

University of Dhaka
 Department of Computer Science and Engineering
 2nd Year 2nd Semester B. Sc. Final Examination 2020
 CSE 2201: Database Management Systems-I

Total Marks: 70

Time: 2 Hours

[Answer any three (3) of the following Questions]

1. a) Consider the schemas of the following relational database with usual primary and foreign keys: 20

employee (emp_id, emp_name, dob, gender, salary, dept_no)
 department (dept_no, dept_name, manager_name)
 project (p_no, p_name, dept_no)
 work_on (emp_id, p_no, hours)

Now give the SQL and Relational Algebra expressions for the following queries:

- i) Find employees, date of birth with the project name for which they work.
- ii) Find how many employees are working with each project with their average working hours.
- iii) Find the department number where more than 3 projects are running.
- iv) Update salary of the employees by 15% who are female and working for the department number 7.
- v) Remove the projects that are supervised by the manager 'Ahsan'.

- (P.R.A.Y.)*
- b) Express the following query in SQL using no subqueries and no set operations. Given 3.33
 schemas are:
student (s_id, name, dept_name, tot_cred)
advisor (s_id, i_id)

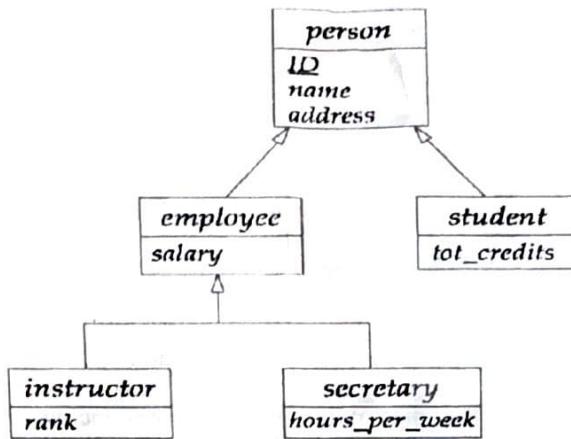
select s_id
 from student
 except
 select s_id
 from advisor
 where i_id is not null

2. a) Explain the concept of physical data independence and its importance in database systems. 4
 b) List two reasons why null values might be introduced into the database. 2
 c) With example show that, in SQL, <> all is identical to not in. 5
 d) List the names of fundamental relational algebra operation. Give the equivalent relational algebra expression of the following SQL form: 2+3

```
select A1, A2, sum(A3)
from r1, r2, ..., rm
where P
group by A1, A2
```

- e) Including example explain the difference between schema and instance. 3.33
 f) Using relational algebra show how 'set-intersection' and 'natural-join' operations can be replaced by fundamental operations? 4
3. a) With appropriate data, show the differences among left-outer, right-outer and full-outer join based on joining outcome. 6
 b) What do you understand by *integrity constraints* in database? Give some appropriate example. 3
 c) What are the purposes of using *view* in database? What might be problem of data manipulation using views? What is *materialized views*? 6

- d) Explain why, when a manager, say Satoshi, grants an authorization, the grant should be done by the manager role, rather than by the user Satoshi. 3
- e) Explain how authorization graph is used for granting and revoking the authorization. 5.33
4. a) Find relationships and differences between E-R model and relational model. 5
- b) With example explain participation constraint in E-R model. How primary keys are defined for binary relationship sets for different mapping cardinalities in E-R model? 3+3
- c) Design an E-R diagram for the database mentioned in 1(a). 5
- d) A weak entity set can always be made into a strong entity set by adding to its attributes the primary-key attributes of its identifying entity set. Outline what sort of redundancy will result if we do so. 4.33
- e) Show the relational representation of 'instructor', 'secretary' and 'student' entity sets for the following specialization and generalization. 3



5. a) List all non-trivial functional dependencies satisfied by the following relation. 5.33

