इन्जीनियरिंग सेवा परीक्षा, 2029
Engineering Service Examination.

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

T.B.C. : O–FTF–J–NFB

Test Booklet Series

A

Serial No. 30581

TEST BOOKLET

MECHANICAL ENGINEERING

Paper—II

Time Allowed : Two Hours

Maximum Marks : 200

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. ENCODE CLEARLY THE TEST BOOKLET SERIES **A, B, C** OR **D** AS THE CASE MAY BE IN THE APPROPRIATE PLACE IN THE ANSWER SHEET.
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. *DO NOT* write *anything else* on the Test Booklet.
4. This Test Booklet contains **120** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.
5. You have to mark all your responses *ONLY* on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the responses to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *only the Answer Sheet*. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**
    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.
    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0·33)** of the marks assigned to that question will be deducted as penalty.
    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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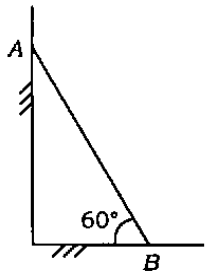
1.



A rod of length 1 m is sliding in a corner as shown in the figure above. At an instant when the rod makes an angle of 60° with the horizontal plane, the downward velocity of point A is 1 m/s. What is the angular velocity of the rod at this instant?

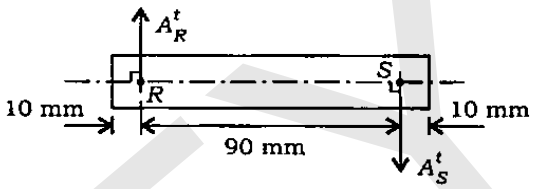
(a) 2·0 rad/s

(b) 1·5 rad/s

(c) 0·5 rad/s

(d) 0·75 rad/s

2.



The figure as shown above is a rigid body undergoing planar motion. The absolute tangential accelerations of the points R and S on the body are 150 mm/sec^2 and 300 mm/sec^2 respectively in the directions shown. What is the angular acceleration of the rigid body?

(a) 1·66 rad/sec^2

(b) 3·33 rad/sec^2

(c) 5·00 rad/sec^2

(d) 2·50 rad/sec^2

3. Why is an offset provided in a radial cam-translating follower mechanism?

(a) To avoid obstruction due to some other machine part

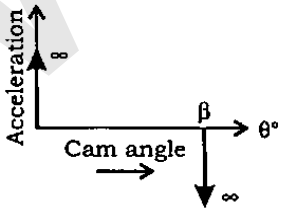
(b) To decrease pressure angle during ascent of the follower

(c) To increase pressure angle during ascent of the follower

(d) To decrease pressure angle during descent of the follower

4. A cam rotating with a uniform angular velocity pushes its flat-faced radial follower upwards. If the nature of the upward displacement of the follower with respect to the angle of cam rotation is cycloidal, then what is the shape of acceleration curve?

(a)



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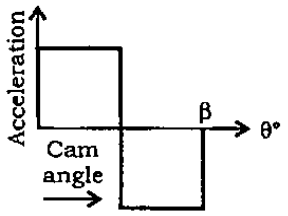

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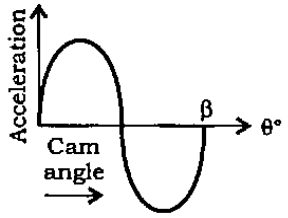

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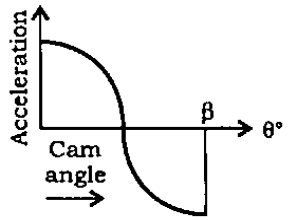


5. An external gear with 60 teeth meshes with a pinion of 20 teeth, module being 6 mm. What is the centre distance in mm?

(a) 120

(b) 180

(c) 240

(d) 300

6. A gear having 100 teeth is fixed and another gear having 25 teeth revolves around it, centre lines of both the gears being joined by an arm. How many revolutions will be made by the gear of 25 teeth for one revolution of arm?

(a) 3

(b) 4

(c) 5

(d) 6

7. A machine is coupled to a power source. The machine requires constant torque but torque supplied by the power source is $(800 + 200\sin\theta)$ N-m. Mass moment of inertia of the flywheel is 400 kg-m^2. What is the maximum angular acceleration of the flywheel and at what position does it occur?

(a) 0·5 rad/sec^2 at $\theta = 90°$

(b) 1·0 rad/sec^2 at $\theta = 90°$

(c) 0·5 rad/sec^2 at $\theta = 180°$

(d) 2·0 rad/sec^2 at $\theta = 90°$

8. In a flywheel, the safe stress is 25·2 MN/m^2 and the density is 7 g/cm^3. Then what is the maximum peripheral velocity?

