Punjab Engineering College
(Deemed to be University)

End-Term Examination
May 2024

Programme: **B. Tech**

Course Name: **Introduction to Mechatronics**

Maximum Marks: **50**

Year/semester: **First / 2nd**

Course Code: **ES2304**

Time allowed: **3 Hour**

Notes:

1. All questions are compulsory.
2. Unless stated otherwise, the symbols have their usual meanings in context with subject.Assume suitably and state, additional data required, if any.
3. The candidates, before starting to write the solutions, should please check the question paper for any discrepancy, and also ensure that they have been delivered the question paper of right course code.

Q. No		Questions	Marks
1.	(a)	Explain with a block diagram the key elements of Mechatronics system for a biometric facial recognition system.	5
	(b)	(i) What is the function of program counter in the 8085 MPU?	1
		(ii) For a common collector transistor-based NOC relay, an input base current 0.3 mA is applied through potential divider circuit. Comment whether the relay coil will operate or not, if the rating of relay coil is given 35 mA. (Current gain of the given common-emitter transistor is 100).	1
		(iii) Write an application of ratchet and pawl mechanism.	1
		(iv) Draw the speed – armature current characteristics of DC series motor. Why this motor should not be started at no load?	1
		(v) What is Tool Center Point (TCP) in a robotics system?	1
2.	(a)	What is a load cell? Write down the construction and operation of a load cell?	2
	(b)	A second-order band pass filter is to be constructed using RC components that will only allow a range of frequencies to pass above 1kHz and below 30kHz. Assuming that both the resistors have values of 10kΩ, calculate the values of the two capacitors required.	3
	(c)	Consider the following circuit where Rs is a temperature sensor whose characteristics are given as: RS(T)=$R(T_0)[1 + K(T - T_0)]$ with K=0.01^0C^{-1}, $T_0 = 0^0C$, $R(T_0) = R_0 = 100K\Omega$ The circuit parameters are: $V_0 = 5V, R_1 = 3R_0$. If V_{out} is limited in the interval of $\pm 10V$, calculate the measurable interval of temperature at the output of the inverting amplifier in Fig 1.	5

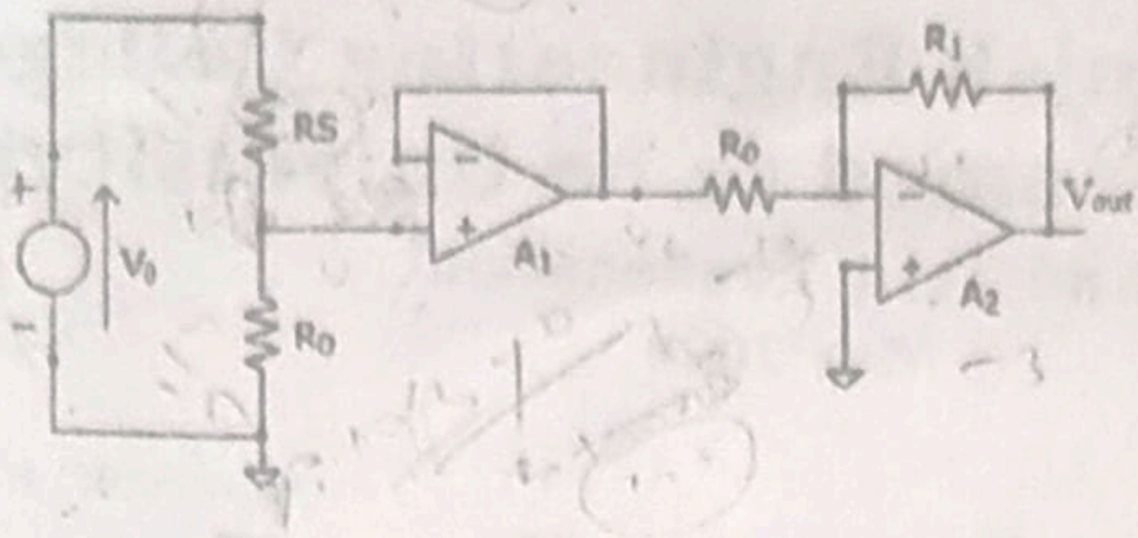

Fig. 1

3	(a)	Two input signals are applied to the inverting and non-inverting terminals of the difference amplifier as shown in Fig. 2. Find the output voltage when the inputs are $V_1 = 50$ mV and $V_2 = 90$ mV and $R_1 = 10$ KΩ and $R_2 = 120$ KΩ.B	5

