UPPSC AE 2019 ASSISTANT ENGINEER	MECHANICAL ENGINEERING	Test 3

Part Syllabus Test

Industrial Engineering + Mechatronics and Robotics

ANSWER KEY

1.	(c)	11.	(d)	21.	(d)	31.	(a)	41.	(c)
2.	(a)	12.	(a)	22.	(c)	32.	(b)	42.	(c)
3.	(b)	13.	(a)	23.	(a)	33.	(b)	43.	(b)
4.	(b)	14.	(b)	24.	(b)	34.	(c)	44.	(b)
5.	(c)	15.	(b)	25.	(d)	35.	(a)	45.	(a)
6.	(a)	16.	(d)	26.	(b)	36.	(b)	46.	(a)
7.	(b)	17.	(b)	27.	(a)	37.	(a)	47.	(a)
8.	(b)	18.	(a)	28.	(a)	38.	(d)	48.	(a)
9.	(a)	19.	(b)	29.	(d)	39.	(d)	49.	(b)
10.	(c)	20.	(a)	30.	(b)	40.	(b)	50.	(a)

DETAILED EXPLANATIONS

2.   (a)

Microprocessor typically consists of
1. Registers: Temporary storage location for performing instruction of data.
2. Arithematic logic unit (ALU): Performs arithematic and logical operation.
3. Timing and control unit: Its keeps all other parts of system (registor, ALU, memory and Input/output) working together in right time sequence.

4.   (b)

For linear sensor $\text{Sensitivity} = \dfrac{\text{Change in output signal}}{\text{Change in input signal}}$

$$2.2 = \frac{X}{0.38}$$

$\Rightarrow$ X = Deflection on the screen = 0.836 mm

5.   (c)

Dynamic characteristic means, the parameters which are varying with time.
1. Response time
2. Over shoot
3. Setting time
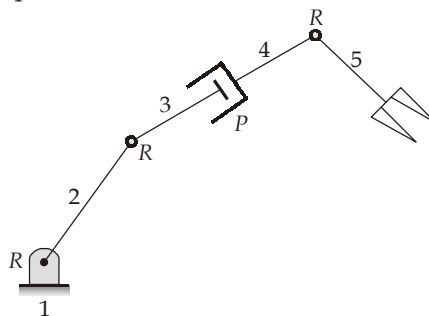4. Rise time

6.   (a)

Switching Algorithm is very complex in permanent magnet type stepper motor.

7.   (b)

$$\text{Work envelope volume} = \frac{\pi}{4}\left[d_o^2 - d_i^2\right] \times h = \pi\left[r_o^2 - r_i^2\right] \times h$$

$$= \pi\left[(3L)^2 - L^2\right] \times 2L = 16\pi L^3$$

8.   (b)

As shown below for serial manipulator

n = Number of link = 5

C_i = Connectivity of ith joint i = 1, 2, 3, ... m

$(3 - C_i)$ = Number of constraints by i^{th} joint

$$C_1 = 1, C_2 = 1, C_3 = 1, C_4 = 1$$

So, from Grubler's criterion for planar manipulator.

$$\text{DOF} = 3(n-1) - \sum_{i=1}^{i=m}(3-C_i)$$
$$= 3(5-1) - (3-C_1) - (3-C_2) - (3-C_3) - (3-C_4)$$
$$= 3 \times 4 - 2 - 2 - 2 - 2 = 12 - 8 = 4$$

9. (a)

Exteroceptive sensors gives the robot information about the surrounding environment allowing the robot to interact with the world through vision and sound.

10. (c)

Register Array:
- Registers are small storage devices that are available to CPU or processors.
- They act as temporary storage for processing of intermediate data by mathematical or logical operations.

