UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 5 Examination in Engineering: March 2026

Module Number: EE5202 **Module Name: Electronic Circuit Design**

[Three Hours]

[Answer **all questions**, each question carries **12.5 marks**]

Q1 a) What are the two types of electrical components in circuits. Write the differences of those two.

(2 Marks)

b Mention two main specifications for capacitors and two main specifications for resistors

(2 Marks)

c) What is meant by worst-case circuit analysis?

(1 Mark)

d) In the given circuit diagram Fig. 1 below find the nominal value of the gain and also worst-case minimum and worst-case maximum gain. Tolerance of the resistors are ± 5 %.

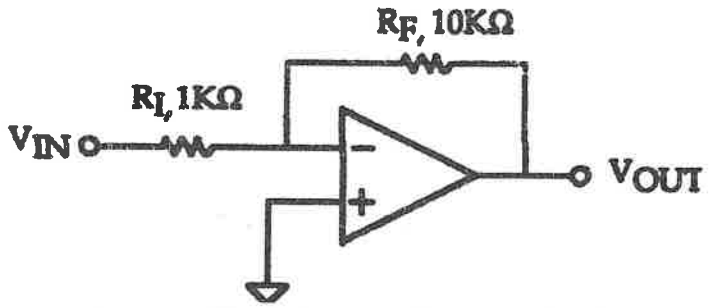

Fig 1. Inverted Op-amp Circuit

(2) Marks)

e) Draw the V-I characteristic graph of a Zener diode and explain the concept of reverse breakdown in a Zener diode.

(1 Mark

f) Consider a basic Zener regulator circuit given in Fig. 2;
Given that $\mathbf{0 \leq I_L \leq 150\ mA}$, $I_{z,knee} = \mathbf{1\ mA}$, $\mathbf{V_{in} = 20\ V \pm 5\%}$, and $\mathbf{V_{out} = 10\ V}$. Find,

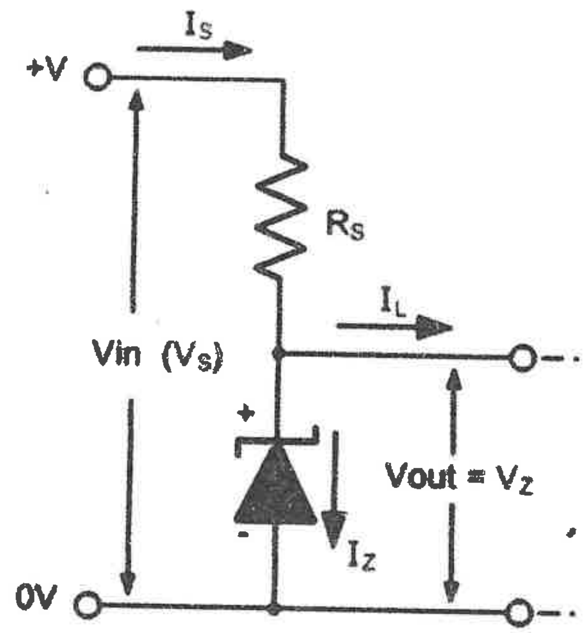

Fig 2. Basic Zener regulator circuit

i) The value for **Rs** from when the tolerance is 5% (range of the **R_s**).
ii) Suitable Zener diode from the followings. **P_{ZM1}** = 3 **W** **P_{ZM2}** = 1. 5 **W**

(4.5 Marks)

Q2 a) Write 4 benefits of PCBs.

(2 Marks)

b) Write 4 types pf PCBs.

(2 Marks)

c) Write 2 types of holes drilled in PCBs.

(2 Marks)

d) Explain the solder masking process and the benefits of it.

(2 Marks)

e) What is **signal integrity**, and what is meant by **etching** in the context of PCB fabrication?

(2 Marks)

f) What are **three major coating techniques**, and give **one advantage** for each?

(2.5 Marks)

Q3 a) Draw the **construction of an n-type MOSFET** and label all the essential regions.

(2 Marks)

b) Write down types of the MOSFETs.

(1 Mark)

c) What is the primary purpose of the oxide layer in a MOSFET?

(1 Mark)

d) What are the **operating regions of a MOSFET**, and explain the behavior of the device in each region.

(1.5 Marks)

e) Write two advantages of small signal MOSFET Amplifiers.

(1 Mark)

f) Design the circuit in Fig. 3 to obtain $I=1\ \mu A$, $I_D=0.5$ mA, $V_S=2$ V, and $V_{DD}=5$ V. The NMOS transistor has $V_{th}=0.5$ V, $\beta=4\ mA/V^2$.

(3 Marks)

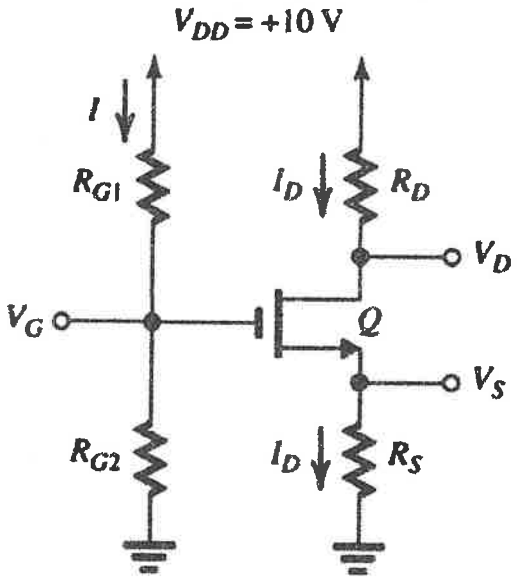

Fig.3 MOSFET circuit diagram

(3 Marks)

g) prove that small signal resistance is $r = \frac{1}{\sqrt{2\beta I}}$.

