UPPSC AE

Previous Year Paper
(Mechanical) Paper-I
2007

MECHANICAL ENGINEERING

Paper-I

1. The [110] direction in a cubic unit cell is parallel to the following :
(a) Face diagonal of unit cell
(b) Edge of the cube
(c) Body diagonal of the cube
(d) None of the above

2. When mechanical properties of a material remain same in all directions at each point, such a material is called
(a) Isotropic
(b) Homogenious
(c) Orthotropic
(d) Anisotropic

3. German silver is an alloy of
(a) Silver and Tin
(b) Silver and Gold
(c) Nickel and Copper
(d) Nickel, Copper and Zinc

4. Iron is 'Face Centered Cubic (FCC) at which one of the following temperatures ?
(a) Room temperature
(b) 1400 °C
(c) 910 °C
(d) None of the above

5. Babbit metal is an alloy of which one of the following ?
(a) Lead and Tin
(b) Lead and Magnesium
(c) Tin and Bismuth
(d) None of the above

6. Griffith theory of failure is suitable for
(a) Mild Steel
(b) Low Carbon Steel
(c) Alloy Steel
(d) Glass

7. Mild Steel is an example of
(a) Substitution solid solution
(b) Interstitial solid solution
(c) Inter metallic compound
(d) None of the above

8. Bronze contains
(a) 70% Cu and 30% Zn
(b) 90% Cu and 10% Zn
(c) 75% Cu and 25% Zn
(d) None of the above

9. The processes, used to make the steel magnetically softer, are
(a) Annealing and Decarburization
(b) Decarburization and Quenching
(c) Annealing, Grain growth and Decarburization
(d) Grain growth and Quenching

10. The ductile-brittle transition temperature
(a) depends on size and shape of material, rate of loading, presence of notches, impurities and operating temperature
(b) depends on size but does not depend on shape of material
(c) does not depend on size of material
(d) does not depend on rate of loading but depends on presence of impurities

11. Match the items in List – 1 to that of the List – 2 and choose the correct alternative.

List – 1		**List – 2**
A.	Alnico V	1. Metallic Magnet
B.	Ferrexodur	2. Ceramic Magnet
C.	Nickel Oxide	3. Anti ferromagnetic
D.	Ferrites	4. Compounds containing trivalent iron
		5. Ferrimagnetic
		6. Soft magnetic

Alternatives :

	A	B	C	D
(a)	1	2	3	4
(b)	6	2	3	4
(c)	4	6	1	2
(d)	2	1	6	1

12. Choose the correct statement from the following :
(a) Ceremic compounds involve simple coordination than their corresponding components.
(b) Ceremic compounds are more ductile.
(c) Ceramic compounds are more stable with respect to thermal and chemical environments than their components.
(d) Ceramic compounds have less resistance to slip.

Note : Q. No. 13 to 16 :

13. Choose the alternative from the code given below which explains the correct relationship between the Assertion (A) and Reason (R) :

Assertion (A) : Metallic Magnets cannot be used in high frequency circuits.

Reason (R) : The low resistivity of metallic magnets permits heating from induced currents.

Code :

(a) (A) is true, but (R) is false.

(b) (A) is false, but (R) is true.

(c) Both (A) and (R) are true, but (R) does not explain (A) correctly.

(d) Both (A) and (R) are true and (R) explains (A) correctly.

14. **Assertion (A)** : Little energy is required to break materials such as glass, polystyrene and some cast irons. Conversely, rubber and many steels absorb considerable energy in the fracture process.

Reason (R) : The service limit in many engineering products is not the yield or ultimate strength, rather may be the energy associated with fracture propagation.

Code :

(a) Both (A) and (R) are true and (R) explains (A) correctly.

(b) Both (A) and (R) are true but (R) does not explain (A) correctly.

(c) (A) is true, but (R) is false.

(d) (A) is false, but (R) is true.

15. **Assertion (A)** : In general, materials deform more readily at elevated temperature.

Reason (R) : Plastic deformation commonly arises from dislocation movements that involve a continual displacement of atoms to new neighbours at elevated temperature.

Code :

(a) (A) is true, but (R) is false.

(b) (A) is false, but (R) is true.

(c) Both (A) and (R) are true and (R) explains (A) correctly.

(d) Both (A) and (R) are true, but (R) does not explain (A) correctly.

16. **Assertion (A)** : Soft magnets are the obvious choice for ac or high frequency applications.

Reason (R) : They must be magnetised and demagnetized many times per second.

Code :

(a) Both (A) and (R) are true, but (R) does not explain (A) correctly.

(b) Both (A) and (R) are true, and (R) explains (A) correctly.

(c) (A) is true, but (R) is false.

(d) (A) is false, but (R) is true.

17. Dielectric strength can be reduced by

(a) removing cracks (b) absence of imperfections

(c) absence of flaws (d) impurities, cracks and pores

18. Select the correct answer out of the following alternatives about 'Cyclic Stresses'.

(a) That a material can tolerate are much greater than stresses produced under static loading.

(b) Can lead to fatigue if the stress level is above the endurance limit.

(c) Can lead to fatigue if the stress level is below the endurance limit.

(d) Are not introduced in the axle of a running train.

