Khulna University of Engineering & Technology
Department of Industrial Engineering and Management

B.Sc. Engineering 4th Year 2nd Term, 2017

IPE 4027

Computer Integrated Manufacturing

Full Marks: 210 Time: 3 hrs

N.B: *i) Answer any THREE questions from each section in separate scripts.*
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if missing any.

SECTION–A

1. (a) What is manufacturing system? Briefly explain the manufacturing system on the basis of automation and manning level. 13

   (b) Classify and briefly explain single station manufacturing cell with example. 09

   (c) A worker is currently responsible for loading and unloading in a machine cluster. The service time per machine T_s = 0.35 min, and the time to walk between machines T_r = 0.15 min. The machine cycle time T_m = 1.90 min. Determine how many machines one worker can service, if minimum cost per unit of product is the decision criterion? Given worker's hourly rate $12/hr, machine hourly rate $18/hr. 13

2. (a) What is cellular manufacturing? Discuss about the features of parts classification system. 12

   (b) Develop the form code (first five digits) in the Opitz system for the part illustrated in Figure 2(b). 06

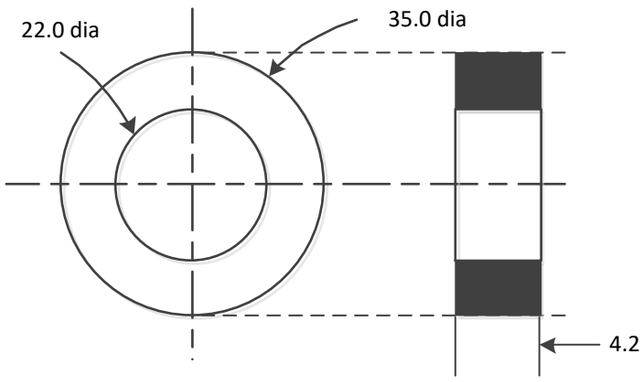

Figure 2(b) [dimensions are in mm]

   (c) Apply the rank order clustering technique to the part machine incidence matrix in the following table to identify logical part families and machine groups. Parts are identified by letters, and machines are identified numerically. 17

	A	B	C	D	E	F	G	H	I
1	1								1
2		1					1		
3			1		1			1	
4		1				1	1		
5			1					1	
6						1	1		
7	1			1					
8			1		1				

3. (a) What is meant by material handling? Briefly describe the design consideration in material handling systems. 13

   (b) Discuss the vehicle management in a material handling systems. 08

   (c) A flexible manufacturing system (FMS) is being planned. It has a ladder layout as shown in Figure 3(c), and use a rail guided vehicle (RGV) system to move parts 14

between stations in the layout. All work parts are loaded into the system at station-1, moved to one of the three processing stations (2, 3, or 4) and then brought back to station-1 for unloading once loaded onto its RGV, each work part stay onboard the vehicle throughout its time in the FMS. Load and Unload times at station-1 are each 1.0 min. Processing times at other stations are 5.0 min at station-2, 7.0 min at station-3, and 9.0 min at station-4. Hourly production of parts through the system is: 7 parts through station-2, 6 parts through station-3, and 5 parts through station-4.

I. Develop the From-To chart for trips and distance.
II. Develop the network diagram.
III. Determine the number of vehicle that are needed to meet the requirements, if vehicle speed = 60 m/min, T_f =0.85 and reliability = 100%

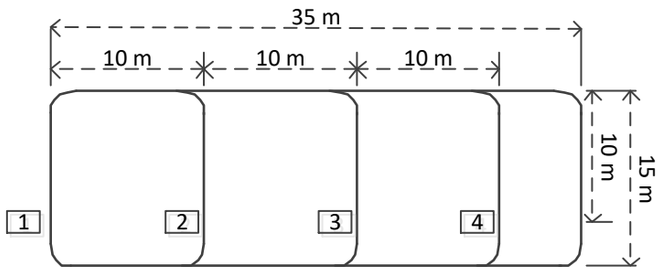

Figure 3(c)