A	B	C
a1	b1	c1
a1	b1	c2
a2	b1	c2
a2	b1	c3

- b) Consider the relation schema $R = (A, B, C, D, E)$ with functional dependencies $F = \{A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A\}$. Is functional dependency $BC \rightarrow ABDE$ in F^+ ? 2
- c) What are the advantages of 3NF over BCNF? Then why don't we decompose into 3NF always? 2+2
- d) Consider $R = (A, B, C, D, E, G)$ with functional dependencies $F = \{A \rightarrow BC, BD \rightarrow E, CD \rightarrow AB\}$.
- i) Find the candidate key/s for R. 4
 - ii) Is this schema in BCNF? Explain. 3
 - iii) How best can you decompose the schema so that it meets the design goals of decomposition? 5

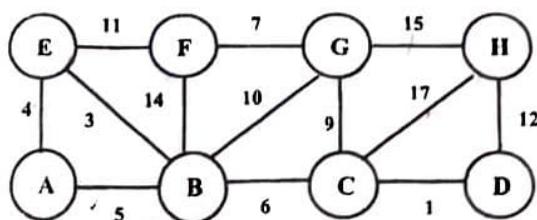
University of Dhaka
Department of Computer Science and Engineering
2nd Year 2nd Semester B. Sc. Final Examination, 2020
CSE-2202: Design and Analysis of Algorithm-I

Total Marks: 70

Time: 2 Hours

(Answer any three (3) of the following questions)

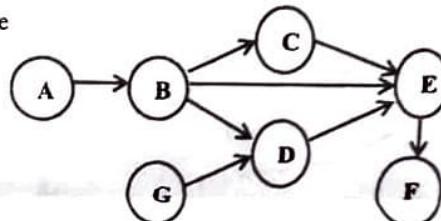
1. a) Given the graph, simulate Dijkstra's shortest path algorithm with intermediate steps. Assume A as the source node.



- b) Mention three cases, where running Breadth First Search should be enough to find the correct shortest path in a weighted graph. 8
- c) If all the edge weights of an undirected graph are unique, then the graph has a unique Minimum Spanning Tree. 7.33

Is the sentence above true? Prove or disprove.

2. a) Given the following graph, list ALL the valid topological orders of the graph. 8



- b) You are given a tree (connected, undirected graph with no cycle). The root of the tree is 1. Write an algorithm to find the size of each subtree. For example, see the output for the following input. Here the first line indicates no of nodes N, next N-1 lines list each edges. 8

Input	Expected Output
6	Size of subtree starting at 1 = 6
1 2	Size of subtree starting at 2 = 3
1 3	Size of subtree starting at 3 = 2
2 4	Size of subtree starting at 4 = 1
2 5	Size of subtree starting at 5 = 1
3 6	Size of subtree starting at 6 = 1

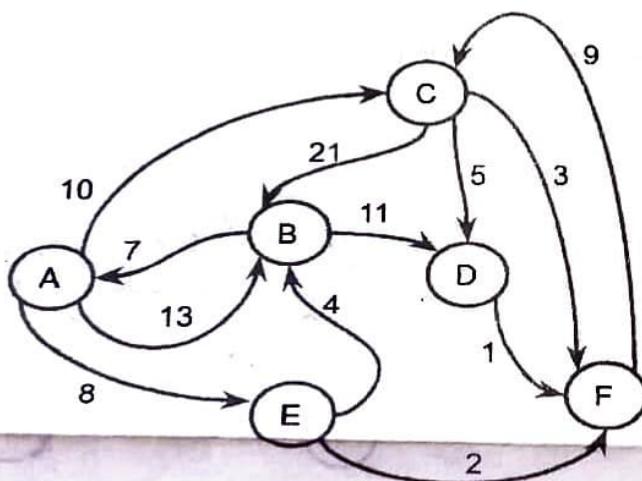
- c) Write an algorithm to find the Euler circuit in an undirected weighted graph. You need to find such circuit which has minimum sum of edge weights. Analyze the complexity of your algorithm. 7.33