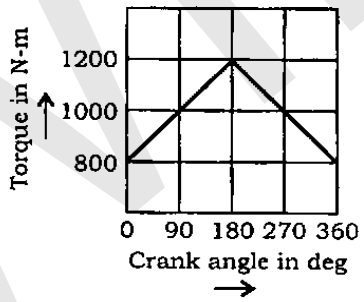
(a) 30 m/s

(b) 45 m/s

(c) 60 m/s

(d) 120 m/s

9.



The above figure shows the turning moment diagram of an engine. The mean speed of prime mover is 2π rad/s and the mass moment of inertia is 0·1 kg-m^2, then what is the coefficient of fluctuation of energy?

(a) 1%

(b) 5%

(c) 7·5%

(d) 10%

10. In a Hartnell governor, the mass of each ball is 2·5 kg. Maximum and minimum centrifugal forces on the balls are 2000 N and 100 N corresponding to radii 20 cm and 15 cm respectively. Lengths of vertical and horizontal arms of the bell-crank levers are the same, then what is the spring stiffness in N/cm?

(a) 100

(b) 200

(c) 400

(d) 800

11. Consider the following statements :

A governor is said to be

1. sensitive when it readily responds to small change in speed
2. isochronous if it has no sensitivity
3. hunting if it is too sensitive

Which of the above statements is/are true?

(a) 1 only

(b) 1 and 2

(c) 1 and 3

(d) 2 and 3

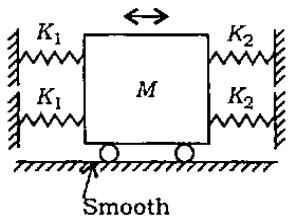
12. Match List–I with List–II and select the correct answer using the code given below the Lists :

List–I	*List–II*
A. Node point	1. Balancing of reciprocating masses
B. Critical damping	2. Torsional vibration of shafts
C. Magnification factor	3. Forced vibration of spring-mass system
D. Hammer blow	4. Damped vibration

Code :

(a)	A	B	C	D
	1	4	3	2
(b)	A	B	C	D
	2	4	3	1
(c)	A	B	C	D
	1	3	4	2
(d)	A	B	C	D
	2	3	4	1

13.



A mass M vibrates on a frictionless platform between two sets of springs having individual spring constant as shown in the figure above. What is the combined spring constant of the system?

(a) $K_1 + K_2$ *(b)* $2(K_1 + K_2)$

(c) $\dfrac{K_1 K_2}{K_1 + K_2}$ *(d)* $\dfrac{2 \cdot (K_1 K_2)}{K_1 + K_2}$

14. A reciprocating engine, running at 80 rad/s, is supported on springs. The static deflection of the spring is 1 mm. Take $g = 10\,m/s^2$. When the engine runs, what will be the frequency of vibrations of the system?

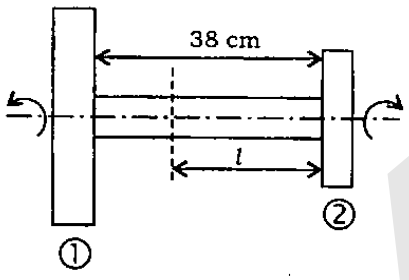
(a) 80 rad/s

(b) 90 rad/s

(c) 100 rad/s

(d) 160 rad/s

15.



The above figure shows two rotors connected by an elastic shaft undergoing torsional vibration. The rotor ① has a mass of 2 kg and a diameter of 60 cm, while the rotor ② has a mass of 1 kg and a diameter of 20 cm. What is the distance l at which the node of vibration of torsional vibration occurs?

(a) 36 cm

(b) 30 cm

(c) 22 cm

(d) 18 cm

16. The static deflection of a shaft under a flywheel is 4 mm. Take $g = 10\,m/s^2$. What is the critical speed in rad/s?

(a) 50

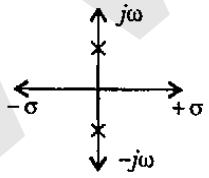
(b) 20

(c) 10

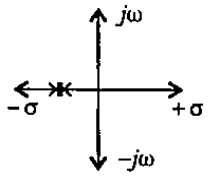
(d) 5

17. Given below are the locations of the poles of a second-order closed-loop automatic control system. Which one of them corresponds to a stable and critically damped system?

