

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

B.Sc. Engineering 4th Year 2nd Term Examination, 2018

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) Define manufacturing system? Classify the production machines of a manufacturing system and briefly describe them. 11
- (b) Briefly explain the manufacturing system on the basis of automation and system layout. 12
- (c) A CNC grinding section has a large number of machines devoted to grinding of shafts for the automatic industry. The grinding machine cycle takes 3.6 min. At the end of cycle an operator must be present to unload and load parts, which takes 40 sec. Determine: 12
 - i) How many machines the worker can service if it takes 20 sec to walk between the machine and no machine idle time allowed?
 - ii) How many seconds during the work cycle is the worker idle?
 - iii) What is the hourly production rate of this machine cluster?
2. (a) Define group technology and cellular manufacturing. Briefly discuss the Opitz classification system with suitable example. 10
- (b) Briefly discuss the composite part concept of cellular manufacturing. 10
- (c) Apply the rank order clustering technique to the following part-machine incidence matrix to identify logical part families and machine groups. Parts are identified by numerically, and machines are identified by letters. 15

		Part Number						
		1	2	3	4	5	6	7
Machine ID	A		1		1			1
	B			1		1		
	C	1	1		1			1
	D	1		1				1
	E			1	1	1	1	

3. (a) What is meant by material handling? Discuss the design consideration in material handling system. 10
- (b) Briefly discuss the automated guided vehicles material handling system. 10

3. (c) A flexible manufacturing system (FMS) is being planned. It has a ladder layout as shown in Figure 3(c). It uses a rail guided vehicle (RGV) system to move parts 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 stays onboard the vehicle throughout its time in the FMS. Load and Unload times at station-1 are each 1.0 min. Processing times 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.

- Develop the From-To chart for trips and distance.
- Develop the network diagram.
- Determine the number of RGV that are needed to meet the requirements of the FMS, if vehicle speed = 60 m/min, Traffic factor = 0.85. Assume A = 100%

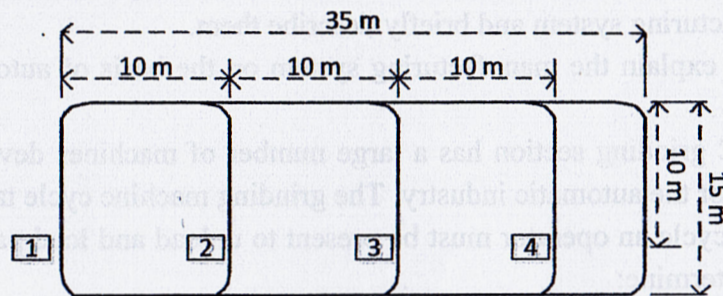


Figure 3(c)

4. (a) What are the various types of AS/RS? Briefly explain their features and applications. 15
- (b) What is code 39? Explain with example. 08
- (c) Four machines used to produce a family parts are arranged into GT cell. The From-To data for the parts processes by the machines are shown in table below. 12
- Determine the most logical sequence of machines using Hollier Method-1.
 - Construct the flow diagram for the data.
 - Compute the percentage of in sequence moves and backtracking moves.

From:	To:			
	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 system. 12
- (b) Why is FAMS more appropriately used than FMS? Explain. 06

5. (c) A flexible machining system consists of two machining workstations and a load/unload station. Station-1 is the load/unload station. Station-2 performs milling operations and consists of two servers. Station-3 has one server that performs drilling. The stations are connected by a part handling system that has four work carriers. The mean transport time is 3.0 min. The FMS produces two parts A and B. The part mix fractions and process routings for the two parts are presented in the following table. The operation frequency $f_{ijk} = 1.0$ for all operations. Determine-

- i) Maximum production rate of the FMS
- ii) Corresponding production rate of each product
- iii) Utilization of each station

If we want to increase the utilization of station-1 to 100%, what will be the production rate?

Part j	Part Mix p_j	Operation k	Description	Station	Processing Time t_{ijk} (min)
A	0.4	1	Load	1	4
		2	Mill	2	30
		3	Drill	3	10
		4	Unload	1	2
B	0.6	1	Load	1	4
		2	Mill	2	40
		3	Drill	3	15
		4	Unload	1	2

6. (a) Differentiate between dedicated FMS and random order FMS. 07
- (b) Two models A and B, hourly production rates are: 4 units/hr for A and 6 units/hr for B. Most of the work elements are common to the two models, but in some cases the elements take longer for one model than for the other. The elements, times and precedence requirements are given in the following table. Also given $E=0.96$, repositioning time $T_r=0.15$ min and $M_i=1$. 15
- i) Construct the precedence diagram for each model and both models combined into one diagram.
 - ii) Use the Kilbridge and Wester method to solve the line balancing problem
 - iii) Determine the balance efficiency for the solution in (ii).