3. a) You are given few activities. Each activity is defined using two integers – (start time of the activity, end time of the activity). Find maximum number of non-overlapping activities that you can choose using the greedy algorithm. Show intermediate steps. The activities are: (1, 100), (10, 20), (3, 5), (1, 10), (7, 12), (8, 9), (13, 21), (25, 70), (26, 30), (50, 60), (45, 65). 8

- b) Write a recursive algorithm to find the size of the longest decreasing sub-sequence of a given sequence of integers. For example, given the sequence 11, 3, 4, 5, 3, 1 the answer 8

is 4 (11, 5, 3, 1). Analyze the time and memory complexity of your algorithm.

- c) Describe Master methods to determine the complexity of a recursive algorithm. Give examples for each case with proper explanations. 7.33
4. a) Given a set of coins $C = \{3, 4, 5, 7, 13\}$, how many way you can make 25 with these coins? 8
- b) Write a recursive algorithm to find the size of the longest common sub-sequence of THREE given strings. Analyze the time and memory complexity of your algorithm. 8
- c) You are given N coins. The i -th coin has an associated value of V_i and a frequency F_i . You want to determine whether it is possible to make an amount X using these coins. Write the most efficient algorithm for the task. Analyze the complexity. 7.33
5. a) Consider the following graph: 8



Find the maximum flow from node **B** to node **F**. Show all steps.

- b) Given a string S as input, find out how many times "Department of Computer Science and Engineering, University of Dhaka, Bangladesh" appears as a sub-sequence in S . 8
- c) You are given an $N \times N$ grid, where each square (i, j) contains $c(i, j)$ gold coins, and (i, j) is the j -th square of i -th row. Assume that $c(i, j) \geq 0$ for all squares. You must start in the upper-left corner $(1, 1)$ and end in the lower-right corner (N, N) , and at each step you can only travel one square down or right. When you visit any square, including the starting or ending square, you may collect all of the coins on that square. Write an algorithm to find the number of ways to go from starting cell to ending cell collecting maximum number of coins. Mention the time and memory complexity of your algorithm. 7.33

University of Dhaka

Department of Computer Science and Engineering

2nd Year 2nd Semester B.Sc. Final Examination, 2020

CSE – 2203: Data and Telecommunications

Total Marks: 70

Time: 2 Hours

Answer any 3 (Three) of the following Questions

1. a) Both Nyquist's and Shanon's theorem place upper bounds on the bitrate of a channel based on two different approaches. How are the two related? 6
- b) We need to send data at a 1-Mbps rate. We have two options- i) a combination of 4B/5B and NRZ-I, and ii) Manchester encoding. Compare and contrast the two options in terms of required bandwidth and dc component. $6 \times 5 / 10 = 3$
- c) How do scrambling techniques overcome the baseline wandering problem of AMI encoding? Explain with proper example. 5.33
- d) We have sampled a low-pass signal with a bandwidth of 200 KHz using 1024 levels of quantization.
- i) Calculate the bit rate of the digitized signal. 4×10^3 bps
 - ii) Calculate the SNR_{dB} for this signal. $6 \text{ K } \text{dB}$
 - iii) Calculate the PCM bandwidth of this signal. 2×10^6
2. a) Briefly describe quadrature phase shift keying with proper diagram. 8.33
- b) Draw the constellation diagram for the following:
- i) ASK, with peak amplitude values of 1 and 3
 - ii) BPSK, with a peak amplitude value of 2
 - iii) QPSK, with a peak amplitude value of 3
 - iv) 8-QAM with two different peak amplitude values (1 and 3 volt) and four different phases.
- c) A corporation has a medium with a 1-MHz bandwidth (low pass). The corporation needs to create 10 separate independent channels each capable of sending at least 10 Mbps. The company has decided to use QAM technology. What is the minimum number of bits per baud for each channel? Let d = 0. 4
- d) Which characteristics of an analog signal are changed to represent the low pass analog signal in each of the following analog-to-analog conversions? 3
- i) AM ii) FM iii) PM
3. a) i) Mention the motivation of spread spectrum. How do you avoid jamming from intruder in Frequency Hopping Spread Spectrum? 4
- ii) We have a digital medium with a data rate of 12 Mbps. How many 64-kbps voice channels can be carried by this medium if we use Direct Sequence Spread Spectrum? 4
- b) i) Give an example of frame of a Statistical Time Division Multiplexing and a Synchronous Time Division multiplexing. 3.33
- ii) Describe slot size in context of Statistical Time Division Multiplexing. 3
- c) Determine the upstream data rate and downstream data rate in case of data transfer using ADSL technology. 3



