UNIVERSITY OF LONDON

B.Sc., B.Eng. and M.Eng. Examination 2002

Parts III and IV

For internal students of Imperial College of Science, Technology and Medicine.

This paper also forms part of the examination for the Associateship.

PROJECT MANAGEMENT

For Chemical Engineering, Mechanical Engineering, Electrical and Electronic Engineering, Information Systems Engineering and Aeronautical Engineering Students.

Wednesday 1 May 2002, 14:30 - 16:30

Closed Book

ANSWER **QUESTION 1** (40%) AND
ANY **TWO** OTHER QUESTIONS (30% EACH)

If more than three questions are answered only question one and the first two other questions answered will be marked

Marks will be deducted in this examination if there is insufficient written explanation

Question 1 (40%)

I. Define a "project".

List the main project characteristics and briefly describe the important features of each.

How does a project differ from an ongoing manufacturing or service operation?

Define "project success". (16 marks)

II. The following table shows the breakdown of a project into activities, precedence constraints and time estimates (given in weeks) for each activity.

Activity	Immediate Predecessor(s)	Optimistic time (weeks)	Most likely time (weeks)	Pessimistic time (weeks)
A	-	2	7	12
B	-	10	15	20
C	A	1	6	11
D	B	6	8	10
E	A	7	12	17
F	C, D	5	5	5
G	C, D	7	7	7
H	B	3	4	5
I	E, F	6	10	14
J	H, G	8	11	14

(a) Draw an **activity-on-node** network to represent the project. (8 marks)

(b) Calculate the expected earliest start and latest start times for each activity and hence the expected total float for each activity.
Determine the expected project completion time and identify the critical path(s).
Which activities should be monitored most closely ? (8 marks)

(c) By making use of the tables (Normal curve) provided calculate the probability that:
(1) the project will take more than 45 weeks;
(2) the project will be completed within 36 weeks or less. (4 marks)

(d) What effect will each of the following changes (when considered separately) have on the completion time of the following project? Give reasons for your answer.
(1) Activity G is delayed by 3 weeks.
(2) Activity F is completed in 10 weeks. (4 marks)

Note:

The mean duration (t_e) and standard deviation (σ_t) of an activity are given as follows:

$$t_e = (a+4m+b)/6$$
$$\sigma_t = (b-a)/6$$

a: optimistic time, b: pessimistic time, m: most likely time

Question 2 (30%)

A cost reimbursable type, design and construct, contract has been let to company A to work as a subcontractor for a project, related to a Space Programme, which involves the construction of a section of a launching platform. A team of engineers has determined the activities, precedence constraints and time estimates as given in the table below.

Activity	Immediate Predecessor(s)	Normal Duration (months)	Increased costs to reduce each activity by:		
			1st month £x10^3	2nd month £x10^3	3rd month £x10^3
A	-	3	50	-	-
B	-	6	60	60	-
C	-	2	25	-	-
D	C	2	80	90	100
E	A	4	90	110	160
F	A	7	40	70	150
G	B, D, E	4	70	100	190
H	F, G	2	-	-	-

You are required to:

(a) Draw either an **activity-on-arrow** or an **activity-on-node** network to represent the above project. Using normal durations calculate the minimum project completion time and identify the critical path(s). (8 marks)

(b) Currently, company A is offered a bonus of £150000 for each month it reduces the project time. On a month-to-month basis, determine which activities should be expedited and by what amount they should be expedited so that the net bonus minus expediting costs will be maximised. How much net bonus will be earned? (12 marks)

(c) What are the strengths and weaknesses of the contracting strategy adopted for this project? What alternative contracts are available and what would be their strengths and weaknesses if adopted? (10 marks)

Question 3 (30%)

Consider the following projects:

(i) The design and development of a new military aircraft.
(ii) The design and construction of a nuclear repository in Greenland for nuclear waste from nuclear warheads.
(iii) The construction of an automobile facility in China.
(iv) The development and implementation of a computerised scheduling system for a hospital's operating rooms.

Choose one of the above projects. With reference to the project that you have selected, you are asked to:

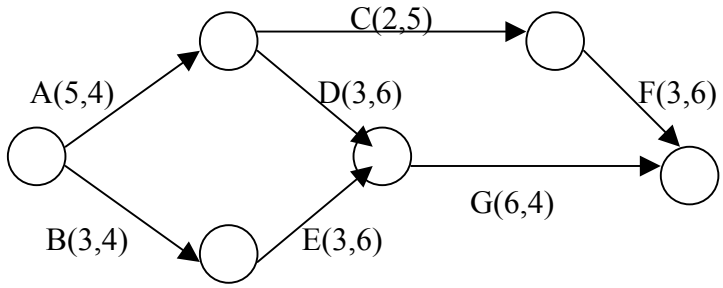
(a) Consider that you are developing a Sponsor's proposal, known as the Sponsor's Requirements Definition (SRD). Indicate the major sections and the type of information that you would include in your proposal. (10 marks)

(b) Discuss what you believe should be some of the important criteria for the selection of a Project Manager. Explain his role and briefly describe his basic responsibilities. (10 marks)

(c) Briefly describe a general model for identifying the principal *stakeholders* for the above project. (10 marks)

Question 4 (30%)

The following **activity-on-arrow** network shows the breakdown of a project. The activities are identified by a letter and the two numbers within brackets, associated with each activity, represent the duration (given in weeks) and the personnel required to complete each activity.