Table 6(b): Work elements for models A and B

Work element, K	T_{CAK} (min)	Preceded by	T_{CBK}	Preceded by
1	3	-	3	-
2	4	1	4	1
3	2	1	3	1
4	6	1	5	1
5	3	2	-	-
6	4	3	2	3
7	-	-	4	4
8	5	5,6	4	7

6. (c) A manual assembly line must be designed for a product with annual demand=100,000 units. The line will operate 50 wk/yr, 5 shifts/wk, and 7.5 hr/shift. Work units will be attached to continuously moving conveyor. Work content time=42.0 min. Assume line efficiency $E=0.97$, balancing efficiency $E_b=0.92$ and repositioning time $T_r=6$ sec. Determine:
- Hourly production rate to meet demand
 - Number of workers required.
7. (a) How Geneva mechanism works for a rotary indexing table? Explain. 10
- (b) A 20 station transfer line has an ideal cycle time $T_C=1.2$ min. The probability of station breakdowns per cycle is equal for all stations, and $P=0.005$ breakdowns/cycle. For each of the upper-bound and lower-bound approach, determine:
- Frequency of the line stops per cycle
 - Average actual production rate
 - Line efficiency
- (c) Briefly describe the parts delivery at workstation for an automated assembly systems. 12
8. (a) What is process planning? Discuss the retrieval process of CAPP. 13
- (b) Differentiate between lean and agile manufacturing. 07
- (c) How do you reorganize your production system into agility? 15

Table (b): Work elements for models A and B

Work element, K	T_{CAK} (min)	Preceded by	Preceded by
1	3	-	3
2	4	1	4
3	2	1	3
4	6	1	2
5	3	2	-
6	4	3	2
7	-	-	4
8	2	2,6	4

Khulna University of Engineering & Technology
Department of Industrial Engineering and Management
B.Sc. Engineering 4th Year 2nd Term Examination, 2018
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. Briefly describe the main features of project. Also, 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) What is project management? Write down the advantages of using formal project management. 10
- (d) Who are stakeholders of a project? Draw project management framework. 10
2. (a) What are the four main components of project management life cycle? Mention 12 steps that we should follow in project initiation phase. 15
- (b) What is gold rule of project management? How can you determine goals of a project, explain? 10
- (c) Why is participatory management beneficial to project planning? How does the process of participatory management actually work in planning? 10
3. (a) Draw a quality planning flowchart. 08
- (b) Write down the tools and techniques to assure quality of a project. 10
- (c) Briefly explain the outputs for quality control of a project. 10
- (d) What is linear responsibility chart and how is it useful to project manager? 07
4. (a) What data are collected to monitor a project? 07
- (b) What are the information you should include in your project progress report? 10
- (c) Explain indexes to monitor progress of a project with its interpretation. 10
- (d) Describe how a project monitoring system can be designed. 08

SECTION-B

5. (a) Write down the fundamental differences between CPM and PERT technique. 10
What is dummy activity and why it is used?

(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 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 consists 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). 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) What is meant by project monitoring? How can be a project monitored by using earned value analysis? Explain. 10

(b) Define crash time. Find 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	1 st week 60 and 2 nd 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

(c) How resource leveling does differ from resource allocation? 05

7. (a) 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
- (b) Obtain a schedule which will minimize the peak manpower requirement and smooth out period to period variation of manpower requirement. 15

Activity	Duration (weeks)	Manpower Requirement
1-2	5	8
1-3	4	10
1-4	6	8
2-4	10	10
2-5	4	7
3-5	4	4
4-5	8	12
5-6	9	6

- (c) Differentiate between Go/No-go control and Post control. 05
- (d) Explain why win-win negotiation is so important in project management. 05
8. (a) Define critical ratio in terms of project controlling. Describe project controlling procedure by using critical ratio method. 10
- (b) 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				Slack time (weeks)	Critical Task	Staff needed
			(weeks)						
A	4	---	0	3	3	6	3	N	2
B	3	---	0	4	0	4	0	Y	4
C	5	A	3	8	6	11	3	N	1
D	7	B	4	11	4	11	0	Y	3
E	2	B	4	6	8	10	4	N	1
F	4	E	6	10	10	14	4	N	2
G	3	C, D	11	14	11	14	0	Y	5

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

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

B.Sc. Engineering 4th Year 2nd Term Examination, 2018

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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iii) Assume reasonable data if missing any.

