



QUESTION BOOKLET MECHANICAL ENGINEERING

787257

PAPER - II (05)

Time Allowed : 2 Hours

Maximum Marks : 200

INSTRUCTIONS FOR CANDIDATES

1. Please do not open this Question Booklet until you are told to do so.
2. Candidate must fill up the necessary informations in the space provided on the OMR answer sheet before commencement of the examination.
3. Answer sheet will be processed by electronic device. Invalidation of answer sheet due to incomplete / incorrect filling of relevant circle of Roll No. and Question Booklet Series in the OMR answer sheet shall result in cancellation of candidature. Any deficiency in filling up OMR answer sheet will be the sole responsibility of the candidate.
4. An example is given below how to fill / mark (darken) Roll No. 41311706 and Question Booklet Series - B. Accordingly, you have to fill / mark (darken) the Roll No. and Question Booklet Series given to you in your OMR answer sheet.

EXAMPLE

Roll No.								Question Booklet Series
4	1	3	1	1	7	0	6	☒ B
1	2	1	2	2	1	1	1	A ☐
2	3	2	3	3	2	2	2	B ☒
3	4	3	4	4	3	3	3	C ☐
4	5	4	5	5	4	4	4	D ☐
5	6	5	6	6	5	5	5	
6	7	6	7	7	6	6	6	
7	8	7	8	8	7	7	7	
8	9	8	9	9	8	8	8	
9	0	9	0	0	9	9	9	
0		0			0	0	0	

5. For marking the correct answer, darken one circle by **BLUE BALLPOINT PEN** only.
6. Please do not mark (darken) more than one circle. Darkening more than one circle against an answer will be treated as wrong answer.
7. Do not detach any leaf from this Question Booklet. After the examination, hand over the OMR answer sheet to the Room Invigilator. You are allowed to take the Question Booklet and carbon copy of the OMR answer sheet after examination is over.
8. Each question carries 2 marks. There is no negative marking for any wrong answer.
9. Possession and use of Calculator, Mobile Phone, Pager or any other electronic gadget is strictly prohibited in the Examination Hall.
10. Please abide by the instructions above and those given on the OMR answer sheet, failure to comply these instructions will be sole responsibility of the candidates.



1. If two gears A with $m_A = 2$ mm and $t_A = 50$ and B with $m_B = 4$ mm and $t_B = 30$ teeth are in mesh with each other such that A rotates with 100 rpm, then revolution of gear B is approximately near to
 - (A) 60 rpm
 - (B) 100 rpm
 - (C) 92 rpm
 - (D) 83 rpm

2. The knuckle pin in a two rod knuckle joint under axial load will be subjected to shear stress. The failure area of the pin under shear will be
 - (A) $\frac{\pi}{4} d^2$
 - (B) πd
 - (C) $\frac{\pi}{2} d^2$
 - (D) None of the above

3. For a square and flat key, the relation between induced stresses due to the transmitted torque will be
 - (A) $\sigma_c = \tau$
 - (B) $\sigma_c = \tau/2$
 - (C) $\sigma_c = 3\tau$
 - (D) $\sigma_c = 2\tau$

4. For the condition of principal stresses σ_1, σ_2 positive and $\sigma_3 = 0$, and also $\sigma_1 > \sigma_2 > \sigma_3$, the equation of boundary line of failure envelop as per maximum shear stress theory will be
 - (A) $\sigma_1 - \sigma_2 = S_{yt}$
 - (B) $\sigma_1 = S_{sy}$
 - (C) $\sigma_1 = S_{yt}$
 - (D) $\sigma_2 = S_{yt}$

5. In case of a bolted joint, if the gasket is too soft, the resultant load, P_b on bolt will be
 - (A) initial tension, P_i only
 - (B) external load, P , only
 - (C) sum of initial tension and external load, $(P_i + P)$
 - (D) difference of external load and initial tension, $(P - P_i)$

6. A screw thread with M12 $\times$ 1.25 designation indicates
 - (A) A coarse thread, with 12 mm major diameter
 - (B) A coarse thread, with 12 mm minor diameter
 - (C) A fine thread with 12 mm major dia and 1.25 mm pitch.
 - (D) A fine thread with 12 mm minor dia and 1.25 mm pitch.