19. Dislocation in material is called

(a) Point defect (b) Line defect

(c) Plane defect (d) Volumetric defect

20. Match the items in List – 1 to the corresponding items in the List – 2.

List – 1 (Heat Treatment)		**List – 2 (Effect on Properties)**
A.	Annealing	1. Refine grain structures
B.	Nitriding	2. Improves the hardness of the whole mass
C.	Martempering	3. Improves surface hardness
D.	Normalising	4. Improves ductility

Choose the correct from the following **:**

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

21. The crystal structure of α-iron is

(a) Simple cubic (b) Face centred cubic

(c) Body centred cubic (d) Close-packed Hexagonal

22. Select the proper sequence for the following :

1. Proportional limit 2. Elastic limit

3. Yield point 4. Fracture/failure point

(a) 1 – 2 – 3 – 4 (b) 2 – 1 – 3 – 4

(c) 1 – 2 – 4 – 3 (d) 2 – 1 – 4 – 3

23. The macro-structure of a material is generally examined by

(a) X-ray techniques (b) Spectroscopic techniques

(c) Optical microscope (d) Metallurgical microscope

24. Gradual time dependent deformation under constant load or self weight is called
(a) Erosion (b) Decay
(c) Tension (d) Creep

25. Which ingredient is responsible for corrosion resistant capability in Stainless Steel ?
(a) Iron (b) Chromium
(c) Zinc (d) Sulphur

26. The property of material, which enables it to withstand bending without fracture, is known as
(a) Mechanical strength (b) Stiffness
(c) Flexural rigidity (d) Ductility

27. The material commonly used for making machine tool bed is
(a) Mild Steel (b) Aluminium
(c) Brass (d) Cast Iron

28. Which one of the following is the ferrous material ?
(a) Zinc (b) Iron
(c) Silicon Carbide (d) Copper

29. Babbit materials are used for
(a) Gears (b) Bearings
(c) Bolts (d) Clutch liners

30. The ultimate tensile strength of low Carbon Steel by working at high strain rate will
(a) increase (b) decrease
(c) remain constant (d) first increase, then decrease

31. Pure iron is the structure of
(a) Ferrite (b) Pearlite
(c) Austenite (d) Cementite

32. An example of amorphous material is
(a) Zinc (b) Lead
(c) Glass (d) Sulphur

33. Binding material in cemented carbide tool is
(a) Graphite (b) Lead
(c) Carbon (d) Cobalt

34. Which of the following are the reasons for reduction of tool life in a machining operation ?
1. Temperature rise of cutting edge.
2. Chipping of tool edge due to mechanical impact.
3. Gradual wear at tool point.
4. Increase in feed of cut at constant cutting force

Select the answer from the following :
(a) 1, 2 & 4 (b) 1, 2 & 3
(c) 1, 3 & 4 (d) 1, 2, 3 & 4

35. Choose the alternative, which explains the correct relationship between the given statements, (A) & (R) from the code given below :

Assertion (A) : In ECM, the shape of the cavity is the mirror image of the tool, but unlike EDM, the tool wear in ECM is a cathode.

Reason (R) : The tool in ECM is a Cathode.

Code :

(a) Both (A) & (R) are true. (R) is the correct explanation of (A).

(b) Both (A) & (R) are true. (R) is not the correct explanation of (A).

(c) (A) is false, but (R) is true.

(d) (A) is true, but (R) is false.

36. An orthogonal cutting operation is being carried out under the following conditions :

Cutting Speed = 2 m/sec, Depth of cut = 0.5 mm, Chip thickness = 0.6 mm.

What is the chip velocity ?

(a) 2 m/sec (b) 2.4 m/sec

(c) 1 m/sec (d) 1.66 m/sec

37. The rake angle of a cutting tool is 15°, the shear angle is 45° and the cutting velocity is 35 mpm. What is the velocity of chip along the tool face ?

(a) 28.5 mpm (b) 27.3 mpm

(c) 25.3 mpm (d) 23.5 mpm

38. In EDM, metal removal rate is proportional to

(a) Frequency of charging (b) Energy delivered in each spark

(c) Both (a) and (b) (d) None of the above

39. Which of the following is not true in case of jigs and fixtures ?

(a) Consistency in dimension (b) Fast production speed is not possible

(c) Auto-location control (d) None of the above

40. The upper and lower control limits in case of R-chart are given by

(a) $A_2\bar{R}$ & $A_3\bar{R}$ (b) $D_3\bar{R}$ & $D_4\bar{R}$

(c) $\bar{R} \pm D_3\bar{R}$ (d) $\bar{R} \pm A_2\bar{R}$

41. A cutting tool is turning a work piece of 40 mm diameter, revolving at 300 rpm. If tool life is 120 min, find the value of constant C as per the Taylor's tool life equation, Assuming n = 1/7.

(a) 85 (b) 80

(c) 70 (d) 75

42. Which of the following should be more to reduce wear of a tool ?
(a) Weight (b) Density
(c) Hardness (d) (b) & (c) both

43. Which of the following instruments is used to measure smoothness of a metallic surface ?
(a) Talysurf (b) Coordinate Measuring Machine
(c) Profile Projector (d) None of the above

44. Life of a single point cutting tool is influenced by which of the following factors ?
(a) Cutting speed (b) Feed rate
(c) Depth of cut (d) All the above

45. The Plug gauge is used to
(a) Check the size and shape of holes
(b) Measure the diameter of holes
(c) Measure the diameter of shafts
(d) Measure the diameters of shafts & holes

46. The relationship between the shear angle (ϕ), friction angle (β), cutting rake angle (α)and the machining constant (C) for the work material is
(a) $2\alpha + \beta - \phi = C$ (b) $2\alpha + \beta + \phi = C$
(c) $2\phi + \beta - \alpha = C$ (d) $2\phi + \beta + \alpha = C$

47. Explosive forming is not used for the following :
(a) Making very small complex parts.
(b) For large parts typical of aerospace industry.
(c) Both (a) & (b) above are correct.
(d) None of the above is correct.

48. In Electro-Discharge-Machining (EDM), the tool is made of
(a) High Speed Steel (b) Copper
(c) Cast Iron (d) Glass

49. The process in which the material removal rate is governed by Faraday's law is ?
(a) ECM (b) EDM
(c) AJM (d) LBM

50. In USM, the tool is vibrated with the frequency of
(a) 5 kHz (b) 10 kHz
(c) 15 kHz (d) 20 kHz

51. Continuous chips will be formed when machining speed is
(a) low (b) medium
(c) high (d) independent of speed

52. Profile of a gear tooth can be checked by
(a) Optical projector (b) Optical pyrometer
(c) Bench micrometer (d) Sine bar.

