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CLASS TEST 2019-2020

MECHANICAL ENGINEERING

Date of Test : 02/07/2019

ANSWER KEY ➤ Industrial Engineering

1.	(a)	7.	(c)	13.	(d)	19.	(b)	25.	(b)
2.	(c)	8.	(b)	14.	(b)	20.	(b)	26.	(a)
3.	(d)	9.	(b)	15.	(d)	21.	(b)	27.	(d)
4.	(d)	10.	(a)	16.	(b)	22.	(b)	28.	(d)
5.	(b)	11.	(a)	17.	(d)	23.	(b)	29.	(a)
6.	(d)	12.	(b)	18.	(c)	24.	(d)	30.	(b)

Detailed Explanations

2. (c)

$$\text{Assuming cycle time} = 10 \text{ minutes}$$
$$\Sigma t_i = 10 + 9 + 7 + 9 + 8 = 43$$
$$\text{Balance delay} = 1 - \frac{\Sigma t_i}{n \times t_c} = 1 - \frac{43}{5 \times 10} = 0.14 = 14\%$$

3. (d)

Since the supply and demand is not balanced. Hence the first step is to balance the problem.

4. (d)

$$\text{TF} = \text{LFT} - \text{EFT} = 58 - 40 = 18$$
$$\text{FF} = (\text{EFT} - \text{EST}) - t_{ij} = (40 - 21) - 19 = 0$$
$$\text{IF} = (\text{E}_j - \text{L}_i) - t_{ij} = (40 - 39) - 19 = -18$$

Now,
$$\text{FF} - \frac{\text{IF}}{\text{TF}} = 0 - \left(-\frac{18}{18}\right) = 1$$

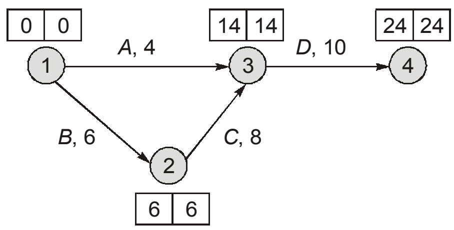
5. (b)

$$\lambda = 6/\text{hour}$$
$$\mu = 20/\text{hour}$$
$$\rho = \frac{\lambda}{\mu} = \frac{6}{20} = \frac{3}{10}$$

Average number of customer in the queue formed from time to time

$$= \frac{\rho^2}{1-\rho} = \frac{0.3^2}{1-3/10} = \frac{9}{70}$$

6. (d)



$$\text{Total float on activity } A = L_3 - (E_1 + a_{13}) = 14 - (0 + 4) = 10$$

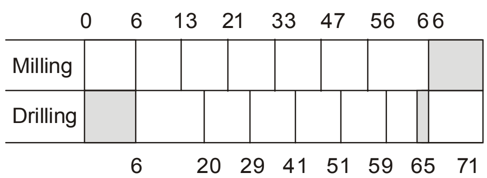
7. (c)

$$\text{Expected demand} = 60 \times 0.17 + 65 \times 0.12 + 70 \times 0.25 + 80 \times 0.26 + 90 \times 0.2 = 74.3$$

11. (a)

According to Johnson rule, the correct order will be

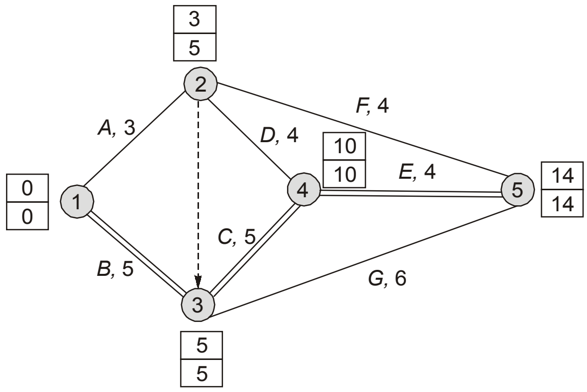
E - F - B - A - D - C - G



$$\text{Utilisation of milling M/C} = \frac{66}{71} \times 100 = 92.95\%$$

$$\text{Utilisation of drilling M/C} = \frac{64}{71} \times 100 = 90.14\%$$

12. (b)



Project duration = 14 days

Critical path = B - C - E

13. (d)

It is evident from the net evaluations of the optimum table that the net evaluation corresponding to non-basic variable y_1 is zero. This is an indication that an alternative basic solution exits. Thus we can bring y_1 into basis in place of y_3 or y_5. The resulting new basic feasible solution will also be an optimum one.

14. (b)

Maximum station time $(T_{s_i})_{max}$ = 10 minutes

Smoothness index (S.I.)

$$= \sqrt{\sum_{i=1}^{n}\left[\left(T_{s_i}\right)_{max} - T_{s_i}\right]^2} = \sqrt{(10-7)^2+(10-9)^2+(10-7)^2+(10-10)^2+(10-9)^2+(10-6)^2}$$

$$(S.I.) = 6$$

16. (b)

$$\begin{bmatrix} 12 & 10 & 10 & 8 \\ 14 & 12 & 15 & 11 \\ 6 & 10 & 16 & 4 \\ 8 & 10 & 9 & 7 \end{bmatrix} = \begin{bmatrix} 4 & 2 & 2 & 0 \\ 3 & 1 & 4 & 0 \\ 2 & 6 & 12 & 0 \\ 1 & 3 & 2 & 0 \end{bmatrix} = \begin{bmatrix} 3 & 1 & \boxed{0} & 0 \\ 2 & \boxed{0} & 2 & 0 \\ 1 & 5 & 10 & \boxed{0} \\ \boxed{0} & 2 & 0 & 0 \end{bmatrix}$$

Minimum time required = 10 + 12 + 4 + 8 = 34.

