Instructions:

ANSWER ANY FIVE (5) QUESTIONS (All questions carry equal marks)

Q1. *"All shipbuilders plan how they will design and build their ships."* In this context, explain the *"top-down* build strategy approach"* as a modern planning tool. Why is a Build Strategy Document based on Group Technology important for shipbuilding? What are the objectives of build strategy?

Q2. Many thousands of years ago a certain official had the problem of organising the construction of a royal barge for the Egyptian Queen Nefertiti. The construction had to be finished before Midsummers Day when the barge launching ceremony was scheduled to take place. As the time scale was tight the official was attempting to plan this project. For initial *heavy* work which needed to be completed in 12 weeks he was able to identify nine sub tasks A to I. He also recognised the following logical sequence between sub tasks. Tasks A, B and C could start immediately. The completion of tasks I and F complete the heavy work.

task	D	E	F	G	H	I
must be preceded by	A,B	B	C	E,C	G	D,H

The duration of the sub tasks naturally depended upon the number of men allocated to them. Only unskilled labour is required. In his view a team of ten on each task would be most efficient and the durations would then be as follows:

task	A	B	C	D	E	F	G	H	I
duration (weeks)	1	2	7	1	3	2	1	3	4

If he allocated more men, then the durations of each task could be reduced further but there would be a tendency for efficiency to drop due to the men getting in each other's way. For instance he estimates that if allocated 20 men to each task the durations would be as shown below :

task	A	B	C	D	E	F	G	H	I
duration (weeks)	$\frac{3}{4}$	$1\frac{1}{2}$	4	$\frac{3}{4}$	2	$1\frac{1}{4}$	$\frac{2}{3}$	2	$2\frac{1}{2}$

The same team of men which starts a task must also work through to its completion. Following normal practice all men working on the Royal Barge's construction are killed as a sacrifice to the Sun God at the launching ceremony. The official is humane man and wishes to employ the minimum number of men needed to complete the project in 12 weeks.

Solve the official's problem, stating any assumptions which you make.

Q3. Explain through a flow diagram the heuristic method for resource limited scheduling. The construction of the bulbous bow panel involves the fitting and welding of 9 sub-assemblies (numbered from A to I). The time taken (in days) for erecting these sub-assemblies and their dependencies are shown below. Draw a network and find the critical path and the earliest time by which the bulbous bow panel can be completed. Each sub-assembly requires a group of 4 men (welders and fitters) to work on them for the required number of days. The foreman has only **two** such groups at his disposal. Solve the foreman's using resource limited heuristic scheduling. The final schedule should be shown in the form of a bar chart along with the daily resource loading.

sub-assembly	A	B	C	D	E	F	G	H	I
must be preceded by	-	-	-	A,B	B	C	E,C	G	D,H
time taken in days	1	2	7	1	3	2	1	3	4

Q4. A marine company supplying a certain outfit item to a shipyard is planning its production for the next 4 weeks. The production cost of the item is $10 for the first two weeks, and $15 for the last 2 weeks. The weekly demands are 300, 700, 900, and 800 which must be met. The plant can produce a maximum of 700 units each week. In addition the company can employ overtime during the second and third week. This increases the weekly production by an additional 200 unit, but the production cost increases by $5 per item. Excess production can be stored at a unit cost of $3 per week. Assuming that the company starts the 4 week period without any stock and does not want to have stock on hand at the end of the fourth week, formulate a model for this production planning problem, and derive the production schedule so as to minimise the total costs. *(Hint : Consider the production periods as "warehouses" and weekly demands as "destinations". As overtime production is possible in second and third weeks, there are in all six "warehouses").*

Q5. Highlight the differences in information generated from ship design and information needed for ship production. How does a modern day loft bridge this gap? In this context, explain at least four important functions of modern of a modern day computer aided loft.

Q6. What is the role of a Product Life-cycle Management (PLM) System for the shipbuilding industry? Define the Bill of Material (BOM) management system which is at the heart of PLM system for shipbuilding. What are the elements of Design/Engineering BOM (E-BOM) and Manufacturing BOM (M-BOM)? Explain them using block diagram and hierarchical structure and highlight their relevance at the design and manufacturing stages of ships.

**********This paper consists of two pages only***********