53. For TIG welding, which of the following gases are used ?
(a) Hydrogen and Carbon-di-oxide (b) Argon and Helium
(c) Argon and Neon (d) Hydrogen and Oxygen

54. Which of the following materials require the largest shrinkage allowance while making a pattern for casting ?
(a) Aluminium (b) Brass
(c) Cast Iron (d) Duralumin

55. Which of the following values of index n is associated with carbide tools when Taylor's tool life equation VT^n = constant is applied ?
(a) 0.65 to 0.90 (b) 0.45 to 0.60
(c) 0.20 to 0.40 (d) 0.10 to 0.15

56. In an orthogonal cutting experiment, with a tool of rake angle $\gamma = 75°$ and shear angle $\phi = 22.8°$, then friction angle β will be
(a) 41.9° (b) 51.4°
(c) 61.2° (d) None of the above

57. Which of the following operation does not use a jig ?
(a) Tapping (b) Reaming
(c) Drilling (d) Turning

58. Which of the following are the quality control limits for p-charts ?
(a) $\bar{p} \pm 3\sqrt{\bar{p}\,(1-\bar{p})}$ (b) $\bar{p} \pm \sqrt{\bar{p}\,(1-\bar{p})}$
(c) $\bar{p} \pm \sqrt[3]{\dfrac{\bar{p}\,(1-\bar{p})}{n}}$ (d) $\bar{p} \pm 3\sqrt{n\bar{p}\,(1-\bar{p})}$

59. Which is the false statement about electro discharge machining ?
(a) It can machine very hard material.
(b) Very good surface finish is obtained.
(c) Section to be machined should be thick.
(d) Metal removal rate is very slow.

60. Choose the false statement from the following :
(a) Control chart indicate whether the process is in control or not.
(b) $\bar{X}$ and R charts are used to evaluate dispersion of measurements.
(c) P-chart is a control chart for percentage defective.
(d) C-charts are prepared for large and complex components.

61. The following is not the characteristics of explosive forming :
(a) Low capital cost of the set up.
(b) Very large components can be formed.
(c) Only a simple die is required.
(d) The tooling material is very expensive.

62. The following is not true for ECM :
(a) It can machine highly complicated shapes in a single pass.
(b) Tool life is very high.
(c) Machinability of the work material is independent of its physical and mechanical properties.
(d) Kerosene is use as electrolyte.

63. Electro-discharge machining uses the following dielectric fluid :
(a) Kerosene (b) Sodium hydroxide
(c) Water (d) Aqueous salt solution

64. A good machinability rating would indicate
(a) long tool life, high power requirement and less machining time.
(b) long tool life, low power requirement and a good surface finish.
(c) short tool life and a good surface finish.
(d) long tool life, high power requirement and a good surface finish.

65. In EDM process, the workpiece is connected to
(a) Cathode (b) Anode
(c) Earth (d) None of the above

66. A hole of 1 mm is to be drilled in glass. It could be best done by
(a) Laser drilling (b) Plasma drilling
(c) Ultrasonic drilling (d) Electron beam drilling

67. A comparator for its working depends on
(a) comparison with standard such as slip gauges
(b) accurately caliberated scale
(c) optical device
(d) limit gauge

68. TMU means
(a) Time Motion Unit (b) Time Method Unit
(c) Time Measurement Unit (d) Time Movement Unit

69. Choose the Correct relationship between the given statements of Assertion (A) and Reason (R).
Assertion (A) : In case of control charts for variables, if some points fall outside the control limits, it is concluded that process is not under control.
Reason (R) : It was experimentally proved by Shewart that averages of four or more consecutive readings from a universe (population) or from a process, when plotted, will form a normal distribution curve.
Code :
(a) Both (A) and (R) are correct. (R) is the correct explanation of (A).
(b) Both (A) and (R) are correct. (R) is not the correct explanation of (A).
(c) (A) is correct, but (R) is in correct.
(d) (A) is incorrect, but (R) is correct.

70. Which one of the following is most important parameter for EDM ?

(a) Thermal capacity (b) Hardness

(c) Strength (d) Geometry

71. Which of the following is not the characteristics of work sampling ?

(a) Any interruption during study will not affect the results.

(b) The study causes less fatigue.

(c) Uneconomical for short cycle jobs.

(d) A stop watch is needed.

72. Which one of the followings statements is not correct regarding simplex method of linear programming ?

(a) It is an iterative procedure.

(b) It has a trial basic feasible solution to constraints.

(c) The collection of feasible solution does not constitute a convex set.

(d) It improves the first trial solution by a set of rules.

73. The following is not true for linear programming problems :

(a) Objective function is expressed as a linear function of variables.

(b) Resources are not limited.

(c) Some alternative course of actions are also available.

(d) Decision variables are inter related.

74. Which of the following are said to be the benefits of assembly line balancing ?

1. It mimises the in-process inventory.
2. It reduces the work content.
3. It smoothens the production flow.
4. It maintains the required rate of output.

Select the correct answer using the codes given below :

Code :

(a) 1, 2 and 3 (b) 2, 3 and 4

(c) 1, 3 and 4 (d) 1, 2 and 4

75. Value Engineering is concerned with the saving of

(a) Un-necessary costs

(b) Administrative difficulties

(c) Overhead costs

(d) Time

Note Q. Nos. 76-77 : Choose the correct relationship between the given statements of Assertion (A) and Reason (R) :

76. **Assertion (A)** **:** Value analysis is superior to other conventional cost reduction techniques.

Reason (R) **:** In conventional cost reduction techniques, value is increased by widening tolerance bands.

Code :

(a) Both (A) and (R) are true. (R) is the correct explanation of (A).
(b) Both (A) and (R) are true. (R) is not the correct explanation of (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true.

77. **Assertion (A)** **:** Vogel's approximation method yields the best initial basic feasible solution of a transportation problem.

Reason (R) **:** Vogel's method give allocations to the lowest cost elements of the whole matrix.

Code :

(a) Both (A) and (R) are correct. (R) is the correct explanation of (A).
(b) Both (A) and (R) are correct. (R) is not the correct explanation of (A).
(c) (A) is correct, but (R) is false.
(d) (A) is false, but (R) is correct.