SECTION-A

- 1 (a) Define Ergonomics and Human Factors Engineering. What is the basic difference between them? 08
- (b) Enlist the ergonomic factors. Show the relationship between man-machine systems in figure and elaborate it. 12
- (c) Define anthropometry and percentiles. What anthropometric dimensions are required to design an ergonomic chair? 15
- 2 (a) What is meant by Office Ergonomics? Discuss the key elements of office ergonomics. 10
- (b) Write down the equations of mismatch analysis in designing furniture. 05
- (c) What are the attributes of an ergonomically designed chair? 10
- (d) Define MSDs. What are the sign and symptoms of MSDs in respect of incompatible workstation setup? 10
- 3 (a) Define computer workstation. How to design an ergonomic computer workstation without perceived any MSDs by the users? 15
- (b) What are the appropriate sitting postures? Write down the bad effects of awkward postures. 10
- (c) Discuss the ergonomic criteria of hand tools design with repetitive tasks. 10
- 4 (a) Define biomechanics. What are the key elements of biomechanics? 08
- (b) What is lifting index? What are the applications and limitations of NIOSH lifting equation? 12
- (c) Write down the ergonomic guidelines of manual lifting. 15

SECTION-B

- 5 (a) Define "Risk", "Injury" and "Hazard". Differentiate between risk, injury and hazard with clear examples. 10
- (b) What are the reasons of preventing accidents? Clearly list the uninsured costs hidden in accident cost. 12
- (c) Define "Safety" and "Safety Management System (SMS)". Discuss the main components of SMS. Also write down the relationships among safety performance indicators, safety performance targets, and safety requirements. 13
- 6 (a) Define "Safety Risk Management". Briefly discuss the types of fire and related fire extinguishers useful and effective in risk management plan. 11
- (b) Briefly explain safety assurance and safety promotion with proper illustration. 12
- (c) Define industrial injury. Discuss any two types of work related injuries with causes and compensation. 12
- 7 (a) What is "Risk Identification"? List the common methods of risk identification. Briefly discuss the Taxonomy based risk identification method. 13
- (b) Explain "Risk Matrix" for determining the severity of the indentified risks with necessary examples. 10
- (c) How can you develop a response for risks? Explain how risk response process control is designed? 12
- 8 (a) Write down the theories of accident and briefly discuss any one of them. 15
- (b) Discuss the necessity of safety training. Clearly enlist OSHA's training guidelines. 10
- (c) Differentiate between accident and incident. Write down the steps involved in investigating an accident. 10

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

B.Sc. Engineering 4th Year 2nd Term Examination, 2018

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) What is the meaning of word "Tooling" as viewed by the professional tool designer? 10
(b) What is meant by degrees of freedom? Explain how nine degrees of freedom can be restricted by 3-2-1 principle of pin location? 13
(c) Explain with figure how shortcoming of a V-locator can be overcome. 12
2. (a) What is the difference between the tool maker and the tool designer? 10
(b) Describe the arrangement of latch clamp with necessary figures. 13
(c) For what purpose split collet chuck is used explain with figure. 12
3. (a) What are the differences between jig and fixture? Explain with figures and also give examples. 11
(b) Figure 3(b) shows a symmetrical cup workpiece with a shell height of 2 in. and a shell diameter of 2 in. The corner radius is $\frac{1}{16}$ in. The workpiece material is 1020 cold-rolled steel 0.032 in. thick. Make the necessary calculations for designing the die these drawing operations. 24

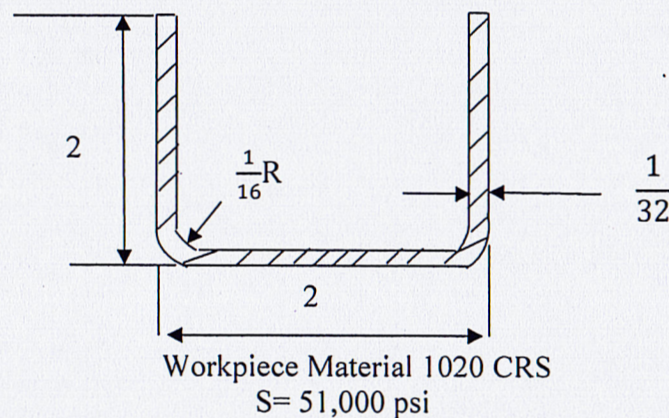


Figure 3(b)

- i) Determine percentage reduction
- ii) Determine radius on punch and die
- iii) Determine die clearance
- iv) Determine drawing pressure.