14. (b)

$$\text{One scale divison} = \frac{50\,\text{mA}}{100} = 0.5\,\text{mA}$$

$$\text{Resolution} = \frac{1}{20}\text{ scale division} = \frac{1}{20} \times 0.5 = 0.025\,\text{mA}$$

17. (b)

$$\text{TIC }(Q_1) = \text{TIC }(Q_2)$$

Then,
$$\text{EOQ} = \sqrt{Q_1 \times Q_2} = \sqrt{(1000 \times 4000)} = 2000\text{ units}$$

19. (b)

Closed loop control system are having following characteristics.
1. A feedback is given to the control system.
2. Intelligent controlling action.
3. It may introduce possibility of undesirable system oscillation (hunting).
4. System output variation due to variation in parameters of the system is less.
5. Error detection is present.
6. Large bandwidth.
7. Less stable or prone to instability.
8. Not affected by non-linearities.
9. Less sensitive to disturbances.
10. Complex design
11. Colstly

20. **(a)**

A thermopile is a circuit in which many themocouples are connected in series or parallel to measure the temperature.

22. **(c)**

In pole changing control method the number of pole pair per phase in the stator winding is changed by switching the supply connections in the stator winding. This is achieved by changing in the interconnection of the winding segments and supply points to the stator winding.

26. **(b)**

Vacuum cups or suction cups, are often used as grippers in manual or automated handling applications. These are used for sheet metal pipes and glass windows.

28. **(a)**

$$\text{Hall voltage, } V_H = K_H \frac{BI}{t} = \left(\frac{1}{ne}\right)\left(\frac{BI}{t}\right)$$

$$= \left(\frac{1}{5 \times 10^{28} \times 1.6 \times 10^{-19}}\right)\left(\frac{1.6 \times 100}{0.2 \times 10^{-2}}\right)$$

$$V_H = \frac{160}{8 \times 10^7 \times 0.2} = 10^{-5} \text{ volt}$$

29. **(d)**

$$EOQ = \sqrt{\frac{2DC_0}{C_h}}$$

$$EOQ_2 = \sqrt{\frac{2 \times 2DC_0}{C_h}}$$

$$\therefore \qquad (EOQ)_2 = \sqrt{2}\ EOQ_1 = 1000\sqrt{2}$$

30. **(b)**

Large size of inventory is a sign of
- poor scheduling
- inefficient planning
- vendors are not well-coordinated

31. **(a)**

The expected time (t_e) of PERT activity in terms of optimistic time (t_o), pessimistic time (t_p) and most likely time (t_m) is given by,

$$t_e = \frac{t_o + 4t_m + t_p}{6}$$

33. **(b)**

Kanban is related to quality and this concept is used in just in time production *i.e.* zero inventory.

35. (a)

While solving a linear programming problem by simplex method, if all the ratios of the right hand side (b_i) to the coefficient in the key column (a_{ij}) become negative, it means problem is having unbounded solution.

36. (b)

In LPP, all parameters are assumed to be known and fixed hence they are not probabilistic. In LPP, decision variables should satisfy non-negativity condition and the number of decision variables and constraints need not be equal.

38. (d)

$$\text{Number of orders} = 12$$

$$Q^* = \frac{7200}{12} = 600$$

$$\text{Average inventory} = \frac{600}{2} = \textbf{300 units}$$

42. (c)

Continuous production system involves a continuous or almost continuous physical flow of materials. It makes use of special pupose machines and produces standarized items in large quantities.

43. (b)

Given:
$$t_o = 14$$
$$t_m = 20$$
$$t_p = 26$$

$$\text{Standard deviation, } \sigma = \frac{t_p - t_o}{6} = \frac{26 - 14}{6} = \textbf{2}$$

44. (b)

$$\text{Forecast for the 7}^{\text{th}}\text{ period} = \frac{42 + 40 + 44 + 38}{4} = 41$$

47. (a)

Primal	⇔	**Dual**
Maximize	⇒	Minimize
Coefficient of objective function	⇒	Constraints
Constraints	⇒	Coefficient of objective function

48. (a)

At break even point,
$$SP = FP + VC$$
$$40 \times x = 1000 + 20x$$
$$\Rightarrow \qquad x = 50 \text{ units}$$

49. (b)

The raw material of particular specification are stored in the inventory for particular products. If the design of the products changes then some of the inventory may become obsolete and useless. Getting the inventory cleared of those obsolete items, is purification of the inventory.

50. (a)

Kendall's Notation

a/b/c : d/e/f

a : Probability distribution of arrival.

b : Probability distribution of service.

c : Number of servers.

d : Service discipline (FCFS, FCLS).

e : System size.

f : Calling source population.

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