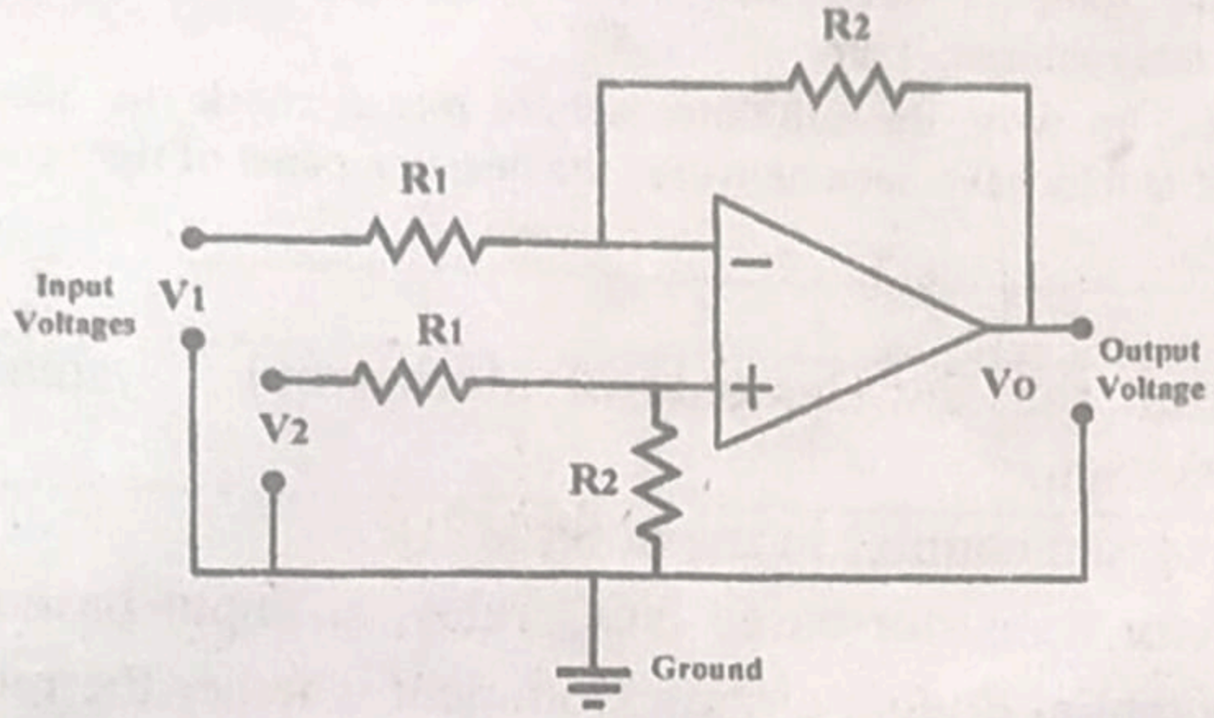

Fig. 2

	(b)	If the digital coded input for a 4-bit word to a Weighted register DAC is 1001, find its equivalent analog value for a reference voltage of 5V. Where Rf = 4K, R1=2.5 kΩ, R2=5 kΩ,R3=10 kΩ and R4=20kΩ.	4
4.	(a)	Draw the RAM and EPROM interfacing with Microprocessor 8085.	2
	(b)	Draw the architecture of an 8051 microcontroller.	4
	(c)	Draw the ladder diagram and write the assembly language program for a Programmable Logic Controller to implement the following objective: A LED lamp in a staircase has two switches, one switch being at the ground floor and the other one at the first floor. The lamp can be turned ON and also can be turned OFF by any one of the switches irrespective of the state of the other switch.	4
5.	(a)	What is stepping angle? Calculate the stepping angle for a three phase, 4 pole permanent magnet stepper motor.	2
	(b)	Draw a pneumatic circuit for opening and closing a bus door using 3/2 spool valve and single acting pneumatic cylinder along with other basic components of a pneumatic system.	4
	(c)	What are the different types of Cam-follower mechanisms? Draw the motion profile of pear-shaped cam.	2
	(d)	Explain with suitable diagram the cartesian, cylindrical, spherical and articulate configuration for a robotics system along with its degrees of freedom (DOFs).	3