7. Transverse shear stress at the root of the nut τ_n is expressed by

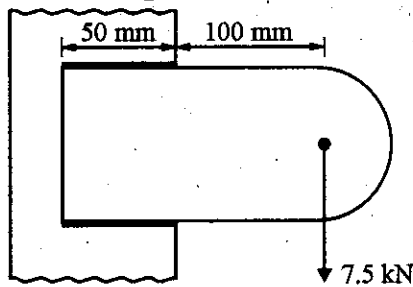
- (A) $\frac{W}{\pi d_c t Z}$
 (B) $\frac{W}{\pi d t Z}$
 (C) $\frac{4 W}{\pi d_c^2}$
 (D) $\frac{16 W t}{\pi d_c^3}$

Where W – load, d – major dia.,
 d_c – core dia.

t – thread thickness at the root
 of the nut and

Z – number of threads in
 engagement with the nut.

8. Magnitude of primary shear stress in case of eccentrically loaded welded connection with throat t of the weld as shown in figure will be in N/mm^2 .



- (A) $\frac{7.5}{t}$
 (B) $\frac{75}{t}$
 (C) $\frac{750}{t}$
 (D) $\frac{7500}{t}$

9. For a parallel fillet weld, the ratio between throat, t and leg, h is

- (A) $\sqrt{2}$
 (B) $2\sqrt{2}$
 (C) $\frac{1}{2\sqrt{2}}$
 (D) $\frac{1}{\sqrt{2}}$

10. If a material fails below its yield point failure would be due to

- (A) Straining
 (B) Fatigue
 (C) Creep
 (D) Sudden loading

11. Maximum principal stress theory is generally applicable for

- (A) Ductile material
 (B) Brittle material
 (C) Elastic material
 (D) None of the above

12. Margin m in rivetted joint is usually kept equal to

- (A) d
 (B) $1.25 d$
 (C) $1.5 d$
 (D) $2 d$

13. If tearing efficiency of a rivetted joint is 80%, then the ratio of diameter d of rivet to the pitch p will be

- (A) 0.2
- (B) 0.25
- (C) 0.3
- (D) 0.4

14. Bearing characteristic number is identified by

- (A) p/ZN
- (B) Z/pN
- (C) Zp/N
- (D) ZN/p

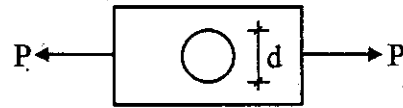
15. When a circular shaft is subjected to torque only, the torsional shear stress is

- (A) Maximum at the axis of rotation and zero at outer surface.
- (B) Maximum at outer surface and zero at axis of rotation.
- (C) Uniform from axis of rotation to outer surface
- (D) None of the above

16. When the diameter of shaft is doubled, its torque transmission capacity will increase by

- (A) 8 times
- (B) 4 times
- (C) 16 times
- (D) 2 times

17. Stress concentration factor in an infinite plate with a transverse hole, loaded by in plane uniaxial tension is



- (A) 2
- (B) 2.5
- (C) 3
- (D) 4

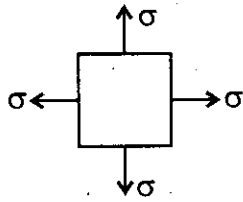
18. Surface finish factor for a mirror polished component is

- (A) 0.75
- (B) 0.85
- (C) 0.9
- (D) 1

19. In order to determine the endurance strength, the rotating beam specimen is subjected to

- (A) Repeated stress
- (B) Completely reversed stress
- (C) Maximum stress
- (D) None of the above

20. Maximum shear stress for the shown stress condition will be



- (A) $\sigma/2$
 (B) σ
 (C) 2σ
 (D) 0
21. If a cylindrical rod of cross section A is applied with uniaxial tension P, the maximum shear stress in the rod will be

- (A) 0
 (B) $\frac{1}{2} \frac{P}{A}$
 (C) $\frac{P}{A}$
 (D) $\frac{2P}{A}$

22. For biaxial state of stress, maximum shear stress in the principal plane will be

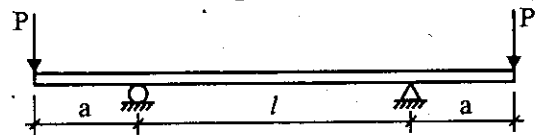
- (A) 0
 (B) σ_1
 (C) σ_2
 (D) $(\sigma_1 - \sigma_2)/2$

23. One of the following expression is true at any cross section of the transversely loaded beam between points of application of concentrated loads

- (A) $\frac{dM_X}{dX} = P$
 (B) $\frac{dM_X}{dX} = W$
 (C) $\frac{dM_X}{dX} = V_X$
 (D) $\frac{dM_X}{dX} = 0$

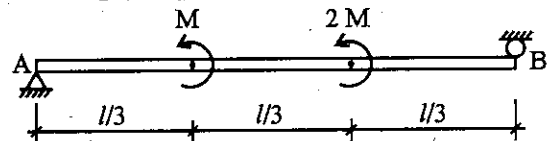
where P – load, W – load intensity, V_X – shear force, M_X – Bending Moment