- d) Ten sources, seven with a bit rate of 250 kbps and three with a bit rate of 400 kbps are to be combined using multilevel Time Division Multiplexing with no synchronization bits. Answer the following questions. 6
- i) What is the size of a frame in bits? ii) What is the frame rate?
 - iii) What is the duration of a frame? iv) What is the data rate?
4. a) What kind of error is undetectable by the following error detection techniques? 7
- i) Single bit parity (even), ii) Two-dimensional parity (even), and iii) Checksum Provide example with proper reasoning.
- b) The polynomial of a CRC generator code is: $x^{19} + x^{12} + x^5 + 1$. Does it detect a burst error of size 6? Does it detect any odd number of error bits? Defend your answer. Also find the probability of failing to detect a burst error of length 20? Is it a good CRC code? 8
1/2¹⁸
- c) i) What is Hamming distance? 2.33
- ii) How does error detection take place in forward error detection? 2
 - iii) How does error correction take place in forward error correction? 2
 - iv) Make comments on overhead in forward error corrections. 2
5. a) Mention the name of the layer at which following switching takes place. 3.33
- i) Circuit-switching
 - ii) Datagram switching
 - iii) Virtual circuit-switching
- b) In virtual circuit-switching, global and local addressing are involved. Briefly describe the role and scope of global and local addressing 4
- d) A path in a digital circuit-switched network has a data rate of 1 Mbps. The exchange of 8 1000 bits is required for the setup and tear down phase. The distance between two parties is 8000 Km. Answer the following question if the propagation speed is $2 \times 10^8 m/s$.
- i) What is the total delay if 2000 bits of data are exchanged during the data transfer phase?
 - ii) What is the total delay if 50000 bits of data are exchanged during the data transfer phase?
 - iii) What is the total delay if 200000 bits of data are exchanged during the data transfer phase?
 - iv) Find the delay per 1000 bits of data for each of the above case.
- e) i) Crossbar switch is inefficient since only 25% cross points are used simultaneously. Multistage switching is the solution of this limitation. Mention the limitation of multistage switching 4
- ii) What is TSI? Describe its role in time-division switching.

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CSE-2204: Computer Architecture and Organization

Total Marks: 70

Time: 2 Hours

(Answer any three (3) of the following questions)

1. a) Discuss the role of tag bits with the associated advantages and disadvantages. [3.33]

b) Discuss how memory address extension is handled in a MIPS processor with respect to different types of instructions. Use examples to explain your answer. [8]

c) Generate the decimal code for the following MIPS instructions (preserve instruction format) 

(i) bne \$s1, \$s2, 150 [opcode=5][assume branch is taken]
 (ii) addi \$s1, \$s2, 10 [opcode=8]
 (iii) sll \$t1, \$s3, 2 [opcode=0, funct=0]

Suppose PC = 10010010 01010001 10101001 00101011. Generate the address of the next instruction for each of instruction mentioned above.