4. (a) What is meant by Automated Storage/Retrival System (AS/RS)? Discuss the unit load AS/RS and deep-lane AS/RS. 10

(b) Define Automatic Data Capture (ADC). Discuss about the Code 39 bar code standard. 10

(c) What is automated inspection? Discuss off-line inspection. 07

(d) Four machines used to produce a family of parts are to be arranged into a GT cell. The From-To chart for the parts processes by the machines are shown in table below. Determine the most logical sequence of machines for this data using Hollier Method-1. 08

	To:			
From:	1	2	3	4
1	0	10	0	40
2	0	0	0	0
3	50	0	0	20
4	0	50	0	0

SECTION–B

5. (a) Define flexible manufacturing system. Discuss about different types of flexibility in manufacturing. 12

(b) Differentiate between FMC and FMS. 08

(c) An FMS consists of three stations plus a load/unload station. Station-1 loads and unloads parts from the FMS using two servers (material handling workers). Station-2 performs horizontal milling operations with two servers (two identical CNC horizontal milling machines). Section-3 performs vertical milling operations with three servers (three identical CNC vertical milling machines). Station-4 performs drilling operations with two servers (two identical drilling processes). The machines are connected by a part handling system that has two work carriers and a mean transport time = 3.5 min. The FMS produces four parts A, B, C and D whose part mix fractions and process routings are presented in the table below. The operation frequency f_{ijk} = 1.0 for all operations. Determine- 15

I. Maximum production rate of the FMS
II. Utilization of each machine in the system and
III. Average utilization of the system.

Part j	Part Mix p_j	Operation k	Description	Station i	Process Time t_{ijk} (min)
A	0.2	1	Load	1	4
		2	H. Mill	2	15
		3	V. Mill	3	14
		4	Drill	4	13
		5	Unload	1	3
B	0.2	1	Load	1	4
		2	Drill	4	12
		3	H. Mill	2	16
		4	V. Mill	3	11
		5	Drill	4	17
		6	Unload	1	3
C	0.25	1	Load	1	4
		2	H. Mill	2	10
		3	Drill	4	9
		4	Unload	1	3
D	0.35	1	Load	1	4
		2	V. Mill	3	18
		3	Drill	4	8
		4	Unload	1	3

6. (a) Discuss about the functions performed by FMS computer control system. 10

(b) Is manual assembly line compatible with advanced assembly facilities? Justify your thought with example. 10

(c) The table below defines the precedence relationships and element times for a new model toy. 15

I. Construct the precedence diagram for this job.

II. If the ideal cycle time = 1.1 min, repositioning time = 0.1 min, and uptime proportion is assumed to be 1.0, what is the theoretical minimum number of workstations required to minimize the balance delay under the assumption that there will be one worker per station?

III. Use the Kilbrigge and Wester method to assign work elements to stations.

IV. Compute the balance delay for your solution.

Work Element	T_e (min)	Immediate Predecessors
1	0.5	---
2	0.3	1
3	0.8	1
4	0.2	2
5	0.1	2
6	0.6	3
7	0.4	4, 5
8	0.5	3, 5
9	0.3	7, 8
10	0.6	6, 9

7. (a) Define line pacing. Explain different levels of pacing with suitable example. 10

(b) Discuss about different layouts of the segmented in-line configuration of automated productions lines with necessary sketches. 12

(c) A part is to be produced on an automated transfer line. The total work content time to make the part is 36 min, and this work will be divided evenly among the workstations so that the processing time at each station is 36/n, where n = the numbers of stations. In addition, the time required to transfer parts between workstations is 6 sec. Thus, the cycle time = 0.1+39/n min. In addition, it is known that the station breakdown frequency will be p = 0.005, and that the average downtime per breakdown = 8.0 min. 13

I. Given these data and using the upper-bound approach, determine the number of workstations that should be included in the line to maximize production rate.