78. The following is the general policy for A class items in ABC analysis :

1. Very strict control
2. Frequent review of their consumption
3. Safety stock kept

Which of these statement/s is/are correct ?

(a) 1 only (b) 1 and 2 only
(c) 2 only (d) 1, 2 and 3

79. In the EOQ model, if the unit ordering cost gets doubled, then the EOQ will be

(a) reduced to half (b) doubled
(c) increased 1.414 times (d) decreased 1.414 times

80. Value engineering is necessary to be used when the following symptoms are indicated

1. New product designs are to be introduced.
2. The firm is unable to meet delivery date.
3. Rate of return on investment goes down.

Which of the above statement/s is/are correct ?

(a) 1, 2 & 3 (b) 2 only
(c) 1 & 3 only (d) 2 & 3 only

81. The leaving basic variable in simplex method is the basic variable that

(a) has the lowest value.
(b) has the largest coefficient in the key row.
(c) goes to zero first, as the entering basic variable is increased.
(d) has the smallest coefficient in the key row.

82. ABC analysis is used in
(a) Job analysis (b) Production Schedule
(c) Inventory Control (d) Simulation

83. In ABC analysis, 'A' items are responsible to share approximately the following percentage of cost :
(a) 80 (b) 60
(c) 40 (d) 20

84. BEP indicates the recovery of
(a) variable costs only
(b) both fixed and variable costs
(c) fixed cost only
(d) both fixed and variable costs along with margin of profit

85. Which of the following is true about the initial basic feasible solution in simplex method ?
(a) It is an optimal solution. (b) All basic variables are zero.
(c) Solution is not possible. (d) Any one basic variable in zero

86. The probability law used for calculating the control limits of 'P' chart is
(a) Binomial (b) Poisson
(c) Normal (d) Exponential

87. If P = % activity and A = limit of accuracy in work sampling. The number of observations at a confidence level of 95% is given by
(a) $\frac{(1-P)}{A^2P}$ (b) $\frac{2(1-P)}{A^2P}$
(c) $\frac{3(1-P)}{A^2P}$ (d) $\frac{4(1-P)}{A^2P}$

88. When order quantity increases, the ordering cost will
(a) increase (b) decrease
(c) remains same (d) None of the above

89. Which type of layout is preferred in order to avoid excessive multiplication of facilities ?
(a) Process layout (b) Product layout
(c) Fixed position layout (d) Cellular manufacturing

90. An assembly activity is represented in an operation process chart by the symbol
(a) ~ (b) A
(c) D (d) ±

91. In an $m \times n$ transportation problem, the maximum number of basic variables is
(a) $m + n$ (b) $m - n$
(c) $m + n - 1$ (d) $m + n + 1$

92. In the model M/M/I : ∞/FCFS with utilization factor ρ, the expected line length is equal to

(a) $1 - \rho$ (b) $\frac{1}{1-\rho}$

(c) $\frac{\rho}{1-\rho}$ (d) $\frac{\rho^2}{1-\rho}$

93. Group 'C' items constitute the following percentage of items in ABC analysis :

(a) 10 (b) 20

(c) 50 (d) 70

94. In linear programming problem, the shadow price is

(a) the value assigned to one unit capacity

(b) the maximum cost per unit item

(c) the lowest sale price

(d) None of the above

95. Annual demand for a product, costing ` 100 per piece, is 900. Ordering cost per order is ` 100 and the holding cost is ` 2 per unit per year.
The economic order quantity is

(a) 200 (b) 300

(c) 400 (d) 500

96. The mathematical technique for finding the best use of limited resources of a company in the optimum manner is known as

(a) Value analysis (b) Network analysis

(c) Linear programming (d) Queuing theory

97. Which of the following charts indicates variability of variability within the collected samples ?

(a) $\bar{X}$ chart (b) σ chart

(c) c chart (d) u chart

98. Which statement is wrong about diamagnetic materials ?

(a) Their susceptibility is positive. (b) Their permeability is less than one.

(c) Super-conductors are diamagnetic. (d) They repel the external magnetic flux.

99. Super conductivity is that state of a material at which it electrical resistance

(a) becomes zero.

(b) becomes infinite.

(c) starts showing a change.

(d) stops being affected by temperature change.

100. The difference between Graphite and Diamond is that

(a) Diamond is transparent while Graphite is opaque.

(b) Diamond is insulator while Graphite is conductor.

(c) Diamond has all primary bonds while Graphite has three primary and one secondary bonds.

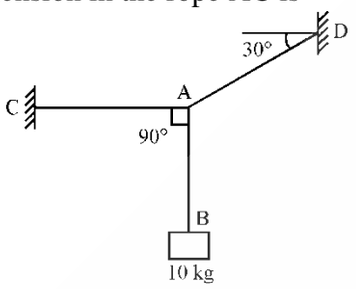
(d) All the above

101. Identify the pair which has same dimensions :

(a) Force and power (b) Energy and work

(c) Momentum and energy (d) Impulse and momentum

102. In the following figure, the tension in the rope AC is



(a) 17.32 N (b) 56.60 N

(c) 169.90 N (d) 113.20 N

103. The maximum frictional force, which comes into play, when a body just begins to slide over the surface of the other body, is known as

(a) Limiting friction (b) Static friction

(c) Dynamic friction (d) Coefficient of friction

104. A body subjected to coplanar non-concurrent forces will remain in a state of equilibrium if

(a) $\Sigma F_x = 0$ (b) $\Sigma F_y = 0$

(c) $\Sigma M = 0$ (d) All the above three

105. A rigid body is subjected to non-coplanar concurrent force system. If the body is to remain in a state of equilibrium, then

(a) $\Sigma F_x = \Sigma F_y = \Sigma F_z = 0$ (b) $\Sigma M_x = \Sigma M_y = 0$

(c) $\Sigma M_y = \Sigma M_z = 0$ (d) None of the above

106. One end of an uniform ladder, of length L and weight W, rests against a rough vertical wall and the other end rests on rough horizontal ground. The coefficient of friction f is same at each end. The inclination of ladder when it is on the point of slipping is

(a) $\tan^{-1}\left(\frac{1-f^2}{2f}\right)$ (b) $\tan^{-1}\left(\frac{1+f^2}{2f}\right)$

(c) $\tan^{-1}\left(\frac{2f}{1+f^2}\right)$ (d) $\tan^{-1}\left(\frac{2f}{1-f^2}\right)$

107. In the analysis of truss, the force system acting at each pin

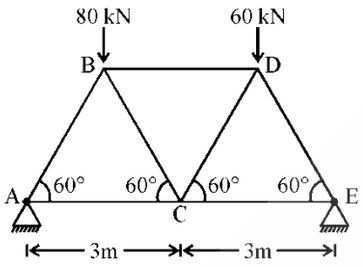
(a) is concurrent but not coplanar.