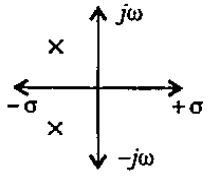
(a)



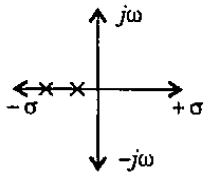
(b)



(c)



(d)



18. Match List–I with List–II and select the correct answer using the code given below the Lists :

List–I (Description)	*List–II (Shape)*
A. Spline	1. Involute
B. Roll pin	2. Semicircular
C. Gib-headed key	3. Tapered on one side
D. Woodruff key	4. Circular

Code :

	A	B	C	D
(a)	1	3	4	2
(b)	2	3	4	1
(c)	1	4	3	2
(d)	2	4	3	1

19. Consider the following joints :

1. Railway carriage wheel and axle
2. IC engine cylinder and liner

Which of the above joints is/are the result(s) of interference fit?

(a) 1 only

(b) 2 only

(c) Neither 1 nor 2

(d) Both 1 and 2

20. A power screw of 32 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 12 kN. Permissible thread bearing pressure is 6 MPa. Considering bearing action between the threads in engagement, what is the number of threads in engagement with the screw?

(a) 6 *(b)* 7

(c) 9 *(d)* 10

21. A spur gear transmits 10 kW at a pitch line velocity of 10 m/s; driving gear has a diameter of 1·0 m. Find the tangential force between the driver and the follower, and the transmitted torque respectively.

(a) 1 kN and 0·5 kN-m

(b) 10 kN and 5 kN-m

(c) 0·5 kN and 0·25 kN-m

(d) 1 kN and 1 kN-m

22. Fatigue strength of a rod subjected to cyclic axial force is less than that of a rotating beam of the same dimensions subjected to steady lateral force. What is the reason?

(a) Axial stiffness is less than bending stiffness

(b) Absence of centrifugal effects in the rod

(c) The number of discontinuities vulnerable to fatigue is more in the rod

(d) At a particular time, the rod has only one type of stress whereas the beam has both tensile and compressive stresses

23. Maximum shear stress developed on the surface of a solid circular shaft under pure torsion is 240 MPa. If the shaft diameter is doubled, then what is the maximum shear stress developed corresponding to the same torque?

(a) 120 MPa

(b) 60 MPa

(c) 30 MPa

(d) 15 MPa

24. An elevator weighing 10000 N attains an upward velocity of 4 m/s in 2 seconds with uniform acceleration. Then what is the tension in the wire rope?

(a) 8000 N

(b) 5000 N

(c) 2500 N

(d) 12000 N

25. On what does the basic static capacity of a ball bearing depend?

(a) Directly proportional to number of balls in a row and diameter of ball

(b) Directly proportional to square of ball diameter and inverse of number of rows of balls

(c) Directly proportional to number of balls in a row and square of diameter of ball

(d) Inversely proportional to square of diameter of ball and directly proportional to number of balls in a row

26. Consider the following statements :

1. Two-dimensional stresses applied to a thin plate in its own plane represent the plane stress condition.
2. Under plane stress condition, the strain in the direction perpendicular to the plane is zero.
3. Normal and shear stresses may occur simultaneously on a plane.

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 1 and 3

27. The principal strains at a point in a body, under biaxial state of stress, are 1000×10^{-6} and -600×10^{-6}. What is the maximum shear strain at that point?

(a) 200×10^{-6}

(b) 800×10^{-6}

(c) 1000×10^{-6}

(d) 1600×10^{-6}

28. What is the relationship between elastic constants E, G and K?

(a) $E = \dfrac{KG}{9K + G}$

(b) $E = \dfrac{9KG}{K + G}$

(c) $E = \dfrac{9KG}{K + 3G}$

(d) $E = \dfrac{9KG}{3K + G}$

29. A bar produces a lateral strain of magnitude -60×10^{-5} m/m, when subjected to tensile stress of magnitude 300 MPa along the axial direction. Find the elastic modulus of the material, if the Poisson's ratio is 0·3.

(a) 100 GPa

(b) 150 GPa

(c) 200 GPa

(d) 400 GPa

30. A uniformly distributed load w (in kN/m) is acting over the entire length of a 3 m long cantilever beam. If the shear force at the mid-point of cantilever is 6 kN, what is the value of w?

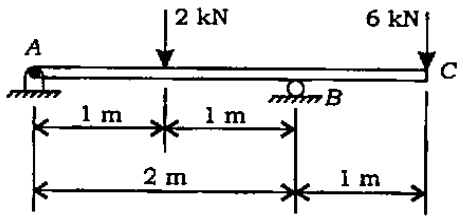
(a) 2

(b) 3

(c) 4

(d) 5

31.