(2 Marks)

h) . Write down the **two types of enhancement-load NMOS** configurations.

(1 Mark)

Q4 a) The two main types of filters used in electronic circuits, when classified by their signal processing domain.

(1 mark)

b) What are the four types of filter responses and draw their response curves.

(2 marks)

c) Define the cutoff frequency of a filter.

(1 Mark)

d) write down the four names characteristic curves of the filters and draw their curves.

(2 Marks)

e) Derive the relationship between the resistance and capacitance in a first-order low-pass filter that has a cutoff frequency of 1 kHz and a DC gain of 2.

(2 Marks)

f) Derive the transfer function of a low pass 2nd order filter using a Sallen key topology given below in Fig.4 using R, C and s.

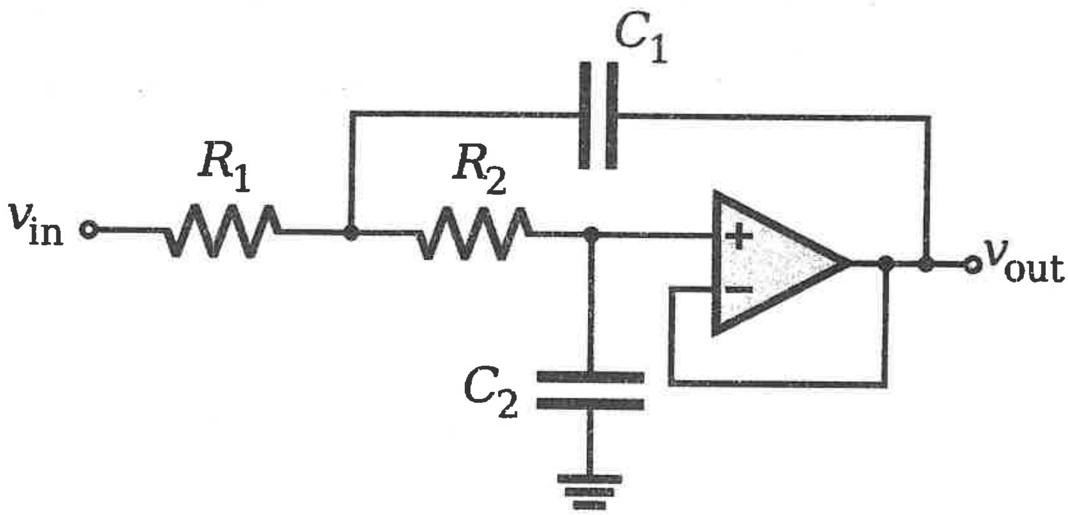

Fig.4 Second Order filter using Sallen key topology

(2.5 Marks)

g) Design a fifth order unity gain Butterworth low pass filter with the corner frequency of 100 **kHz**, C_{A1} ($filter$ 1) = 2 **nF**, C_{B2} ($filter$ 2) = 410 **pF**, and C_{B3} ($filter$ 3) = 660 **pF** using the coefficeint table given below in Fig. 5.

(2 Marks)

n	i	a_i	b_i	$k_i = f_{ci} / f_c$	Q_i
1	1	1.0000	0.0000	1.000	—
2	1	1.4142	1.0000	1.000	0.71
3	1	1.0000	0.0000	1.000	—
	2	1.0000	1.0000	1.272	1.00
4	1	1.8478	1.0000	0.719	0.54
	2	0.7654	1.0000	1.390	1.31
5	1	1.0000	0.0000	1.000	—
	2	1.6180	1.0000	0.859	0.62
	3	0.6180	1.0000	1.448	1.62
6	1	1.9319	1.0000	0.676	0.52
	2	1.4142	1.0000	1.000	0.71
	3	0.5176	1.0000	1.479	1.93
7	1	1.0000	0.0000	1.000	—
	2	1.8019	1.0000	0.745	0.55
	3	1.2470	1.0000	1.117	0.80
	4	0.4450	1.0000	1.499	2.25
8	1	1.9616	1.0000	0.661	0.51
	2	1.6629	1.0000	0.829	0.60
	3	1.1111	1.0000	1.206	0.90
	4	0.3902	1.0000	1.512	2.56
9	1	1.0000	0.0000	1.000	—
	2	1.8794	1.0000	0.703	0.53
	3	1.5321	1.0000	0.917	0.65
	4	1.0000	1.0000	1.272	1.00
	5	0.3473	1.0000	1.521	2.88
10	1	1.9754	1.0000	0.655	0.51
	2	1.7820	1.0000	0.756	0.56
	3	1.4142	1.0000	1.000	0.71
	4	0.9080	1.0000	1.322	1.10
	5	0.3129	1.0000	1.527	3.20

Fig 5 Table of the Butterworth Coefficients