- next instruction for each of instruction mentioned above.

d) Discuss how function calls are handled using different MIPS instructions. [4]

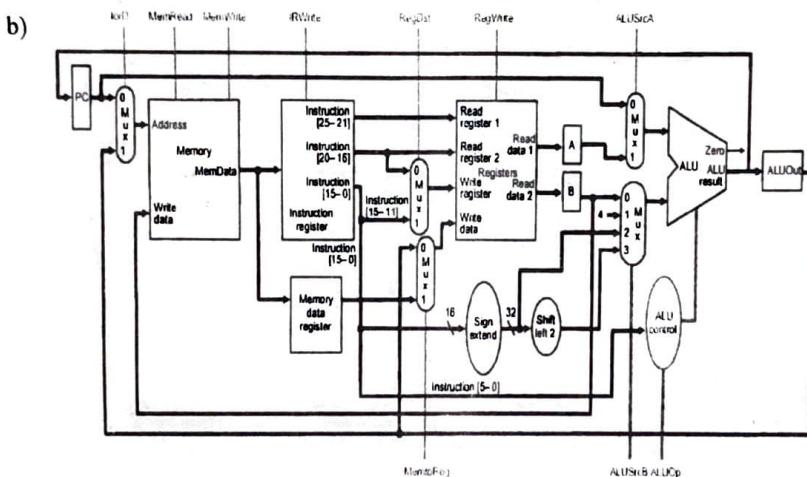
2. a) Find the result of $Z = X \times Y$ where $X = 0111_2$ and $Y=0101_2$. Use Booth's multiplication algorithm. [7.5]

b) Discuss the design of a carry-save adder using an example. Also, explain its advantages over the other existing adders. [5]

c) Represent -35.375 in IEEE-754 32-bit floating-point format. [3.33]

d) Show the steps needed to calculate $Z = X / Y$ using the non-restoring division algorithm, where $X = 10$ and $Y=3$. [7.5]

3. a) Discuss different types of data hazards that may arise in a pipelined MIPS processor [9.5] with appropriate examples. Also, explain how these hazards are handled.



Suppose the following instruction is executed using this processor:

Iw \$s2, 100(\$s1)

- (i) Write down the actions carried out in each cycle of the processor.
(ii) Write down the control signals activated in each cycle.
(iii) Draw the FSM Control for executing this instruction.

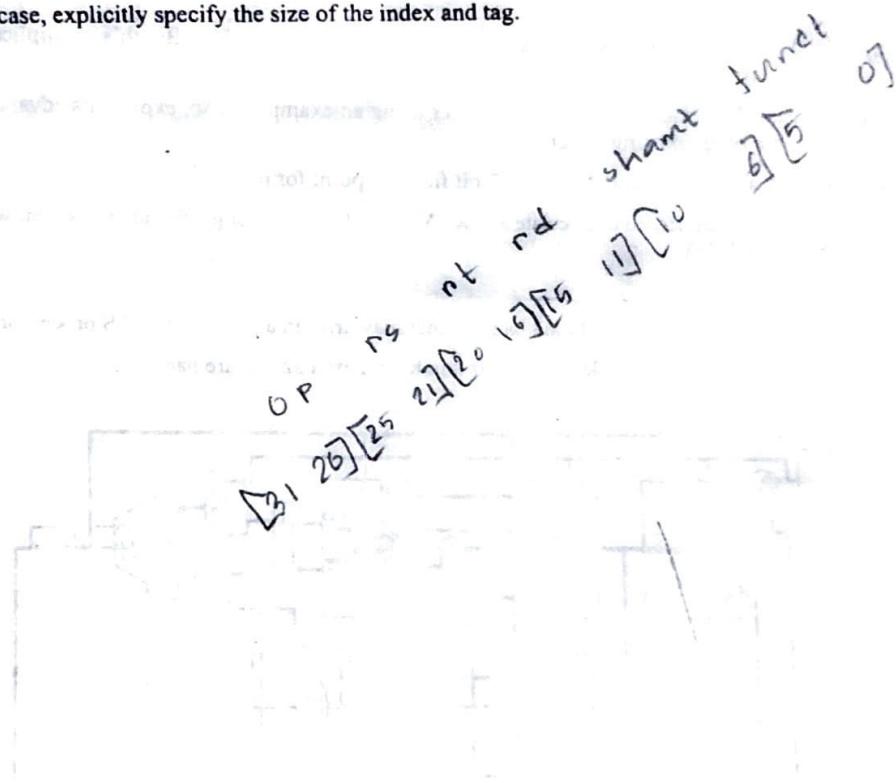
- c) Discuss how dynamic branch prediction is used to handle control hazards. [4.33]