An overhanging beam ABC is supported at points A and B, as shown in the above figure. Find the maximum bending moment and the point where it occurs.

(a) 6 kN-m at the right support

(b) 6 kN-m at the left support

(c) 4·5 kN-m at the right support

(d) 4·5 kN-m at the midpoint between the supports

32. A freely supported beam at its ends carries a central concentrated load, and maximum bending moment is M. If the same load be uniformly distributed over the beam length, then what is the maximum bending moment?

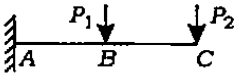
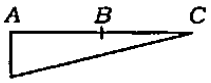
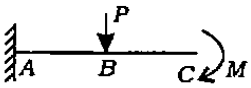
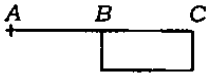
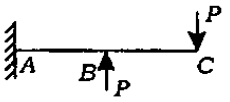
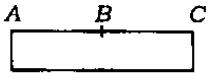
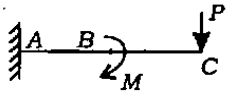
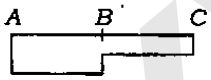
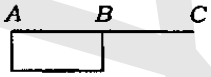
(a) M

(b) $\dfrac{M}{2}$

(c) $\dfrac{M}{3}$

(d) $2M$

33. Match List–I with List–II and select the correct answer using the code given below the Lists :

List–I (Cantilever Loading)	*List–II (Shear Force Diagram)*
A. 	1. 
B. 	2. 
C. 	3. 
D. 	4. 
	5. 

Code :

(a)	A	B	C	D
	1	5	2	4
(b)	A	B	C	D
	4	5	2	3
(c)	A	B	C	D
	1	3	4	5
(d)	A	B	C	D
	4	2	5	3

34. A beam having rectangular cross-section is subjected to an external loading. The average shear stress developed due to the external loading at a particular cross-section is τ_{avg}. What is the maximum shear stress developed at the same cross-section due to the same loading?

(a) $\frac{1}{2}\tau_{avg}$

(b) τ_{avg}

(c) $\frac{3}{2}\tau_{avg}$

(d) $2\tau_{avg}$

35. Consider the following statements :

When two springs of equal lengths are arranged to form a cluster spring

1. angle of twist in both the springs will be equal
2. deflection of both the springs will be equal
3. load taken by each spring will be half the total load
4. shear stress in each spring will be equal

Which of the above statements is/are correct?

(a) 1 and 2

(b) 3 and 4

(c) 2 only

(d) 4 only

36. A water main of 1 m diameter contains water at a pressure head of 100 metres. The permissible tensile stress in the material of the water main is 25 MPa. What is the minimum thickness of the water main? (Take $g = 10\,m/s^2$)

(a) 10 mm

(b) 20 mm

(c) 50 mm

(d) 60 mm

37. Four vertical columns of same material, height and weight have the same end conditions. Which cross-section will carry the maximum load?

(a) Solid circular section

(b) Thin hollow circular section

(c) Solid square section

(d) I-section

38. A steel specimen $150\,mm^2$ in cross-section stretches by 0·05 mm over a 50 mm gauge length under an axial load of 30 kN. What is the strain energy stored in the specimen? (Take $E = 200$ GPa)

(a) 0·75 N-m

(b) 1·00 N-m

(c) 1·50 N-m

(d) 3·00 N-m

39. What is the expression for the strain energy due to bending of a cantilever beam (length L, modulus of elasticity E and moment of inertia I)?