18. (c)

At first we convert it in equivalent two machine problem:

Job	$J_1 = M_1 + M_2$	$J_2 = M_2 + M_3$
A	18	14
B	8	10
C	10	9
D	9	8

Now apply Johnson's algorithm for 2 machine, we can easily find the sequence.

Johnson's Rule:

- If the minimum is on the $J_1(M_1 + M_2)$ machine process is first.
- If the minimum is on the $J_2(M_2 + M_3)$ machine process it last.

20. (b)

$$\text{BEP} = \frac{F}{s-v} = \frac{2000}{9-5} = 500 \text{ units}$$

$$\text{Margin of safety} = \frac{\text{sales} - \text{sales}_{\text{at BEP}}}{\text{sales}} \times 100 = \frac{750-500}{750} \times 100 = 33.3\%$$

21. (b)

Moving forecast for 11th year

$$\text{Sum of weights} = 1 + 2 + 3 + 1 + 1 = 8$$

$$\frac{97 \times 1 + 98 \times 2 + 87 \times 3 + 91 \times 1 + 68 \times 1}{8} = 89.125$$

Hence forecast for 11th year is ₹ 89.125 lakh.

22. (b)

Number of allocation to be done = $m + n - 1 = 6$

Total Number of possible allocation cell = 12

Number of possible solution = $12_{C_6} = 924$

Destination

Source				

23. (b)

Applying the operation on row and column, we get the matrix

[0]	7	5	7
10	17	[0]	7
23	[0]	~~0~~	9
~~0~~	~~0~~	7	[0]

The total minimum times = 10 + 5 + 20 + 20 = 55 hours

24. (d)

$$Q^* \propto \sqrt{\frac{D}{C_h}}$$

$$Q_1^* \propto \sqrt{\frac{4D}{2C_h}}$$

$$\Rightarrow \quad \frac{Q_1^*}{Q^*} = \sqrt{2}$$

$$\Rightarrow \quad Q_1^* = 100\sqrt{2}$$

25. (b)

$$Q_{max} = Q\left(\frac{p-d}{p}\right)$$

$$P = 1000/\text{month}$$

$$d = 500/\text{month}$$

$$Q = 1000$$

$$Q_{max} = 1000\left(\frac{1000-500}{1000}\right) = 500 \text{ units}$$

26. (a)

$$W_S = \frac{1}{\mu-\lambda} < \frac{20}{60} \text{ hour}$$

$$\lambda = 2/\text{hour}$$

$$\Rightarrow \quad \frac{1}{\mu-2} < \frac{1}{3}$$

$$\Rightarrow \quad \mu-2 > 3$$

$$\Rightarrow \quad \mu > 5 \text{ patients/hour}$$

$$\mu < 12 \text{ min/patient}$$

27. (d)

Waiting job (SPT seq)	Processing Time (Days)	Flow time (Days)	Due Date (Days)	Lateness of job (Days)
A	4	4	6	0
D	9	13	12	1
E	11	24	12	12
C	14	38	18	20
B	17	55	20	35

Mean lateness

$$= \frac{0+1+12+20+35}{5} = 13.6 \text{ days}$$

28. (d)

S.No.	Actual	Forecasted	D-F
1.	550	650	–100
2.	730	650	80
3.	850	650	200
4.	950	650	300

$$\text{MAD} = \frac{\sum_{i=1}^{4}|D_i - F_i|}{4} = \frac{+100+80+200+300}{4}$$

$$= 170$$

$$\text{BIAS} = \frac{\sum_{i=1}^{4}(D_i - F_i)}{4}$$

$$= \frac{-100+80+200+300}{4} = 120$$

29. (a)

For a given arrival rate, a discrete Poisson distribution is given by :

$$P(x) = \frac{e^{-\lambda}\lambda^x}{x!} \text{ for } x = 0, 1, 2, 3 \text{ ....}$$

where $P(x)$ = Probability of x arrival

x = Number of arrivals per unit time

λ = Average arrival rate

Here, $x = 3, \lambda = 5$

$$\therefore \quad P(3) = \frac{e^{-5}5^3}{3!}$$

30. (b)

$Z_A = 5 \times 0 + 4 \times 9 = 36$

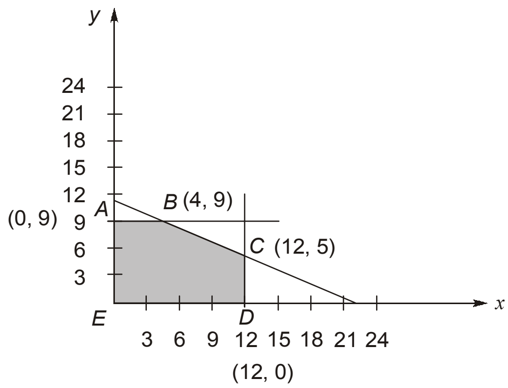
$Z_B = 5 \times 4 + 4 \times 9 = 56$

$Z_C = 5 \times 12 + 4 \times 5 = 80$ (Maximum value)

$Z_D = 5 \times 12 + 0 \times 5 = 60$

$Z_E = 0$

$\therefore$ Z maximum at (12, 5)



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