(b) is coplanar and concurrent.

(c) is coplanar and non-concurrent.

(d) does not satisfy rotational equilibrium.

108. For truss as shown below, the forces in the member AB and AC are



(a) Tensile in each
(b) Compressive in each
(c) Compressive and Tensile respectively
(d) Tensile and Compressive respectively

109. Two equal and mutually perpendicular forces of magnitude 'P', are acting at a point. Their resultant force will be

(a) $P\sqrt{2}$, at an angle of 30° with the line of action of any one force.
(b) $P\sqrt{2}$, at an angle of 45° with the line of action of each force.
(c) $2P\sqrt{2}$, at an angle of 45° with the line of action of each force.
(d) Zero

110. The relationship, between number of joints (J), and the number of members (m), in a perfect truss, is given by

(a) $m = 3j - 2$ (b) $m = 2j - 3$
(c) $m = j - 2$ (d) $m = 2j - 1$

111. Four forces P, 2P, 3 P & 4P act along the sides of a square, taken in order. The resultant force is

(a) zero (b) $\sqrt{5}P$
(c) $2\sqrt{2}P$ (d) 2P

112. According to the Newton's law of gravitation, the force of attraction, between the bodies of masses m_1 and m_2 situated at a distance 'd' apart, is given by

(a) $F = G\dfrac{m_1 m_2^2}{d^2}$ (b) $F = G\dfrac{m_1^2 m_2}{d^2}$

(c) $F = G\dfrac{m_1^2 m_2^2}{d^2}$ (d) $F = G\dfrac{m_1 m_2}{d^2}$

113. Varignon's theorem is related to

(a) Principle of moments (b) Principle of momentum
(c) Principle of force (d) Principle of inertia

114. Choose the correct relationship between the given statements of Assertion (A) and Reason (R).

Assertion (A) : Only axial forces act in members of roof trusses.

Reason (R) : Truss members are welded together.

Code :

(a) Both (A) & (R) are correct. (R) is the correct explanation of (A).

(b) Both (A) & (R) are correct. (R) is not the correct explanation of (A).

(c) (A) is true, but (R) is false.

(d) (A) is false, but (R) is true.

115. If a force of 30 N is required to move a mass of 35 kg on a flat surface horizontally at a constant velocity, what will be the coefficient of friction ?

(a) 0.067 (b) 0.087

(c) 0.098 (d) 0.092

116. A train crosses a tunnel in 30 seconds time. The speed of the train at entry and at exit from the tunnel are 36 and 54 km/hour respectively. If acceleration remains constant, the length of the tunnel is

(a) 350 m (b) 360 m

(c) 375 m (d) 400 m

117. If T_1 and T_2 are the initial and final tensions of an elastic string and x_1 and x_2 are the corresponding extensions, then the work done is

(a) $(T_2 + T_1)(x_2 - x_1)$ (b) $(T_2 - T_1)(x_2 + x_1)$

(c) $\frac{(T_2 - T_1)(x_2 + x_1)}{2}$ (d) $\frac{(T_2 + T_1)(x_2 - x_1)}{2}$

118. The escape velocity on the surface of the earth is

(a) 11.2 km/s (b) 8.2 km/s

(c) 3.2 km/s (d) 1.2 km/s

119. A motor boat whose speed in still water is 15 km/hr goes 30 km downstream and comes back in a total time of four and half hours. The stream has a speed of

(a) 3 km/hr (b) 4 km/hr

(c) 5 km/hr (d) 6 km/hr

120. If the period of oscillation is to become double, then

(a) the length of simple pendulum should be doubled.

(b) the length of simple pendulum should be quadrupled.

(c) the mass of the pendulum should be doubled.

(d) the length and mass should be doubled.

121. Choose the correct relationship between the given statements of Assertion (A) and Reason (R).

Assertion (A) : A dynamically system of multiple rotors on a shaft can rotate smoothly at the critical speeds of the system.

Reason (R) : Dynamic balancing eliminates all the unbalanced forces and couples from the system.

Code :

(a) Both (A) and (R) are true. (R) is the correct explanation of (A).
(b) Both (A) and (R) are true. (R) is not the correct explanation of (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true.

122. A spring scale reads 20 N as it pulls a 5.0 kg mass across a table. what is the magnitude of the force exerted by the mass on the spring scale ?

