

ITMMEC – IIT DELHI
MAJOR TEST- MAINTENANCE PLANNING & CONTROL (ITL 709)

Date: 1-12-2006 (Friday)

Max. Marks: 35

Time : 2 Hours

Note: 1. Attempt all questions

2. Missing data, if any, may be assumed.

- QI. A major maintenance work for a group of machines in a process plant consists of activities A to K, with the details given in the Table 1 below. Develop its network diagram and find the critical path. Also find the earliest and latest occurrence time of all activities of the critical path.

Table 1

Activity	A	B	C	D	E	F	G	H	I	J	K
Predecessor Activities	D	A	B	--	D	E	C, H	E	G	I, F	I, F
Duration in days	4	3	2	5	6	2	3	4	5	8	2

(5)

- QII. A computer manufacturing company has a number of fire fighting appliances distributed throughout the plant. This equipment is essential to control the spread of fire, if any and at the earliest. Preventive Maintenance (PM) of this equipment is carried out by an outside company, but is the responsibility of the site engineer to ensure that the maintenance is executed to a predetermined schedule and program, and the work is subsequently recorded. The type of appliances used together with the suggested maintenance schedules are given in Table 2.

Answer the following questions:

- Suggest an individual identification code to each appliance.
- Propose an outline of the PM system in diagrammatic form so that the required maintenance is carried out at the schedule time by the personnel of the outside party (POP) and the results are recorded for the site engineer's reference.
- Devise a format for 'Job Specification Card', a document issued to POP that lists the appliances and the services to be carried out on a particular day / week.

(1, 5, 3 = 9)

- QIII. Do as directed. Be brief and to the point.

- Mention typical human related errors in maintenance work due to poor skill
- Situations where Condition Based Maintenance not recommended
- Measures in order of priority to minimize downtime in the plant
- List maintenance effectiveness parameters to analyze the extent of planning
- Desirable features in a 'Work Order' maintenance module

(1, 2, 2, 4, 4 = 13)

- QIV. a) Refer Table 3 which shows the operating records for a group of machines in a machine tool unit. Classify these machines in groups A, B and C for choosing a maintenance strategy based on their criticality.

Table 3

Machine Number, i	1	2	3	4	5	6	7	8	9	10	11	12	13
Downtime Cost, C_i	120	34	56	12	9	28	41	76	45	135	180	12	29
Number of Failures, F_i	4	16	3	11	3	9	14	5	7	11	5	9	0

- A multi-national manufacturing company is operating a 3-shift production – 24 hrs / day to manufacture home appliances. Time due to change of tools, product, changing shift is 3 hrs/ day and is not accounted in the availability calculation. It is planned to have availability of 92 % during the year financial year 2006-2007 to meet the production target, with three close days on the National Holidays. During the first six-month (April to September), production downtime of 406 hours has resulted in 65 maintenance actions.
 - What is the targeted downtime for the on-going six-month period (October – March)?
 - What is the meantime to failure during the operating year, if expected maintenance actions are 90 in all?

(4, 4 = 8)

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Table 2.

6-monthly Maintenance Schedule	
1	Unwind all hose from the reel by taking the nozzle to an open window or other place where a short water discharge will cause no damage
2	Examine hose for bursts or undue wear; check that reel runs freely
3	Ensure that nozzle control is closed, then open reel valve
4	Examine reel and hose for water leaks and remedy as required
5	Open nozzle control, checking for free movement; ensure that water jet is satisfactory
6	Close reel valve, drain water from hose and close nozzle control
7	Rewind hose neatly, wipe over reel, grease as necessary and enter details of check on the maintenance tally
<i>Note.</i> It will normally be found desirable to employ two men on hose-reel maintenance.	
Suggested hose-reel maintenance	
6-monthly Maintenance Schedule	
1	Examine hose and discharge horn and replace any defective parts
2	Ensure that safety-pin and wire-locking is intact
3	Weigh extinguisher and compare with weight stamped on cylinder neck; If a loss of 5 per cent or more is apparent, return extinguisher to recharging depot
4	Wipe over external surface of unit and enter details of check on the maintenance tally
<i>Note.</i> Extinguishers recharging agents will subject all CO ₂ cylinders to a hydraulic pressure test of 23 000 kN/m ² (3360 p.s.i.) if they have not been so tested within the previous 5 years when presented for recharging. Cylinders are also heated to 150 °C, cleaned, descaled and thoroughly dried. The date of test is then stamped on the neck of the cylinder.	
Suggested maintenance for CO ₂ extinguishers	

Maintenance Schedule	
6-monthly	
1	Examine for leaks and check liquid level of contents
2	Test pump operation by giving one or two strokes; top up quantity lost during this test
3	Ensure that nozzle is clean
4	Wipe over external surface of unit and enter details of check on the maintenance tally
3-yearly	
1	Discharge extinguisher into a clean vessel
2	Lightly grease plunger rod
3	Recharge with original contents, topping up as necessary
4	Wipe over external surface of unit and enter details of check on maintenance tally
<i>Note.</i> Water must never be used for cleaning or flushing carbon-tetrachloride extinguishers, as severe corrosion will result.	
Suggested maintenance for carbon-tetrachloride extinguishers	

Maintenance Schedule	Soda-acid	Foam	Water	Dry Powder
6-monthly				
1 Unscrew and remove head	x	x	x	x
2 Examine and clean relief vent holes, nozzle, plunger and washers	x	x	x	x
3 Examine and clean snifter valve	x			
4 Withdraw acid bottle inner container or CO ₂ cartridge	x	x	x	x
5 Stir liquid in outer container with a clean stick	x	x		
6 Agitate powder to ensure it is free-running and has not caked down				x
7 Stir liquid in inner container using a different stick		x		
8 Mix 4 parts from outer container and 1 part from inner container to produce 5 to 8 times the volume of foam mixture; recharge if not satisfactory		x		
9 Ensure that CO ₂ cartridge seal is intact			x	x
10 Ensure that acid bottle is intact	x			
11 Lightly grease plunger and check for free movement	x		x	x
12 Lightly Vaseline threads on cap and screw on tightly	x	x	x	x
13 Wipe over external surface of unit and enter details on the maintenance tally	x	x	x	x
3-yearly Discharge extinguisher and re-charge to maker's instructions	x	x	x	x

Note. Each new extinguisher is subjected to a hydraulic pressure test of 2400 kN/m² (350 p.s.i.) for a period of 5 minutes before leaving the manufacturers. This test should be repeated every 5 years and inexpensive test gear can be purchased for this purpose. Any extinguishers found on any maintenance check to be internally corroded must be withdrawn from service.

Suggested maintenance schedules for commonly-used extinguishers.