(a) $\frac{P^2L^3}{3EI}$

(b) $\frac{P^2L^3}{6EI}$

(c) $\frac{P^2L^3}{4EI}$

(d) $\frac{P^2L^3}{48EI}$

40. Which one of the following crystal systems is valid for gold?

(a) Orthogonal

(b) Cubic

(c) Hexagonal

(d) Triclinic

41. Which one of the following is correct for 'Climb'?

(a) Dislocation moves parallel to the slip plane

(b) Dislocation moves perpendicular to the slip plane

(c) Sliding of one plane of atoms over the other plane

(d) Dislocation moves from a slip plane to another slip plane

42. Which one of the following is correct for "Burger's vector" in screw dislocation?

(a) Perpendicular to the dislocation line

(b) Inclined to the dislocation line

(c) Parallel to the dislocation line

(d) Opposite to the dislocation line

43. Which one of the following defects is 'Schottky defect'?

(a) Vacancy defect

(b) Compositional defect

(c) Interstitial defect

(d) Surface defect

44. Which one of the following elements is an austenitic stabilizer?

(a) Chromium

(b) Tungsten

(c) Nickel

(d) Molybdenum

45. Which one of the following elements is a ferritic stabilizer?

(a) Nickel

(b) Manganese

(c) Copper

(d) Chromium

46. The elements which, added to steel, help in chip formation during machining are

(a) sulphur, lead and phosphorus

(b) sulphur, lead and cobalt

(c) aluminium, lead and copper

(d) aluminium, titanium and copper

47. Which one of the following cast irons consists of carbon in rosette form?

(a) White cast iron

(b) Gray cast iron

(c) Malleable cast iron

(d) Nodular cast iron

48. Which one of the following possesses the property of nonsparking character?

(a) Hadfield's manganese steel

(b) Spring steel

(c) Stellite

(d) Invar

49. Nano composite materials are highly preferable in design consideration for their

(a) high resistance to crack propagation

(b) vibration resistance

(c) impact resistance

(d) high resilience

50. Which one of the following mediums is used for the fastest cooling rate of steel quenching?

(a) Air

(b) Oil

(c) Water

(d) Brine

51. Which one of the following materials is ***not*** a composite?

(a) Wood

(b) Concrete

(c) Plywood

(d) Sialon

52. Match List–I with List–II and select the correct answer using the code given below the Lists :

List–I (Article)	*List–II (Processing Method)*
A. Disposable coffee cups	1. Rotomoulding
B. Large water tanks	2. Expandable bead moulding
C. Plastic sheets	3. Thermoforming
D. Cushion pads	4. Blow moulding
	5. Calendering

Code :

(a)	A	B	C	D
	3	5	1	2
(b)	A	B	C	D
	4	5	1	2
(c)	A	B	C	D
	4	3	2	1
(d)	A	B	C	D
	3	1	5	2

53. Which of the following composites are 'dispersion-strengthened composites'?

(a) Particulate composites

(b) Laminar composites

(c) Fiber reinforced composites

(d) Short-fiber discontinuous composites

54. Why are Babbitt alloys used for bearing material?

(a) They have excellent embeddability

(b) They are relatively stronger than other bearing materials

(c) They do not lose strength with increase in temperature

(d) They have high fatigue strength

55. Which one of the following materials can be subjected to an age hardening process?

(a) HSS

(b) Aluminium

(c) Pure iron

(d) Stellite

56. Consider the following characteristics :

1. Porosity in the metal is largely eliminated.
2. Strength is decreased.
3. Close tolerances cannot be maintained.

Which of the above characteristics of hot working is/are correct?

(a) 1 only

(b) 3 only

(c) 2 and 3

(d) 1 and 3

57. Which one of the following processes is the wiredrawing process?

(a) Compressive

(b) Tensile

(c) Shear

(d) Hydrostatic stress

58. Which one of the following statements is correct?

(a) In extrusion process, thicker walls can be obtained by increasing the forming pressure

(b) Extrusion is an ideal process for obtaining rods from metal having poor density

(c) As compared to roll forming, extruding speed is high

(d) Impact extrusion is quite similar to Hooker's process including the flow of metal being in the same direction

59. What is the major problem in hot extrusion?

(a) Design of punch

(b) Design of die

(c) Wear and tear of die

(d) Wear of punch

60. Which one of the following is a high energy rate forming process?

(a) Roll forming

(b) Electrohydraulic forming

(c) Rotary forging

(d) Forward extrusion

61. Which of the following cutting tool bits are made by powder metallurgy process?

(a) Carbon steel tool bits

(b) Stellite tool bits

(c) Ceramic tool bits

(d) HSS tool bits

62. Which of the following are the most suitable materials for die casting?

(a) Zinc and its alloys

(b) Copper and its alloys

(c) Aluminium and its alloys

(d) Lead and its alloys

63. Which one of the following casting processes is best suited to make bigger size hollow symmetrical pipes?

(a) Die casting

(b) Investment casting

(c) Shell moulding

(d) Centrifugal casting

64. Which of the following are the most likely characteristics in centrifugal casting?

(a) Fine grain size and high porosity

(b) Coarse grain size and high porosity

(c) Fine grain size and high density

(d) Coarse grain size and high density

65. Consider the following statements :

1. The actual entry point through which the molten metal enters the mould cavity is called in-gate.
2. Bottom gate in case of a mould creates unfavourable temperature gradient.
3. Sprue in case of a mould is made tapered to avoid air inclusion.