(a) 4.0 N (b) 5.0 N
(c) 20.0 N (d) 49.0 N

123. A thin circular ring of mass 100 kg and radius 2 m resting on a smooth surface is subjected to a sudden application of a tangential force of 300 N at a point on its periphery. The angular acceleration of the ring will be

(a) 1.0 rad/sec^2 (b) 1.5 rad/sec^2
(c) 2.0 rad/sec^2 (d) 2.5 rad/sec^2

124. The loss of kinetic energy, during inelastic impact of two bodies having masses m_1 and m_2, which are moving with velocity v_1 and v_2 respectively, is given by

(a) $\frac{m_1 m_2}{2(m_1 + m_2)} (v_1 - v_2)^2$ (b) $\frac{2(m_1 + m_2)}{m_1 m_2} (v_1 - v_2)^2$

(c) $\frac{m_1 m_2}{2(m_1 + m_2)} (v_1^2 - v_2^2)$ (d) $\frac{2(m_1 + m_2)}{m_1 m_2} (v_1^2 - v_2^2)$

125. The unit of energy in S.I unit is

(a) Dyne (b) Watt
(c) Newton (d) Joule

126. Polar moment of inertia of an equilateral triangle of side 'x' is given by

(a) $\frac{x^4}{16}$ (b) $\frac{x^4}{16\sqrt{3}}$
(c) $\frac{x^4}{32}$ (d) $\frac{x^4}{64}$

127. Poison's ratio is the ratio of

(a) Lateral stress to longitudinal stress
(b) Lateral stress to longitudinal strains
(c) Lateral strain to longitudinal strain
(d) Shear stress to shear strain

128. If the sum of all the forces acting on a moving object is zero, the object will
(a) continue moving with constant velocity
(b) accelerate uniformly
(c) change the direction of motion
(d) slow down and stop

129. Dynamic friction as compared to static friction is
(a) less (b) same
(c) more (d) None of the above

130. When a body is thrown up at an angle of 45° with a velocity of 100 m/sec, it describes a parabola. Its velocity on point of return down will be
(a) zero (b) 50 m/sec
(c) $100/\sqrt{2}$ m/s (d) $100\sqrt{2}$ m/sec

131. A projectile on a level ground will have maximum range if the angle of projection is
(a) 30° (b) 45°
(c) 60° (d) 75°

132. Which one of the following is not an example of plane motion ?
(a) Motion of a duster on a black board.
(b) Motion of ball point of pen on the paper.
(c) Motion of a cursor on the computer screen.
(d) Motion of a nut on a threaded bolt.

133. Which one of the following is a scalar quantity ?
(a) Force (b) Displacement
(c) Speed (d) Velocity

134. A 44 N block is thrust up a 30° inclined plane with an initial speed of 5 m/sec. It travels a distance of 1.5 m before it comes to rest. The frictional force acting upon it would be
(a) 18.3 N (b) 15.3 N
(c) 12.3 N (d) 9.3 N

135. A body is moving with a velocity 1 m/s and a force F is needed to stop it within a certain distance. If the speed of the body becomes three times, the force needed to stop it within the same distance would be
(a) 1.5 F (b) 3.0 F
(c) 6.0 F (d) 9.0 F

136. In a loaded beam, the term $\frac{dm}{dx}$ represents
(a) Deflection at a section (b) Slope at a section
(c) Intensity of loading at a section (d) Shear force at a section

137. A beam is of rectangular section. The distribution of shearing stress across a section is
(a) Parabolic (b) Rectangular
(c) Triangular (d) None of the above

138. In a stressed field, the change in angle between two initially perpendicular lines is called

(a) Normal strain (b) Shear strain

(c) Principal strain (d) Poisson's ratio

139. A metallic cube is subjected to equal pressure (P) on its all the six faces. If $\in_v$ is volumetric strain produced, the ratio $\frac{P}{\in_v}$ is called

(a) Elastic modulus (b) Shear modulus

(c) Bulk modulus (d) Strain-Energy per unit volume

140. To express stress-strain relations for a linearly elastic, homogeneous, isotropic material, minimum number of material constants needed are

(a) Two (b) Three

(c) Four (d) One

141. A tension member with a cross-sectional area of 30 mm^2 resists a load of 60 kN. What is the normal stress induced on the plane of maximum shear stress ?

(a) 2 kN/mm^2 (b) 1 kN/mm^2

(c) 4 kN/mm^2 (d) 3 kN/mm^2

142. If the Mohr's circle for a state of stress becomes a point, the state of stress is

(a) Pure shear state of stress (b) Uniaxial state of stress

(c) Identical principal stresses (d) None of the above

143. Torsional rigidity of a solid cylindrical shaft of diameter 'd' is proportional to

(a) d (b) d^2

(c) d^4 (d) $\frac{1}{d^2}$

144. In theory of simple bending of beams, which one of the following assumptions is incorrect ?

(a) Elastic modulus in tension and compression are same for the beam materials.

(b) Plane sections remain plane before and after bending.

(c) Beam is initially straight.

(d) Beam material should not be brittle.

145. A cylindrical shell of diameter 200 mm and wall thickness 5 mm is subjected to internal fluid pressure of 10 N/mm^2. Maximum shearing stress induced in the shell in N/mm^2, is

(a) 50 (b) 75

(c) 100 (d) 200

146. Consider the following statements :

1. An I.C. engine transforms chemical energy into mechanical energy.
2. A compressed spring possess potential energy.
3. A football rolling on the ground performs plane motion.
4. Strain gauges are used to measure torque.

Following are the correct statements :

(a) 1 and 2 only (b) 2 and 3 only
(c) 3 and 4 only (d) 1, 2 and 4 only

147. In a static tension tests of a low carbon steel sample, the gauge length affects

(a) yield stress
(b) ultimate tensile stress
(c) percentage elongation
(d) percentage reduction in cross-sectional area

148. One end of a metallic rod is fixed rigidly and its temperature is raised. It will experience

(a) zero stress (b) tensile stress
(c) compressive stress (d) None of the above

149. Two cantilever steel beams of identical length and of rectangular section are subjected to same point load at their free end. In one beam, the longer side of section is vertical, while in the other, it is horizontal. Beams defect at free end :

(a) equally irrespective of their disposition.
(b) more in case of longer side vertical.
(c) less in case of longer side horizontal.
(d) less in case of longer side vertical.

150. A long column of length (l) with both ends hinged, is to be subjected to axial load. For the calculation of Euler's buckling load, its equivalent length is

(a) $l/2$ (b) $l/\sqrt{2}$
(c) l (d) $2l$

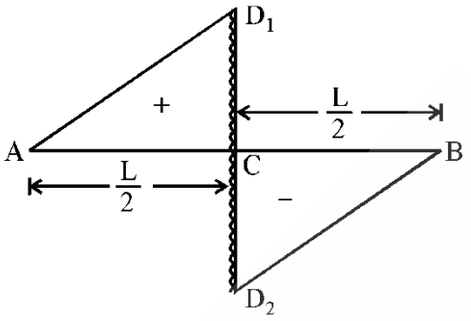
151. Match List – I with List – II and select the correct answer using the code given below the lists.