4. (a) How are the milling fixtures classified? Why must the clamp on milling fixture be extremely rigid? 12
 (b) Sketch the different vice fixture with their application. 13
 (c) Discuss the different types of faceplate fixture. Write down the basic principles for designing the lathe fixture. 10

SECTION-B

5. (a) What is meant by locating? What is the major factor that determines how a workpiece will be located? 10
 (b) What is meant by complete location? Why locating points should be placed as far as possible? 10
 (c) Describe in brief with sketch 15
 i) Quick-acting screw clamp
 ii) Quick-acting knob
6. (a) What is die clearance? What are the effects of insufficient and excessive die clearance? 10
 (b) What are the methods of preventing spring back in bending operation? Explain any one method with necessary figures. 13
 (c) What are the methods of reducing cutting forces? Explain with figure. 12
7. (a) Describe in brief with necessary sketch 15
 i) Type S slip renewable bushing
 ii) Type F fixed renewable bushing
 (b) Why should a drill jig stand on four legs rather than three? 05
 (c) How are broaching fixtures classified? What precautions should be taken when designing external broaching fixtures? 10
 (d) How is a faceplate fixture located on the lathe faceplate? 05
8. (a) Write down the basic principle of horizontal and vertical boring operations. 10
 (b) What is vise fixture? Describe in brief about various methods of production milling with necessary sketch. 15
 (c) Explain why it is important not stop once a drawing operation is started. 10

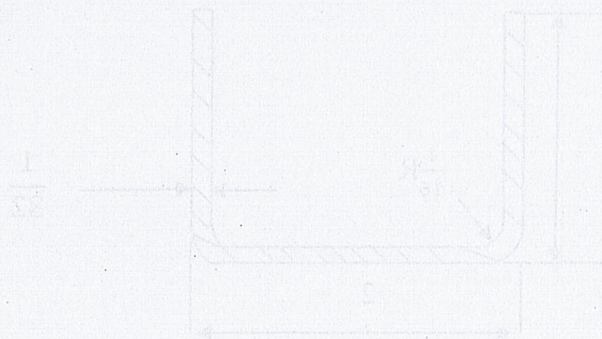


Figure 2(b)

- (i) Determine percentage reduction
- (ii) Determine radius on punch and die
- (iii) Determine die clearance
- (iv) Determine drawing pressure

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

B.Sc. Engineering 4th Year 2nd Term Examination, 2018

IPE 4227
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) How can CAM boost the production process in Bangladesh? Explain. 10
(b) Define part programming. Explain numerical control with two examples. 12
(c) Describe the basic components of an NC system. 13
2. (a) Clarify floating zero, and absolute programming with sketches. 11
(b) How does NC provide greater manufacturing flexibility, and reduced floor space? 12
(c) What are the basic types of motion control systems in NC machines? Describe them with necessary figures. 12
3. (a) Define CAPP and route sheet. Mention the benefit of the generative process planning system. 10
(b) Explain circular interpolation and canned cycle with figures. 12
(c) A profile milling operation is to be performed on a machining center equipped with APT standard controller to generate the outline of the part shown in the following figure. All dimensions are in inch in the figure. 13

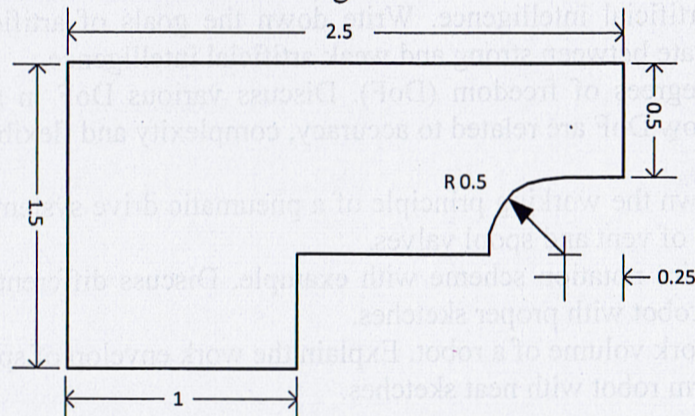


Figure 3(c)

The part is $\frac{1}{2}$ inch thick. Assume that the part has been cut to rough size with a band saw which has left about $\frac{1}{6}$ inch of material to be cut in final profile pass. Write a program to perform the profile milling around the periphery of the part.