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 1 and 3

66. In which one of the following furnaces most of the nonferrous alloys are melted?

(a) Reverberatory furnace

(b) Induction furnace

(c) Crucible furnace

(d) Pot furnace

67. By which one of the following methods gray iron is usually welded?

(a) TIG welding

(b) MIG welding

(c) Gas welding

(d) Arc welding

68. Match List–I with List–II and select the correct answer using the code given below the Lists :

List–I (Welding Process)	*List–II (Application)*
A. Laser welding	1. Uniting large-area sheets
B. Friction welding	2. Repairing large parts
C. Ultrasonic welding	3. Welding a rod to a flat surface
D. Explosive welding	4. Fabrication of nuclear reactor components
	5. Welding very thin materials

Code :

	A	B	C	D
(a)	5	4	3	2
(b)	1	4	2	5
(c)	1	3	4	2
(d)	5	3	4	1

69. Which one of the following methods should be used for turning internal taper only?

(a) Tailstock offset

(b) Taper attachment

(c) Form tool

(d) Compound rest

70. What is the number of jaws in self-centred chuck?

(a) Eight

(b) Six

(c) Four

(d) Three

71. For the manufacture of screw fasteners on a mass scale, which is the most suitable machine tool?

(a) Capstan lathe

(b) Single-spindle automat

(c) CNC turning centre (lathe)

(d) CNC machining centre

72. What is the drilling time for producing a hole in an MS sheet of 25 mm thickness using an HSS drill of 20 mm diameter? The cutting speed and feed for drill are 20 m/min and 0·25 mm/revolution respectively. Neglect time taken for setting up, approaching and travelling of tools.

(a) 0·314 min

(b) 0·236 min

(c) 0·438 min

(d) 0·443 min

73. For machining, which one of the following gang milling operations is employed?

(a) Threads

(b) Bores

(c) Grooves

(d) Steps on prismatic parts

74. The arbor of a milling machine is used to hold which one of the following?

(a) Spindle

(b) Overarm

(c) Cutting tool

(d) Mandrel

75. By which one of the following machines the teeth of an internal spur gear can be cut accurately?

(a) Milling machine

(b) Slotting machine

(c) Hobbing machine

(d) Gear-shaping machine

76. Which one of the following is ***not*** used as abrasive material in grinding wheels?

(a) Aluminium oxide

(b) Silicon carbide

(c) Cubic boron nitride

(d) Manganese oxide

77. Given that the peripheral speed of the grinding wheel of 100 mm diameter for cylindrical grinding of a steel workpiece is 30 m/s, what will be the estimated rotational speed of the grinding wheel in revolution per minute (r.p.m.)?

(a) 11460

(b) 5730

(c) 2865

(d) 95

78. In which of the following machining manual part programming is done?

(a) CNC machining

(b) NC machining

(c) DNC machining

(d) FMS machining

79. Interpolation in the controller refers to control of which one of the following in a CNC machine?

(a) Loading/unloading of jobs on machine

(b) Loading/unloading of tools from the tool changer

(c) Axes of machine for contouring

(d) Coolant and miscellaneous functions on machine

80. What is the purpose of satellite computers in Distributed Numerical Control machines?

(a) To act as stand-by systems

(b) To share the processing of large-size NC programs

(c) To serve a group of NC machines

(d) To network with another DNC setup

81. In which machining system, the highest level of automation is found?

(a) CNC machine tools

(b) Automatic transfer machines

(c) Machine tools with electro-hydraulic positioning and control

(d) DNC machining system

82. Consider the following statements with respect to the effects of a large nose radius on the tool :

1. It deteriorates surface finish.
2. It increases the possibility of chatter.
3. It improves tool life.

Which of the above statements is/are correct?

(a) 2 only

(b) 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

83. The following tool signature is specified for a single-point cutting tool in American system :

10, 12, 8, 6, 15, 20, 3

What does the angle 12 represent?

(a) Side cutting-edge angle

(b) Side rake angle

(c) Back rake angle

(d) Side clearance angle

84. Consider the following :

1. Tool life
2. Cutting forces
3. Surface finish

Which of the above is/are the machinability criterion/criteria?

(a) 1, 2 and 3

(b) 1 and 3 only

(c) 2 and 3 only

(d) 2 only

85. A capstan lathe is used to mass-produce, in batches of 200, a particular component. The direct material cost is Rs 4 per piece, the direct labour cost is Rs 3 per piece and the overhead costs are 400% of the labour costs. What is the production cost per piece?

(a) Rs 19

(b) Rs 23

(c) Rs 16

(d) Rs 15

86. Which one of the following statements is correct in respect of unconventional machining processes?

(a) The cutting tool is in direct contact with the job

(b) The tool material needs to be harder than the job material

(c) The tool is never in contact with the job

(d) There has to be a relative motion between the tool and the job

87. By which one of the following processes the metering holes in injector nozzles of diesel engines can be suitably made?