a) Draw the block diagram of a single-cycle processor datapath and label necessary [4+6=10]

control signals. Describe the steps and highlight the datapath in the figure involved in operation for a STORE instruction.

- b) Discuss different ways to perform ALU expansion. Also, mention the pros and cons of each method. [5]
- c) Find the summation of two floating-point numbers: 2.736584×10^7 and 1.106954×10^4 . Discuss each step of the addition operation. You can store four decimal digits of the significand and two decimal digits of the exponent [5]
- d) What is a delayed branching? Discuss the strategies of implementing a delayed branching. [3.33]

5. a) What are the differences between RISC and CISC instruction sets? [5.33]
- b) Present the pros and cons of the following cache schemes using suitable examples: [9]
- (i) Direct mapped cache memory
 - (ii) n-way set associative cache memory
 - (iii) Fully associative cache memory
- c) Suppose you need to store 32KB data in a cache memory where the block size is 8 words. The length of the memory address is 32 bits. Calculate the total number of bits required for (i) direct-mapped cache (ii) 2 way set associative cache, and (ii) fully associative cache.
- In each case, explicitly specify the size of the index and tag.



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CSE-2205: Introduction to Mechatronics

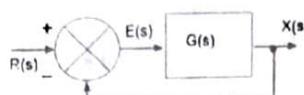
Time: 2 hours

Full Marks: 70

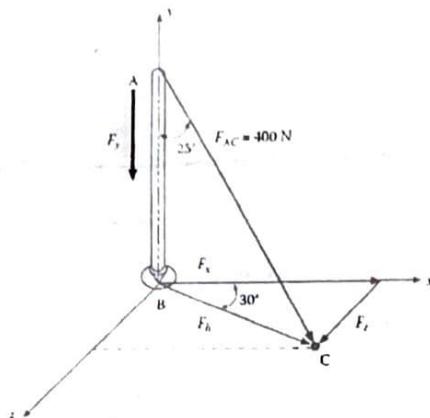
Answer any three of the following questions

- 1 a With the help of a suitable diagram show the main components of any mechatronic system and mechatronics design process. 6
- 1 b Explain the difference between sensors and transduces. 4
- 1 c Why does an LED emit light when current passes through it? Explain it with a suitable diagram. 6
- 1 d What is the non-linearity error, as a percentage of full range, produced when a $1\text{ K}\Omega$ potentiometer has a load of $10\text{ K}\Omega$ and is one-third of its maximum displacement? 4
- 1 e What are the different types of PLC timers? 3.33

- 2 a Consider a control system which has unity feedback (shown in Fig below). Derive the equation of steady state error. 3

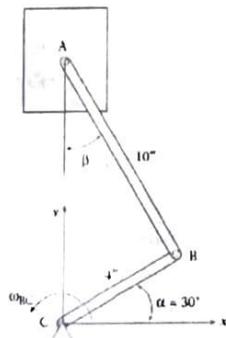


- 2 b As shown in the figure below, the angle between a vertical boom AB and guy wire AC is 25° . If the tension in AC is 400 N, calculate:
 i) x, y, and z components of the force exerted on the vertical boom at point B
 ii) The angles θ_x , θ_y , and θ_z . 8