II. Also, what is the production rate and line efficiency for this number of stations?

8. (a) What is route sheet? Show the operations sequence of a retrieval type computer-aided process planning system by flowchart. 10

(b) Define concurrent engineering. How design affects process planning? 10

(c) Justify the term "*Lean means thin*". Differentiate between lean and agile manufacturing. 15

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management

B.Sc. Engineering 4th Year 2nd Term, 2017

IPE 4059

Project Management

Full Marks: 210 Time: 3 hrs

N.B: *i) Answer any THREE questions from each section in separate scripts.*
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if missing any.

SECTION–A

1. (a) Define project. List the characteristics that distinguish project from function. 08
   (b) Name the three prime goals of a project and discuss why there are trades-off among them. 07
   (c) Discuss different types on non-numeric project selection methods. 10
   (d) Contrast win-lose negotiation with win-win negotiation and explain why the letter is so important in project management. 10

2. (a) Define life cycles of a project and explain the two different project life cycle shapes. 12
   (b) Discuss the advantages of matrix organization over functional organization. What are the criteria for choosing an organization structure? 12
   (c) Discuss the major categories of skills should have a project manager. Also differentiate between project manager and functional manager. 11

3. (a) What are some of the benefits of setting up a project plan for routine, frequent projects? 10
   (b) Discuss the pros and cons of identifying and including the project team at the project launch meeting. 10
   (c) Why is participatory management beneficial to project planning? How does the process of participatory management actually work in planning? 15

4. (a) What is budgeting the project? Contrast the disadvantages of top-down budgeting and bottom-up budgeting. 12
   (b) How does a tracking signal improve budget estimates? 08
   (c) Distinguish among highly probable risks, extremely serious risks and highly vulnerable areas in risk identification. 15

SECTION–B

5. (a) Write down the fundamental differences between AOA network and AON network diagram. What is dummy activity and why it is used? 10
   (b) Consider the following data of a project: 20

Activity	Predecessor (s)	Durations (weeks)		
		t_0	t_m	t_p
A	---	3	5	8
B	---	6	7	9
C	A	4	5	9
D	B	3	5	8
E	A	4	6	9
F	C, D	5	8	11
G	C, D, E	3	6	9
H	F	1	2	9

   I. Construct a project network.

II. Find the critical path and the expected project completion time, and

III. What is probability of completing the project on or after 30 weeks? Also find project completion time that will have 95% chance of completion.

(c) Define precedence diagram. A project consist of series of tasks labeled A, B, ……, H, I with the following relationships (W<X, Y means X and Y cannot start until W is completed; X, Y<W means W cannot start until both X and Y are completed). With this notation construct the network diagram having the following constraints: A<D, E; B, D<F; C, E<G; B<H; F,G<I. 05

6. (a) Distinguish between resources allocation and resource leveling. 05

(b) What is meant by "Fast-Track" a project? Why is the problem of allocating scarce resources to a set of projects similar to the problem of scheduling a job shop? 10

(c) Fins the optimal crashed project completion time if the indirect cost per week is TK 150. 20

Activity	Normal Time (weeks)	Normal Cost (TK)	Crash Time (weeks)	Crash Cost (TK)
1-2	6	700	4	840
1-3	12	300	10	1st week 60 and 2nd week 90
1-4	4	200	2	360
2-3	8	900	6	1000
2-4	4	600	2	760
2-5	15	100	8	380
3-5	8	500	3	960
4-5	6	400	4	500

7. (a) What does it meant to say that project monitoring and controlling are on the opposite sides of project selection and planning? 10

(b) Identify the situations where each of the following control tools might be useful: earned value charts, control charts, variance analysis, and trend projections. 12

(c) Explain how the earned value chart captures all three objectives of a project performance, cost and schedule. 13