List – I (Characteristic)		**List – II (Member)**
A.	Kernel of section	1. Helical spring
B.	Tie and Strut	2. Bending of beams
C.	Section modulus	3. Eccentric loading of short column
D.	Stiffness	4. Roof truss

Code :

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

152. The bending moment diagram for a simply supported beam AB of length 'L' is shown below :



$CD_1 = CD_2 = \frac{M}{2}$

Sagging moment : positive

Hugging moment : negative

What is the load acting on beam AB ?

(a) An upward concentrated load $\frac{M}{2}$ at C.

(b) A downward concentrated load $\frac{M}{2}$ at C.

(c) An anticlockwise moment 'M' at C

(d) A clockwise moment 'M' at C.

153. Two simply supported beams of equal lengths, cross sectional areas, and section moduli, are subjected to the same concentrated load at its mid-length. One beam is made of steel and other is made of Aluminium. The maximum bending stress induced will be in

(a) Steel beam

(b) Aluminium beam

(c) Both beams of equal magnitude

(d) The beams according to their Elastic Moduli magnitude.

154. Two strips of equal lengths and widths are joined together by two rivets, one at each end. One strip is of copper and the other of steel. Now, the temperature of this assembly is lowered, the rivets will undergo.

(a) Bending (b) Single shear

(c) Double shear (d) Both (a) & (b) above

155. A uniform metal bar of weight 'W', length '*l*', cross-sectional area 'A' is hung vertically with its top end rigidly fixed. Which section of the bar will experience maximum shear stress ?

(a) Top-section (b) Mid-section

(c) Bottom-section (d) *l*/3 from top

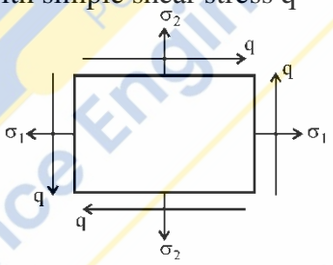
156. Which one of the following will result into a constant strength beam ?
(a) The bending moment at every section of the beam is constant.
(b) Shear force at every section is same.
(c) The beam is of uniform section over its whole length.
(d) The ratio of bending moment to the section modulus for every section along the length is same.

157. A beam of Z-section is called a
(a) doubly symmetric section beam (b) singly symmetric section beam
(c) a-symmetric section beam (d) none of the above

158. The outside diameter of a hollow shaft is twice its inside diameter. The ratio of its torque carrying capacity to that of a solid shaft of the same material and the same outside diameter is
(a) 15/16 (b) 3/4
(c) 1/2 (d) 1/16

159. Choose the correct relationship in the given statements of Assertion (A) and Reason (R).
Assertion (A) : A plane state of stress does not necessarily result into a plane state of strain.
Reason (R) : Normal stresses acting along X and Y directions will also result into strain along the Z-direction.
Code :
(a) Both (A) & (R) are correct. (R) is the correct explanation of (A).
(b) Both (A) & (R) are correct. (R) is not the correct explanation of (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true.

160. A body is subjected to two unequal like direct stresses σ_1 and σ_2 in two mutually perpendicular planes along with simple shear stress q



Which among the following is then a wrong statement ?
(a) The principal stresses at a point are

$$P_1, P_2 = \frac{\sigma_1 + \sigma_2}{2} \pm \sqrt{\left[\left(\frac{\sigma_1 - \sigma_2}{2}\right)^2 + q^2\right]}$$

(b) The position of principal planes with the plane of stress σ_1, are

$$\theta_1 = \frac{1}{2} \tan^{-1} \frac{2q}{\sigma_1 - \sigma_2}; \theta_2 = \theta_1 + 45°$$

(c) Maximum shear stress is $(\sigma_t)_{max} = \pm \sqrt{\left[\left(\frac{\sigma_1 - \sigma_2}{2}\right)^2 + q^2\right]}$

(d) Planes of maximum shear are inclined at 45° to the principal planes.

161. Slenderness ratio has dimension of

(a) cm (b) cm^{-1}

(c) cm^2 (d) None

162. When a body is subjected to direct tensile stresses (σ_x and σ_y) in two mutually perpendicular directions, accompanied by a simple shear stress τ_{xy}, then in Mohr's circle method, the circle radius is taken as

(a) $\frac{\sigma_x - \sigma_y}{2} + \tau_{xy}$ (b) $\frac{\sigma_x + \sigma_y}{2} + \tau_{xy}$

(c) $\frac{1}{2}\sqrt{(\sigma_x - \sigma_y)^2 + 4\tau_{xy}^2}$ (d) $\frac{1}{2}\sqrt{(\sigma_x + \sigma_y)^2 + 4\tau_{xy}^2}$

163. The ratio of hoop stress to longitudinal stress in thin walled cylinders is

(a) 1 (b) 1/2

(c) 2 (d) 1/4

164. The theory applicable for the analysis of thick cylinders, is

(a) Lame's theory (b) Rankine's theory

(c) Poisson's theory (d) Caurbon's theory

165. The unit of modulus of elasticity is same as those of

(a) stress, strain and pressure

(b) stress, pressure and modulus of rigidity

(c) stress, force and modulus of rigidity

(d) stress, force and pressure

166. The relation among the elastic constants E, G and K is

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

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

167. Which of the following has no unit ?

(a) Kinematic viscosity (b) Strain

(c) Surface Tension (d) Bulk Modulus

168. What does the elasticity of material enables it to do ?

(a) Regain the original shape after the removal of applied force.

(b) Draw into wires by the application of force.

(c) Resist fracture due to high impact.

(d) Retain deformation produced under load permanently.