4. (a) Describe the sources of variation in machining. 10
 (b) Draw a parallel path left to path ABCDE. Offset = 0.2 unit. 12

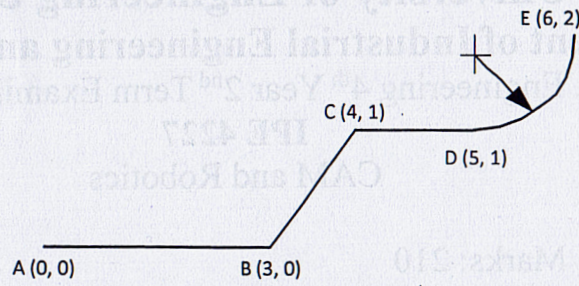


Figure 4(b)

- (c) Visit the periphery to smoothen using manual part programming. Thickness is 10 mm. All the units are in mm. Assume reasonable data. 13

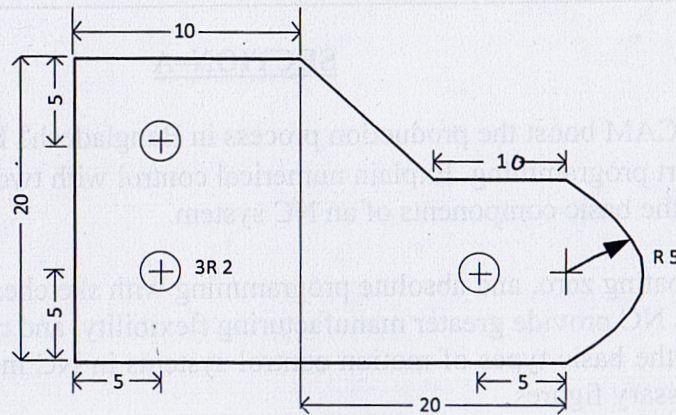


Figure 4(c)

SECTION-B

5. (a) Define the term "Robot". Write down the laws of robotics. Also mention some specific applications of robot in different industrial sectors. 13
 (b) Define artificial intelligence. Write down the goals of artificial intelligence. Also differentiate between strong and weak artificial intelligence. 12
 (c) Define degrees of freedom (DoF). Discuss various DoF in a robotic system with figure. How DoF are related to accuracy, complexity and flexibility. 10
6. (a) Write down the working principle of a pneumatic drive system. Also write down the functions of vent and spool valves. 15
 (b) Define joint notation scheme with example. Discuss different types of manipulator joints of robot with proper sketches. 10
 (c) Define work volume of a robot. Explain the work envelop of spherical robot and jointed arm robot with neat sketches. 10
7. (a) How do sensors sense proximity and temperature? Explain. Also write down some certain features which have to be considered when choose a sensor. 10
 (b) How could you design a control process? Design open loop and closed loop control system for the speed of a rotating element. 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. 10
 (d) Define interlock on the basis of robotics. Also write down the error recovery strategies for a robotic system. 05

8. (a) Define cycle time of a robot. Discuss work cycle elements of a robot. 08
 (b) With the help of neat sketch, discuss Denavit-Hartenberg parameters. Find the values of θ_2 and θ_1 in figure 8(b). 12

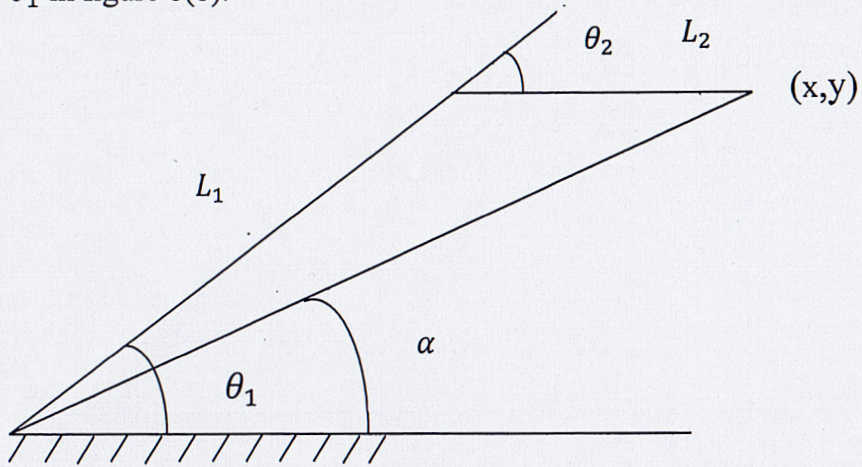


Figure 8(b)

- (c) What is meant by robot kinematics? 05
 (d) A frame $\{B\}$ is located initially coincident with a frame $\{A\}$. We rotate $\{B\}$ about \hat{Z}_B by 30 degrees and then we rotate the resulting frame about \hat{X}_B by ϕ degrees. Give the rotation matrix that will change the descriptions of vectors from ${}^B P$ to ${}^A P$. 10