(a) Ultrasonic machining

(b) Abrasive jet machining

(c) Electron beam machining

(d) Chemical machining

88. A lever having two precisely drilled holes, one smaller than the other, has to be located in a fixture using hardened and ground plugs for further machining in relation to the holes. Select the correct method of locating the lever from the given alternatives.

(a) Using two hardened and ground plugs, the smaller one having flats machined on each side

(b) Using two hardened and ground plugs

(c) Using one hardened and ground plug and one V-block

(d) Using two V-blocks

89. Which of the following is the measure of forecast error?

(a) Mean absolute deviation

(b) Trend value

(c) Moving average

(d) Price fluctuation

90. In a forecasting situation, exponential smoothing with a smoothing constant $\alpha = 0 \cdot 2$ is to be used. If the demand for nth period is 500 and the actual demand for the corresponding period turned out to be 450, what is the forecast for the $(n+1)$th period?

(a) 450

(b) 470

(c) 490

(d) 500

91. Consider the following aspects :

1. Functional
2. Operational
3. Aesthetic

Which of the above aspects is/are to be analyzed in connection with the product development?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 3 only

92. Consider the following statements :

The immediate objective of a product is

1. to simulate sales function
2. to utilize the existing equipment and power
3. to monopolize the market

Which of the above statements is/are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 3 only

93. Process *X* has a fixed cost of Rs 40,000 per month and a variable cost of Rs 9 per unit. Process *Y* has a fixed cost of Rs 16,000 per month and a variable cost of Rs 24 per unit. At which value, total costs of processes *X* and *Y* will be equal?

(a) 800

(b) 1200

(c) 1600

(d) 2000

94. Consider the following statements :

The break-even point increases

1. if the fixed cost per unit increases
2. if the variable cost per unit decreases
3. if the selling price per unit decreases

Which of the above statements is/are correct?

(a) 1 only

(b) 1 and 2

(c) 2 and 3

(d) 1 and 3

95. An operations consultant for an automatic car wash wishes to plan for enough capacity to handle 60 cars per hour. Each car will have a wash time of 4 minutes, but there is to be a 25% allowance for setup time, delays and payment transactions. How many car wash stalls should be installed?

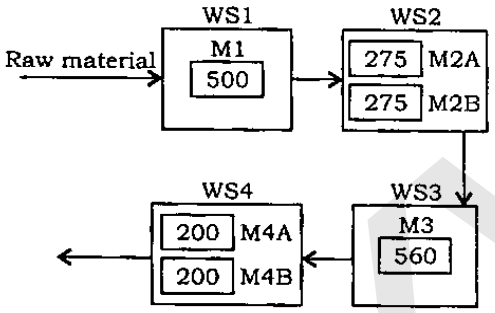
(a) 3

(b) 4

(c) 5

(d) 6

96.



A product is manufactured by processing on the four work-stations (WS). The capacity of each machine on these work-stations is given in the diagram as shown above. In the diagram M1, M2A, M2B, M3, M4A and M4B are the machines and 500, 275, 275, 560, 200 and 200 are their capacities in number of products made per shift. If the products made in this system are 5% defective, then what will be the output from this system?

(a) 380

(b) 475

(c) 522

(d) 532

97. If demand is doubled and ordering cost, unit cost and inventory carrying cost are halved, then what will be the EOQ?

(a) Half

(b) Same

(c) Twice

(d) Four times

98. Consider the following statements :

The MRP inventory status file contains

1. material on hand
2. planned order
3. planned order release

Which of the above statements is/are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 3 only

99. Consider the following :

1. A mass production schedule
2. An inventory status file
3. Bill of material

Which of the above are the inputs to MRP systems?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

100. Which one of the following is ***not*** a work measurement technique?

(a) Time study

(b) Work sampling

(c) Motion time data

(d) Micromotion study

101. If in a time study, the observed time is 0·75 min, rating factor = 110% and allowances are 20% of normal time, then what is the standard time?

(a) 0·82 min

(b) 0·975 min

(c) 0·99 min

(d) 1·03 min

102. For a confidence level of 95% and accuracy ±5%, the number of cycles to be timed in a time study is equal to

$$\left[K\sqrt{\frac{N\Sigma X^2 - (\Sigma X)^2}{\Sigma X}}\right]^2$$

where N = number of observations taken; $X = X_1, X_2, \ldots, X_N$ are individual observations. What is the value of K?