8. (a) Differentiate between Go/no-go control and post control. Discuss any two types of control tools. 10

(b) What might be some characteristics of a good termination manager? 10

(c) Construct a GANTT chart and calculate staff utilization for the following list of activities. Also assume 6 people are available for working but two of them return from holidays after 1 week, for this consideration re-schedule all activities. 15

Task	Duration weeks	Precedence	ES	EF	LS	LF (weeks)	Slack time (weeks)	Critical Task
A	4	---	0	3	3	6	3	N
B	3	---	0	4	0	4	0	Y
C	5	A	3	8	6	11	3	N
D	7	B	4	11	4	11	0	Y
E	2	B	4	6	8	10	4	N
F	4	E	6	10	10	14	4	N
G	3	C, D	11	14	11	14	0	Y

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 4th Year 2nd Term, 2017

IPE 4219

Human Factors Engineering and Safety Management

Full Marks: 210 Time: 3 hrs

N.B: *i) Answer any THREE questions from each section in separate scripts.*
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SECTION–A

1. (a) Define ergonomics and human factor engineering. What is the basic difference between them? 05
   (b) Define workstation. How ergonomics fit the workstation to the person who used it? Discuss with ergonomic principles. 10
   (c) Enlist the ergonomic factors. Show the relation between man- machine systems in figure and elaborate it. 10
   (d) Define anthropometry and percentiles. How percentiles value is used in designing of a control system? 10

2. (a) Define neutral posture. What are the ways of maintaining neutral posture? 08
   (b) Define coronal straight and horizontal plane with figure. Discuss the dimensions of horizontal workspace for a seated person proposed by Barnes and Squires with diagram. 15
   (c) Define neutral standing posture. Choosing posture with reason when: i) designing a passenger seat in bus, ii) work is prolonged, and iii) work spread out over several areas. 12

3. (a) What is musculoskeletal disorder? How can musculoskeletal disorders be avoided? 10
   (b) How can machine tools lab be designed with the help of general workstation design principle of ergonomics? 13
   (c) Explain various types of grip with figure. "*It is better to bend metal than to twist arm.*"- Explain with example. 12

4. (a) Define biomechanics. How does biomechanics relate to other areas of movement science? 07
   (b) Discuss the differences between bio-engineering and biomedical. 07
   (c) Explain NIOSH lifting equation. What are the limitations of NIOSH lifting equation? 12
   (d) Explain biomechanical levers with proper example. 09

SECTION–B

5. (a) Define safety and safety management system. Discuss the main components of safety management system. 10
   (b) Differentiate among risk, injury, and hazard. Also write down the relationship among acceptable level of safety, safety performance indicators, safety performance targets, and safety requirement. 07
   (c) Define safety risk management. Also discuss the main routes of safety management system. 10
   (d) Differentiate between safety circle and safety culture. Draw a system model of safety. 08

6. (a) Why are work related injuries occurred despite of using all safety guidelines in industry? Discuss any two types of work related injuries with causes and compensations. 15

(b) Define risk management. Write down steps involving in risk management plan. 10

(c) How can you assess and prioritize the risk? Also discuss some risk mitigation options. 10

7. (a) How you can develop a response for risk? Also explain how risk response process control is designed. 12

(b) Discuss the necessity of safety training. Also enlist OSHA's training guidelines. 10

(c) Write down the general characteristics of strong safety culture. How can the safety environment be established to a company by applying general safety rules. 13

8. (a) Differentiate between accident and incident. Write down the steps involved in investigating an accident. 10

(b) How you can investigate the incident with management oversight and risk tree. 10

(c) What is workplace emergency? What should your emergency action plan include? 08

(d) What is a vulnerability assessment? Write down the steps for efficient EHS budgeting. 07

Khulna University of Engineering & Technology
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B.Sc. Engineering 4th Year 2nd Term, 2017

IPE 4225

Tool Engineering

Full Marks: 210 Time: 3 hrs

N.B: *i) Answer any THREE questions from each section in separate scripts.*
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iii) Assume reasonable data if missing any.

