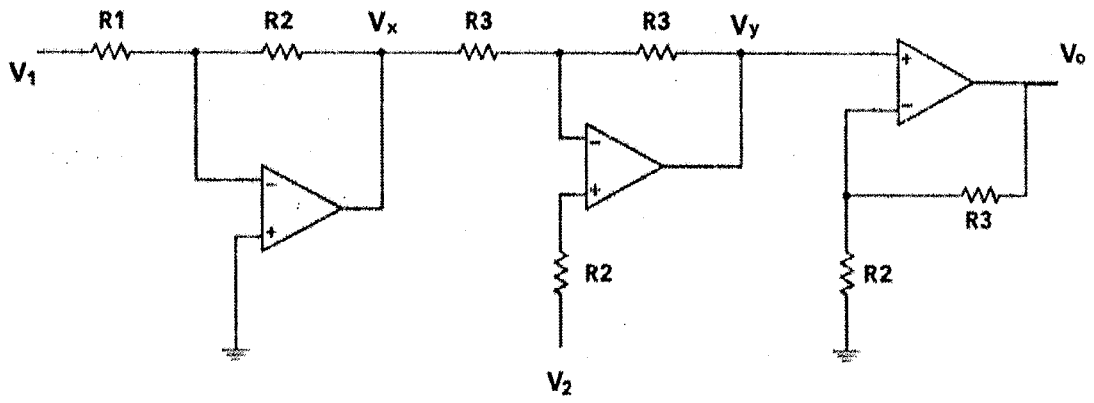


Figure Q3-(b)

Question 4 **(20 Marks)**

a) For the MOSFET biasing circuit shown in Figure Q4-(a) below, the following parameters are given:

$$R_1 = 400\,k\Omega, R_2 = 600\,k\Omega, V_{DD} = 12\,V, R_D = 1.5\,k\Omega, \text{and } R_S = 500\,\Omega.$$

The MOSFET parameters are: transconductance parameter $(K_n) = 0.5\,mA/V^2$, threshold voltage $(V_t) = -1.5\,V$, and $\lambda = 0.01$.

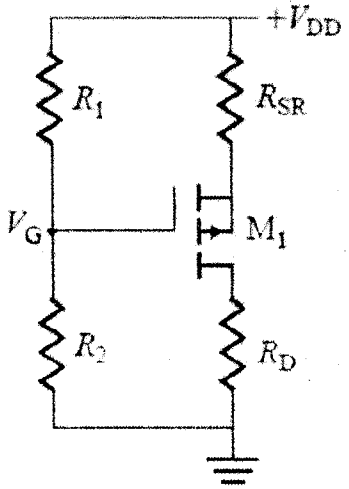


Figure Q4-(a)

Determine the following:

i. The drain current, I_D. (06 marks)

ii. The gate-to-source voltage, V_{GS}. (02 marks)

iii. The drain-to-source voltage, V_{DS}. (02 marks)

**Hint: use the equation,* $I_D = K_n(V_{GS} - V_t)^2$

b) The single-phase half wave rectifier shown in Figure Q4-(b) supplied directly from 120V(rms), 60Hz source through a step-down transformer with turns ratio n=10:1. The load resistance R_L=10Ω.

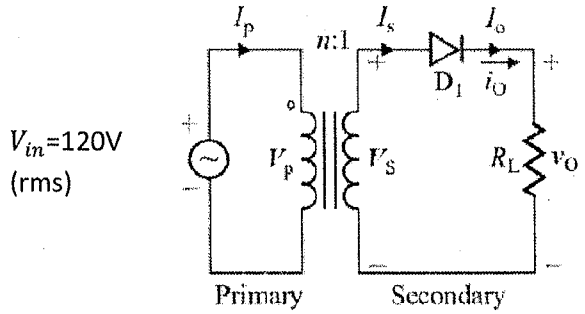


Figure Q4-(b)

Determine the

i. Average output voltage $V_0(av)$. (02 marks)

ii. Average load Current $I_0(av)$. (02 marks)

iii. The rms load voltage $V_0(rms)$. (02 marks)

iv. RMS load current $I_0(rms)$. (02 marks)

v. The ripple factor (RF) of the output voltage. (02 marks)

Question 5 **(20 Marks)**

a) A modern greenhouse must maintain suitable environmental conditions to support healthy plant growth. Excessive temperature or high humidity inside the greenhouse can damage plants and reduce productivity. To address this, a smart greenhouse ventilation and cooling system is used to automatically activate an exhaust fan when cooling or ventilation is required.

System Inputs

The controller monitors the following sensors and control switch:

1. **Control Switch (C)**

This switch enables or disables the automatic operation of the system.

- C = 1 → Automation enabled
- C = 0 → Automation disabled

2. **Temperature Sensor (T)**

This sensor detects whether the greenhouse temperature has exceeded a safe limit.

- T = 1 → Temperature is high (overheating condition)
- T = 0 → Temperature is normal

3. **Humidity Sensor (H)**

This sensor detects whether the humidity level inside the greenhouse is too high.

- H = 1 → Humidity is high
- H = 0 → Humidity is normal

4. **Window Sensor (W)**

This sensor indicates the position of the ventilation window.

- W = 1 → Ventilation window is open
- W = 0 → Ventilation window is closed

System Output

- **Fan / Exhaust System (F)**
  - F = 1 → Fan ON
  - F = 0 → Fan OFF

Fan Activation Rule:

The exhaust fan turns ON (F = 1) only when:

- The control switch is enabled,
- At least one of the environmental conditions (high temperature or high humidity) is present, and

- The ventilation window is open.

If any one of these conditions is not satisfied, the fan remains OFF (F = 0).

Considering the above scenario:

i. Construct the truth table for the fan control system, showing all possible combinations of the four inputs and the corresponding fan output. (05 Marks)

ii. Using a Karnaugh map (K-map), derive a simplified Boolean expression for the fan control logic. (04 Marks)

iii. Draw the logic circuit using basic logic gates and then implement the same logic using only NAND gates. Clearly state any assumptions made. (04 Marks)

b) A logic circuit output is related to the inputs by:

$$F = \prod M(1,3,4,6)$$

Construct a 3-variable Karnaugh map and determine the minimum SOP and POS expressions. (04 Marks)

c) Perform the operation,$(41-58)$ using 8-bit Two's complement arithmetic. (03 Marks)

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