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**BE1401: Business Operations & Processes**  
**EXERCISES – Project Management**

**Question 1**

An airborne warning and control system is being built as part of a large defence project. The project comprises two main sub-systems (a) detection sub-system and (b) guidance sub-system. In implementing the project, the following precedence relationships must be adhered to:

1. Calibration of machines precedes production, independently for each sub-system i.e.,
  - a. Calibration of machine 1 must be done prior to production of detection sub-system.
  - a. Calibration of machine 2 must be done prior to production of guidance sub-system.
1. Testing of detection sub-system can only be done after production of detection sub-system and testing of electronic controls.
2. Testing of guidance sub-system can only be done after production of guidance sub-system and testing of electronics controls.
1. Projectile testing required for guidance sub-system can be started immediately after calibration of machine 2 is completed.
1. Assembly of detection and guidance sub-systems as well as ground control co-ordination can be started only after the testing of both sub-systems has been completed.
1. Preparation of final test gear involves several complex assemblies and can be initiated at the beginning of the project. However it must be completed before final testing can start.
1. Final testing requires the completion of assembly of detection and guidance sub-systems, ground control co-ordination, and projectile testing.

The time required to complete the various tasks of the project are given in the table below:

Task	Description	Activity Time (weeks)
A	Calibrate machine 1 - for detection subsystem	3
B	Calibrate machine 2 - for guidance subsystem	2
C	Production of detection subsystem	5
D	Test electronics controls	4
E	Production of guidance subsystem	6
F	Test detection sub-system	1
G	Test guidance sub-system	5
H	Assembly of detection and guidance sub-systems	3
I	Ground control co-ordination	4
J	Prepare Final Test Gear	10
K	Projectile Testing	5
L	Final Testing	4

**TABLE 1: Tasks and Activity Times**

**Required**

- a. Identify the immediate predecessor activities for each task in Table 1 and develop a project network.
- b. Determine the earliest and latest start and finish times for each activity. Identify the critical activities which if delayed will delay the overall completion time of the project.
- c. Which activities should be definitely completed by week 15 if the project completion is not to be delayed.

**Question 2**

Roberto Giovanni is a participant of the MBA(Accountancy) programme at NTU. He has invited some of his fellow MBA participants for an Italian Dinner at his flat. He plans to serve Lasagne as the main course for the dinner. Since Roberto had a tough day at school, he could return back home only at 5.00 PM. His friends are expected only at 7.30

PM. However, he has to finish preparing the dinner by 7.00, since he needs sufficient time to freshen-up before the guests arrive.

The activities, their time (in minutes) and the precedence relationship for preparing the dinner are given below:

Activity Code	Activity Description	Activity Time (in minutes)	Immediate Predecessors
A	Buy drinks, dessert and ingredients for Lasagne.	60	
B	Prepare the ingredients for lasagne and sauce.	15	A
C	Cook the sauce	30	B
D	Boil the lasagne noodles	30	A
E	Drain the noodles	5	D
F	Assemble all the ingredients	15	C, E, A
G	Preheat the oven	15	A
H	Bake the Lasagne	30	F, G

### Required

- Draw the project network corresponding to Roberto's task of preparing the lasagne dinner.
- Solve the network and calculate the earliest time by which Roberto would finish preparing the dinner. Also identify the activities in which Roberto cannot afford to have any delay.
- Does the solution obtained in part (b) satisfy Roberto's objective of having the dinner ready by 7.00 PM? What should Roberto do to ensure that the dinner is ready and he is freshened up, before the guests arrive?

### Question 3

The Aswan Software Company has been contracted by Shana-Cuna Bank to develop "*Card-Track*" a software for tracking the spending pattern of credit-card holders. The Bank wants this software developed as quickly as possible. Aswan has identified the list of activities (and their precedence relationship) that are required to be performed for completing this software development project. The precedence relationships and time required for each activity are given in the table below.

Activity Code	Activity Description	Immediate Predecessor Activity	Minimum Time required (Weeks)	Maximum Time required (Weeks)
A	Basic design	--	2	6
B	Detailed design for I/O interface.	A	4	6
C	Coding for I/O interface.	B	6	12
D	Detail design for main code	A	10	16
E	Coding for module 1	D	6	10
F	Coding for module 2	D	8	16
G	Integrate system	C, E, F	2	4
H	Alpha-testing of software	G	4	6
I	Beta-testing of software	H	3	5
J	Documentation	G	4	8

The time required for completing each activity follows a **uniform distribution** between the minimum and maximum times given above (the expected time for the uniform distribution is given by the mean of Minimum and Maximum values).

Draw the network for this project. Based on the expected time for each activity, determine the critical path and the expected time required to complete the critical path.

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#### **Question 4**

Adrian Sim and Cecilia Tan, Computer consultants, are considering embarking on a joint project that will involve development of a relatively small commercial software package for personal computers. The program involves scientific calculations for a specialised portion of the engineering market. Sim and Tan have broken down the project into nine tasks.

The first task is to undertake a market survey in order to determine exactly what the potential clientele will require and what features of the software are likely to be the most attractive. Once this stage is completed, the actual development of the programs can begin. The programming requirements fall into two main categories: Graphics design and Code development. Since the system will be interactive and icon driven, the first task is to identify and design the icons. After the programmers have completed the icon designs, they can proceed with the second part of the graphics development namely design of the input/output screens. These include the various menus and report generators required in the system.

The code development mainly involves developing the source code for the modules which do the scientific calculations. The first step here is to develop a detailed flow chart of the system. After they complete the flow chart, the programmers can begin work on the modules. There are a total of four modules. Work on modules 1 and 2 can begin immediately after completion of the flow chart, Since module 3 requires parts of module 1, the work on module 3 cannot begin until module 1 is finished. The programming of module 4 cannot start until both modules 2 and 3 are completed. Once the graphics portion of the project and the modules are completed, the two separate phases of the system must be merged and the entire system tested and debugged.

Sim and Tan have obtained funding for the project but this source requires that the entire project be completed in 24 weeks. In order to determine whether this is feasible, the two programmers have divided the project into nine indivisible tasks and estimated the time required for each task. The list of these tasks, the times required, and the precedence relationships are given below:

<b>Task</b>	<b>Time Required (in weeks)</b>	<b>Immediate Predecessors</b>
<b>A:</b> Perform market survey	3	-
<b>B:</b> Design graphic icons	4	A
<b>C:</b> Develop flow charts	2	A
<b>D:</b> Design input/output screens	6	B, C
<b>E:</b> Module 1 coding	5	C
<b>F:</b> Module 2 coding	3	C
<b>G:</b> Module 3 coding	7	E
<b>H:</b> Module 4 coding	5	F,G
<b>I:</b> Merge modules and graphics and test program	7	D,H

#### **Required**

Draw the project network incorporating the precedence relationships for different activities, and determine whether the project can be completed in 24 weeks. Also determine the critical activities.