SECTION–A

1.	(a)	Define the modes of freedom. Explain how nine degrees of freedom can be restricted.	10
	(b)	What is meant by radial location? Explain how degrees of freedom are restricted in radial locator.	13
	(c)	Explain the locating principle of V- locator with sketches.	12
2.	(a)	What are the different types of clamp generally used? Write down the principles of clamping.	10
	(b)	Describe the purpose and working principle of latch clamp with sketches.	13
	(c)	Mention the advantages and disadvantages of screw clamp over wedge clamp.	12
3.	(a)	Why is it necessary to establish complete location of work piece whose configuration is formed by flat planes?	10
	(b)	What is a drill jig? What are the differences between a drill jig and fixture?	10
	(c)	What are the major differences between reaming with guide bushing and drill with guide bushing?	10
	(d)	What are the advantages of a cast constructed jig body?	05
4.	(a)	Write down the basic principles of horizontal boring operations and vertical boring operations.	10
	(b)	How are broaching fixture classified? What are additional considerations applied to lathe fixtures?	12
	(c)	Explain briefly with sketches- i) Single-Piloted Boring Bar, ii) Double-Piloted Boring Bar.	13

SECTION–B

5.	(a)	Draw a progressive die and discuss its various features.	13
	(b)	What are the various shear angles? Discuss why the double shear angle is preferred over single shear angle.	12
	(c)	Differentiate between blanking and piercing with sketches.	10
6.	(a)	What are the major differences between fixed unit gages and indicating gages?	07
	(b)	What are the major problems in using the c-frame to position gage heads?	10

6. (c) Design a template gage for the work piece shown in figure 6(c). Dimension fully. 12

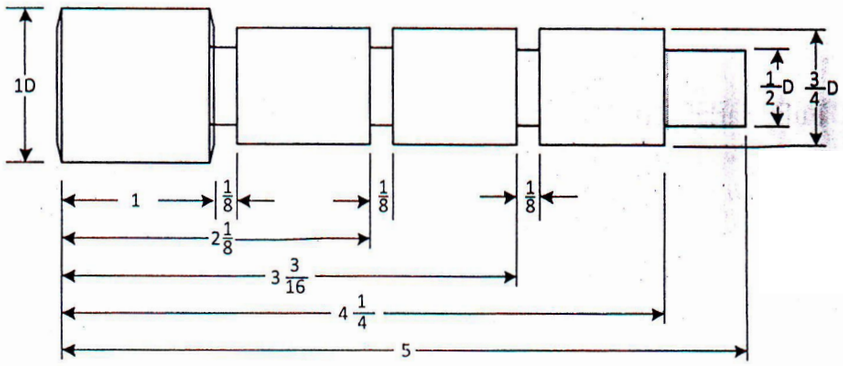

Figure 6(c)

(d) What are the general principles of sizing and coining? 06

7. (a) Write basic operations for shaping sheet metal: 09
i) Bending, ii) Forming, and iii) Drawing.

(b) Spring back increases with the increase of hardness number of a material. Explain the reason. 08

(c) Why is it important not to stop once a drawing operation is started? 08

(d) What is a curling die? What is the purpose of curling? 10

8. (a) Mathematically explain how to determine: 12
i) Bending Allowance, ii) Bending Length, and iii) Bending Pressure.

(b) Explain with sketches: 12
i) Open Die Forging and ii) Closed Die Forging

(c) What is swaging? Write down the difference among rod, bar and wire drawing with sketches. 11

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 4th Year 2nd Term Examination, 2016

IPE4227

CAM and Robotics

Full Marks: 210 Time: 03 hrs

N.B: *i) Answer any THREE questions from each section in separate scripts.*
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if missing any.