169. Which of the following brakes is commonly used in motor cars ?

(a) Band Brake (b) Shoe Brake

(c) Internal expanding Shoe Brake (d) All the above

170. Which one of the following is not an example of higher pair ?

(a) Disc Cam and roller follower (b) Spur Gear meshing teeth

(c) Ball Bearing (d) Bush Bearing

171. The minimum number of teeth which can be cut for standard tooth for a given pressure angle 'ϕ' the following

(a) $\sin^2 \phi/2$ (b) $2/\sin^2 \phi$

(c) $2 \sin^2 \phi$ (d) $\frac{2}{\sin 2\phi}$

172. When there is no slip, the power transmitted by belts is proportional to

(a) $(T_1 - T_2)\ V$ (b) $(T_1 + T_2)\ V$

(c) $(T_1 / T_2)\ V$ (d) $\frac{(T_1 - T_2)}{V}$

173. When two gear teeth are in mesh, then pure rolling occurs at the

(a) root of tooth (b) tip of tooth

(c) pitch point (d) flank

174. In a governor, if the equilibrium speed is constant for all radii of rotation of balls, the governor is said to be

(a) stable governor (b) unstable governor

(c) inertia governor (d) isochronous governor

175. The instantaneous centre of rotation of a circular disc rolling on a straight path is at

(a) the centre of the disc (b) their point of contact

(c) the centre of gravity of the disc (d) infinity

176. For a safe design, a friction clutch is designed assuming

(a) uniform wear (b) uniform pressure

(c) any one of the above (d) None of the above

177. In a simple gear train, there is odd number of idlers. The direction of rotation of the driver and the driven gears will be

(a) same

(b) opposite

(c) depends upon the number of teeth of the gears

(d) depends upon the diameter of idlers used

178. In free vibrations, the acceleration vector leads the displacement vector by

(a) $\pi/3$ (b) $\pi/2$

(c) $2\pi/3$ (d) π

179. At a certain speed, revolving shafts tend to vibrate violently in transverse directions, this speed is known as

(a) whirling speed (b) critical speed

(c) whipping speed (d) All the above

180. If the speed of the engine varies between 390 and 410 rpm in a cycle of operation, the coefficient of fluctuation of speed will be

(a) 0.01 (b) 0.03

(c) 0.05 (d) 0.07

181. When teeth formed on the cones are straight, the gears are known as

(a) worm gear (b) helical gear

(c) straight bevel (d) spiral bevel

182. Creep in belts occurs due to which one of the following :
(a) Belt and pulley surfaces are smooth
(b) Belt is thick
(c) Due to unequal tensions on the two sides of the pulley
(d) The pulley diameters are large

183. The point on the Cam with maximum pressure angle is known as the
(a) Cam centre (b) Pitch point
(c) Trace point (d) Prime point

184. Static balancing involves balancing of
(a) forces (b) couples
(c) masses (d) All the above

185. The motion of a nut on a threaded bolt is
(a) Helical (b) Plane
(c) Spherical (d) None of the above

186. Spur gears have/are
(a) straight teeth perpendicular to the axis.
(b) curved teeth perpendicular to the axis.
(c) not subjected to axial thrust due to tooth load.
(d) subjected to axial thrust due to tooth load.

187. Coriolis' component of acceleration occurs in
(a) quick return mechanism (b) four bar mechanism
(c) slider crank mechanism (d) none of the above

188. Identify the wrong statement :
(a) A mechanism is an assemblage of four or more links.
(b) A slider crank chain consists of two sliding pairs and two turning pairs.
(c) A kinematic chain requires at least four links and four turning pairs.
(d) Open pairs are those whose elements are not held together mechanically.

189. Any distributed mass can be replaced by two point masses to have the same dynamical properties, if
(a) The sum of the two masses is equal to the total mass.
(b) The combined centre of mass coincides with that of the rod.
(c) The moment of inertia of two point masses about perpendicular axis through their combined centre of mass is equal to that of the rod.
(d) All the above.

190. For steady state forced vibrations, the phase lag at resonance condition is
(a) 0° (b) 45°
(c) 80° (d) 90°

191. The maximum efficiency of a screw jack having square threads and friction angle of 30° will be
(a) 11 % (b) 20 %
(c) 30 % (d) 33 %

192. If the damping factor for a vibrating system is unity, then the system is
(a) critically damped (b) under damped
(c) over damped (d) zero damped

193. A gear train, in which at least one of the gear axes is in motion relative to the frame, is known as

(a) reverted gear train (b) non-reverted gear train
(c) epicyclic gear train (d) none of the above

194. In a mechanism having six links, the number of instantaneous centres of rotation present are

(a) 15 (b) 12
(c) 9 (d) 6

195. A flywheel in an I.C. engine :

(a) controls the supply of fuel to the engine
(b) controls the cyclic fluctuation of speed
(c) controls the speed variation due to load
(d) All the above

196. In a slotted lever and crank quick return mechanism used in shapers, the beginning and end of cutting stroke occurs when

(a) cranked lever are in line with each other
(b) crank is perpendicular to lever
(c) crank is horizontal
(d) lever is horizontal

197. Stress and Strain are tensor of

(a) zero-order (b) first order
(c) second order (d) None of the above

198. $\sigma_x + \sigma_y = \sigma_{x'} + \sigma_{y'} = \sigma_1 + \sigma_2$

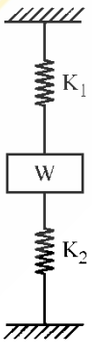
The above relation is called

(a) independency of normal stresses (b) constancy of normal stresses
(c) first invariant of stress (d) all the above three

199. In a slider-crank mechanism, the piston velocity is maximum, when :

(a) Crank is perpendicular to line of stroke.
(b) Crank and connecting rod are collinear.
(c) Crank is perpendicular to connecting rod.
(d) None of the above.

200. A body of weight w is supported by two springs as shown below. The equivalent spring constant is :



(a) $\frac{1}{K_1} + \frac{1}{K_2}$ (b) $K_1 + K_2$
(c) $K_1 - K_2$ (d) $K_1 K_2$

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