(a) Determine the critical path(s) and the duration for the above project. Calculate the total float for each activity. (4 marks)

(b) Calculate and chart the labour profile required to complete the project assuming that all activities begin as early as possible.
What is the average weekly requirement for labour? (5 marks)

(c) The personnel manager wishes to assign ten people full-time for the duration of the project. Using the base of ten people, identify the standby (or idle) time and the overtime periods. Determine the overtime and standby costs assuming that each employee is paid £200 per week and overtime is paid at time and a half. During standby time the employee draws his full salary. (5 marks)

(d) Using the labour profile specified in part (b), level the required labour as much as possible with the goal of completing the project within the time period specified in part (a) and minimising the standby and overtime costs. What are the standby and overtime costs associated with the new schedule? (10 marks)

(e) Briefly explain why time and cost estimate accuracy depends on the technical definition of an engineering project. What are the key benefits of good cost control? (6 marks)

N(0.1) values

	0.00	*0.01*	*0.02*	*0.03*	*0.04*	*0.05*	*0.06*	*0.07*	*0.08*	*0.09*
0.0	0.500	0.504	0.508	0.512	0.516	0.520	0.524	0.528	0.532	0.536
0.1	0.540	0.544	0.548	0.552	0.556	0.560	0.564	0.567	0.571	0.575
0.2	0.579	0.583	0.587	0.591	0.595	0.599	0.603	0.606	0.610	0.614
0.3	0.618	0.622	0.626	0.629	0.633	0.637	0.641	0.644	0.648	0.652
0.4	0.655	0.659	0.663	0.666	0.670	0.674	0.677	0.681	0.684	0.688
0.5	0.691	0.695	0.698	0.702	0.705	0.709	0.712	0.716	0.719	0.722
0.6	0.726	0.729	0.732	0.736	0.739	0.742	0.745	0.749	0.752	0.755
0.7	0.758	0.761	0.764	0.767	0.770	0.773	0.776	0.779	0.782	0.785
0.8	0.788	0.791	0.794	0.797	0.800	0.802	0.805	0.808	0.811	0.813
0.9	0.816	0.819	0.821	0.824	0.826	0.829	0.831	0.834	0.836	0.839
1.0	0.841	0.844	0.846	0.848	0.851	0.853	0.855	0.858	0.860	0.862
1.1	0.864	0.867	0.869	0.871	0.873	0.875	0.877	0.879	0.881	0.883
1.2	0.885	0.887	0.889	0.891	0.893	0.894	0.896	0.898	0.900	0.901
1.3	0.903	0.905	0.907	0.908	0.910	0.911	0.913	0.915	0.916	0.918
1.4	0.919	0.921	0.922	0.924	0.925	0.926	0.928	0.929	0.931	0.932
1.5	0.933	0.934	0.936	0.937	0.938	0.939	0.941	0.942	0.943	0.944
1.6	0.945	0.946	0.947	0.948	0.949	0.951	0.952	0.953	0.954	0.954
1.7	0.955	0.956	0.957	0.958	0.959	0.960	0.961	0.962	0.962	0.963
1.8	0.964	0.965	0.966	0.966	0.967	0.968	0.969	0.969	0.970	0.971
1.9	0.971	0.972	0.973	0.973	0.974	0.974	0.975	0.976	0.976	0.977
2.0	0.977	0.978	0.978	0.979	0.979	0.980	0.980	0.981	0.981	0.982
2.1	0.982	0.983	0.983	0.983	0.984	0.984	0.985	0.985	0.985	0.986
2.2	0.986	0.986	0.987	0.987	0.987	0.988	0.988	0.988	0.989	0.989
2.3	0.989	0.990	0.990	0.990	0.990	0.991	0.991	0.991	0.991	0.992
2.4	0.992	0.992	0.992	0.992	0.993	0.993	0.993	0.993	0.993	0.994
2.5	0.994	0.994	0.994	0.994	0.994	0.995	0.995	0.995	0.995	0.995
2.6	0.995	0.995	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996
2.7	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
2.8	0.997	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998
2.9	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.999	0.999	0.999
3.0	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999
3.1	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999
3.2	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999
3.3	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
3.4	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
3.5	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000