SECTION–A

1. (a) Define CAD and CAM. Discuss the benefits of CAD/CAM to engineering design as compared to conventional methods. 10
   (b) What CAD tools are required to support the design process? How you can implement a typical CAM process on a CAD/CAM system? 13
   (c) What is meant by Numerical Control? Briefly describe the working principle of an NC system with neat sketch. 12

2. (a) Explain Floating zero and incremental positioning. 10
   (b) "*Contouring NC is the most complex and the most flexible type of machine tool*"- explain. 10
   (c) The workpiece is a low-carbon steel plate, which has previously been cut out in the rough shape of the part outline. The tool is ½" -diameter side-milling cutter, cutting speed=573 rpm and feed=2.29"/min. Now smooth the periphery. Assume reasonable data and use ATP. 15

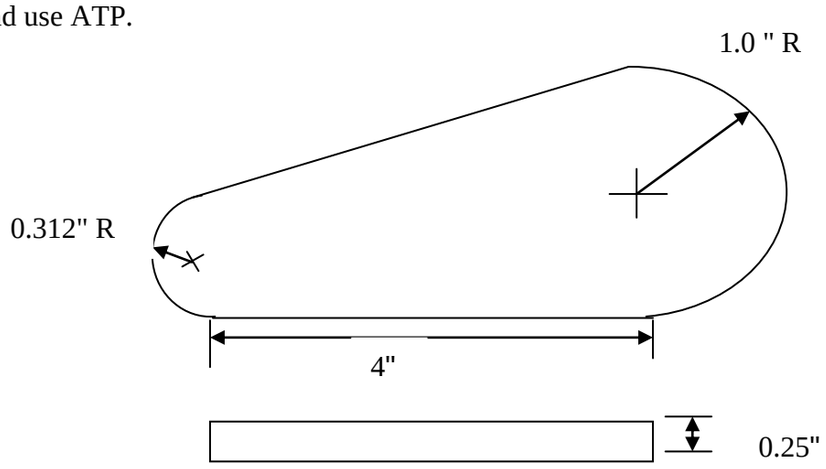

Figure 2(c)

3. (a) What is ATP language? Explain the role of 3 surfaces in ATP language. 11
   (b) Define route sheet. Discuss the problems with conventional NC. 10
   (c) What is word address format? CNC machining centre equipped with the ISO controller. Produce the following part (sheet) from the inside of a large sheet. Assume reasonable data. 14

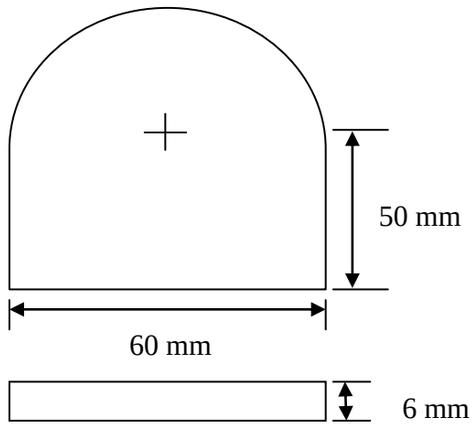

Figure 3(c)

4. (a) Discuss hybrid CNC and straight CNC. 12
(b) Explain the requirements of in-process compensation. 11
(c) Discuss the sources of variability in machining. 12

SECTION–B

5. (a) Define the term "*Robot*". Write down some specific applications of robot in different industrial sectors. 10
(b) What is robot autonomy? Sketch a robotic system with basic main components. 12
(c) Define work envelop of a robot. Explain the work envelop of Cartesian coordinate robot and SCARA robot. 13

6. (a) Differentiate betweencylindrical and jointed body and arm configuration robot. 10
(b) What are the different types of end effectors? Also describe the various types of grippers. 12
(c) Define sensors and transducers. Also write down their distinguish characteristics and differentiate them. 13