(a) 10

(b) 20

(c) 30

(d) 40

103. If in a process on the shop floor, the specifications are not met, but the charts for variables show control, then which of the following actions should be taken?

(a) Change the process

(b) Change the method of measurement

(c) Change the worker or provide him training

(d) Change the specifications or upgrade the process

104. An operating characteristic curve (OC curve) is a plot between

(a) consumers' risk and producer's risk

(b) probability of acceptance and probability of rejection

(c) percentage of defectives and probability of acceptance

(d) average outgoing quality and probability of acceptance

105. In a linear programming problem, which one of the following is correct for graphical method?

(a) A point in the feasible region is not a solution to the problem

(b) One of the corner points of the feasible region is not the optimum solution

(c) Any point in the positive quadrant does not satisfy the nonnegativity constraint

(d) The lines corresponding to different values of objective functions are parallel

106. A linear programming problem with mixed constraints (some constraints of $\leq$ type and some of $\geq$ type) can be solved by which of the following methods?

(a) Big-M method

(b) Hungarian method

(c) Branch and bound technique

(d) Least cost method

107. While solving a linear programming problem by simplex method, if all ratios of the right-hand side (b_i) to the coefficient in the key row (a_{ij}) become negative, then the problem has which of the following types of solution?

(a) An unbound solution

(b) Multiple solutions

(c) A unique solution

(d) No solution

108. Which one of the following is true in case of simplex method of linear programming?

(a) The constants of constraints equation may be positive or negative

(b) Inequalities are not converted into equations

(c) It cannot be used for two-variable problems

(d) The simplex algorithm is an iterative procedure

109. When solving the problem by Big-M method, if the objective functions row (evaluation row) shows optimality but one or more artificial variables are still in the basis, what type of solution does it show?

(a) Optimal solution

(b) Pseudooptimal solution

(c) Degenerate solution

(d) Infeasible solution

110. Which of the following distributions is followed by the number of arrivals in a given time in a single-server queueing model?

(a) Negative exponential distribution

(b) Poisson distribution

(c) Normal distribution

(d) Beta distribution

111. If the arrivals at a service facility are distributed as per the Poisson distribution with a mean rate of 10 per hour and the services are exponentially distributed with a mean service time of 4 minutes, what is the probability that a customer may have to wait to be served?

(a) 0·40

(b) 0·50

(c) 0·67

(d) 1·00

112. A single-bay car wash with a Poisson arrival rate and exponential service time has cars arriving at an average rate of 10 minutes apart and an average service time of 4 minutes. What is the system utilization?

(a) 1·00

(b) 0·67

(c) 0·40

(d) 0·24

113. Consider the following :

1. A system-oriented approach
2. A multidisciplined team approach
3. A function-oriented approach

Which of the above refer to value engineering?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

114. Which one of the following is used for data processing carried out by the CPU of the computer?

(a) ROM

(b) RAM

(c) Hard disk

(d) Floppy disk drive

115. What is the full form of RISC?

(a) Reduced Instruction Set Chip

(b) Read Instruction Set Computers

(c) Reduced Instruction Set Computers

(d) Redundant Instruction Set Chip

116. What is the size of the spreadsheet in Lotus?

(a) 1028 rows and 256 columns

(b) 2048 rows and 1028 columns

(c) 1028 rows and 1028 columns

(d) 2048 rows and 256 columns

Directions :

Each of the following **four (4)** items consists of two statements, one labelled as 'Assertion (A)' and the other as 'Reason (R)'. You are to examine these two statements carefully and select the answers to these items using the code given below :

Code :

(a) Both A and R are individually true and R is the correct explanation of A

(b) Both A and R are individually true but R is ***not*** the correct explanation of A

(c) A is true but R is false

(d) A is false but R is true

117. Assertion (A) :

Mohr's construction is possible for stresses, strains and area moment of inertia.

Reason (R) :

Mohr's circle represents the transformation of second-order tensor.

118. Assertion (A) :

Gears produced by employing form-cutting principle using gear-milling cutter on a milling machine are not very accurate.

Reason (R) :

Production of the correct gear tooth profile employing form-cutting principle would require a separate cutter for cutting different numbers of teeth even for the same module and also errors are associated with inaccurate operation of indexing mechanism.

119. Assertion (A) :

Moving average method of forecasting demand gives an account of the trends in fluctuations and suppresses day-to-day insignificant fluctuations.

Reason (R) :

Working out moving averages of the demand data smoothens the random day-to-day fluctuations and represents only significant variations.

120. Assertion (A) :

Assembly line balancing increases productivity.

Reason (R) :

Assembly line balancing reduces in-process inventory.

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