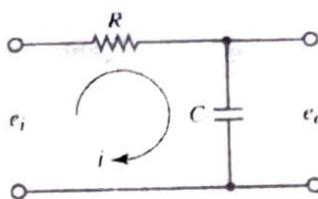
- 2 c What do you mean by translation in dynamics? Explain it with a suitable diagram. 4.33

- 2 d In the engine system shown below, determine the velocity of the piston and the angular velocity of connecting rod AB. Assume that when crank angle $\alpha = 30^\circ$, crank arm CB rotates at 2500 rpm. 8

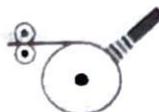


- 3 a What type of temperature sensor would you recommend for the following cases and why? 6
- 3 i) Temperature measurement of a small volume electronic part with highly transient temperature condition. 8
- 3 ii) Temperature measurement of a liquid in a large container. 6

- b Convert the RC circuit as shown in the figure below into a block diagram.



- c What kind of sensor could be applied to determine roll diameter sensing as shown in the following figure? Explain. 4

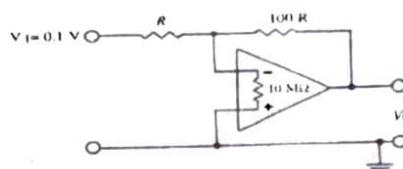


- d Consider the force measurement using a strain gauge on a shaft under compression. Let us consider that the shaft material is steel. The elastic Young's modulus $E = 2 \times 10^8 \text{ kN/m}^2$, and cross-sectional area of the shaft is $A = 10.0 \text{ cm}^2$. We have a strain gauge bonded on the shaft in the direction of the tension. The nominal resistance of the strain gauge is $R_0 = 600\Omega$, the gauge factor is $G = 2.0$. The other three legs of the Wheatstone bridge also have constant resistances of $R_2 = R_3 = R_4 = 600\Omega$. The reference voltage for the Wheatstone bridge is 10.0 VDC. If the output voltage measured $V_{out} = 2.0 \text{ mV}$, what is the force? 6

- e How can the rigidity of a system be checked?

3.33

- 4 a Consider the op-amp circuit shown in the following figure. Determine the output voltage when the input voltage is $V_i = 0.1 \text{ V}$, and the current that flows to the inverting input. 5.33



- b Design a summing amplifier circuit that can be used to produce an output that ranges from -1 to -5v when the input goes from 0 to 100mv. 4

- c An inverting amplifier has an input resistance of $2 \text{ k}\Omega$. Determine the feedback resistance needed to give a voltage gain of 100. 4

- d Explain how a thyristor can be used to control the level of a d.c. voltage by chopping the output from a constant voltage supply. 5

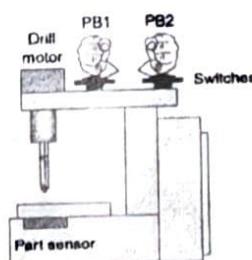
- e If a stepper motor has a step angle of 7.5° , what digital input rate is required to produce a rotation of 10 rev/sec? 5

7

5

- 5 a Construct a ladder diagram to run a motor in forward and reverse direction using timers. 7

- b The following figure shows the sketch of a drilling process that requires the drill press to turn on only if there is a part present and the operator has one hand on each of the start switches. This precaution will ensure that the operator's hands are not in the way of the drill. The sequence of operation requires that switches 1 and 2 and the part sensor all be activated to make the drill motor operate. Devise the ladder logic program required for the process implemented. 5



- c Motor inertia, J_m , for a typical 27 W motor is given as $J_m = 20 \times 10^{-7} \text{ kg m}^2$ if the gear ratio is 10, then the reflected motor inertia on the load side J_{ml} is 0.0003 kg m^2 . If someone is driving a load of 3 kg on wheels of 0.04 m radius mounted on an axis to which the output side of the gear system is attached, compute the moment of inertia of the load at the drive wheel and compare it. 8

- d For designing mobile robot in deciding the PWM frequency which ratio needs to be considered? 3.33