7. (a) How do sensors sense proximity and temperature? Explain. 10
(b) How could you design a control process? Differentiate between intermittent transfer and non-synchronous transfer. 10
(c) A unity feedback system has the open loop transfer function $G(s) = \frac{s+1}{s^3+s^2}$; find the error constant K_p ,K_v and K_a for this system. 15

8. (a) Figure 8(a) shown a block diagram with two feedback loops for which the transfer functions are $G_1(s)=\frac{1+4s}{4+4s}$; $G_2(s)=\frac{1}{1+0.5s}$; $G_3(s)=\frac{1}{1+s+s^2}$; $G_4(s)=\frac{1}{s}$; $H_1(s)=\frac{1}{1+0.1s}$ and $H_2(s)=\frac{s}{1+0.2s}$. Find the transfer functions from R and disturbance D to the output C. 10

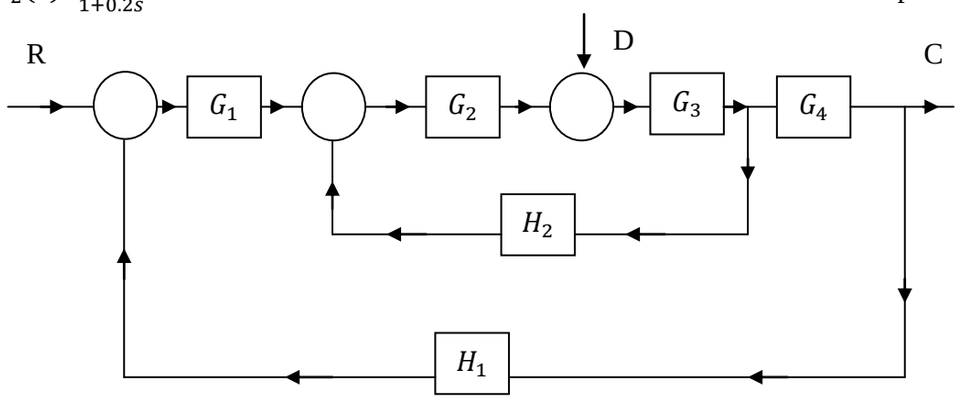

Figure 8(a)

(b) With the help of neat sketch, discuss Denavit-Hartenberg parameters. What are the values of θ_2 and θ_1 in figure 8(b). 15

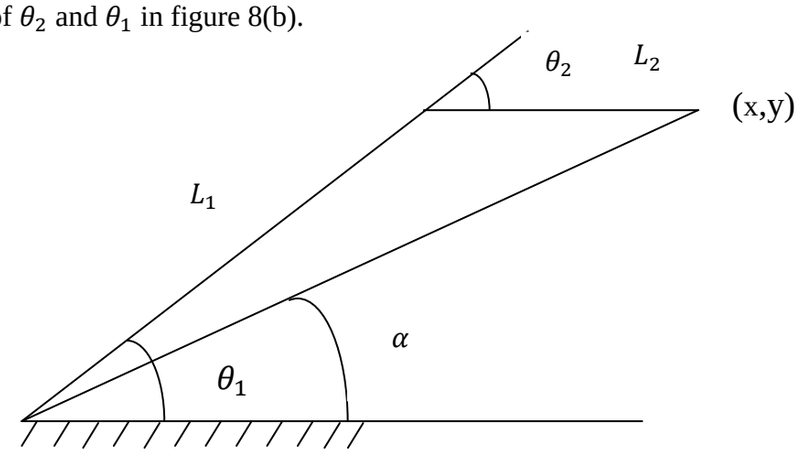

Figure 8(b)

(c) Given the world coordinates for a TRL:R robot as $x = 300\ mm, y = 350\ mm, z = 400\ mm$and $\alpha = 45°$;and given that the links have values $L_0 = 0, L_1 = 325\ mm$, λ_3 has a range from 300 to 500 mm, and $L_4 = 25\ mm$. Determine the joint anglesθ_1, θ_2, λ_3 and θ_4. 10