24. Maximum bending moment for the shown overhang beam with loads will be



- (A) $P\left(a + \frac{l}{2}\right)$
 (B) $P \cdot \frac{l}{2}$
 (C) Pa
 (D) $P(2a + l)$

25. Reaction R_B at support B for the shown simply supported beam will be



- (A) zero
 (B) $3M$
 (C) M/l
 (D) $3M/l$

26. For a cast iron simply supported beam with low strength in tension and high strength in compression, due to the transversely applied load, with beam bent concave upwards, following section will be better

(A) Square



(B) Rectangular



(C) Circular



(D) Trapezoidal



27. Two coiled springs each having stiffness k are placed in parallel. The stiffness of the combination will be

(A) $4k$

(B) $2k$

(C) $\frac{k}{2}$

(D) $\frac{k}{4}$

28. If strain energy at the point of application of a point load P at the mid span of a simply supported beam is $U = \frac{P^2 l^3}{96EI}$, the deflection at this point will be

(A) $\frac{Pl^3}{3EI}$

(B) $\frac{Pl^3}{48EI}$

(C) $\frac{Pl^3}{96EI}$

(D) $\frac{5Pl^4}{384EI}$

29. For a hollow circular shaft under torsion T only the shear stress, τ will be expressed by

(A) $\frac{16T}{\pi(d_o^3 + d_i^3)}$

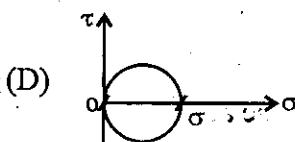
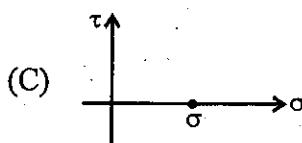
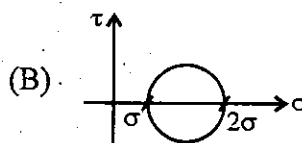
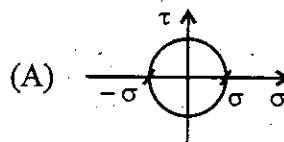
(B) $\frac{32T}{\pi(d_o^3 + d_i^3)}$

(C) $\frac{16\sqrt{M^2 + T^2}}{\pi d_o^3}$

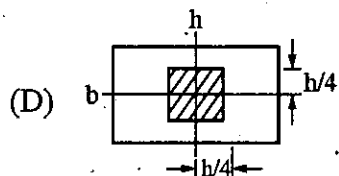
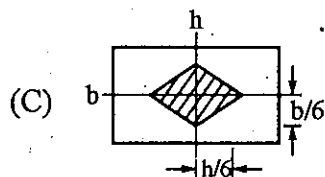
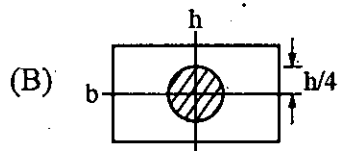
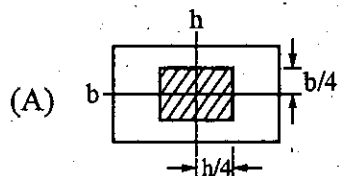
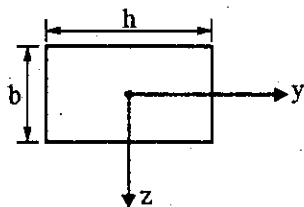
(D) $\frac{16T d_o}{\pi(d_o^4 + d_i^4)}$

Where d_o , d_i are outer and inner diameters.

30. Mohr's circle for membrane stresses in a thin walled spherical pressure vessel with radius r and wall thickness t , under internal pressure p will be



31. The core of a section in a strut within which the load P will induce compression over the entire section for the rectangular section will be



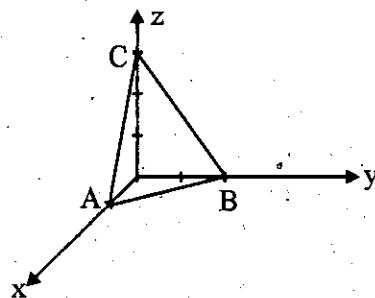
32. α -iron has following crystalline structure :

- (A) BCC
- (B) FCC
- (C) HCP
- (D) None of the above

33. A FCC crystalline structure unit cell shares

- (A) 8 atoms
- (B) 9 atoms
- (C) 13 atoms
- (D) 14 atoms

34. Miller indices of the plane ABC will be



- (A) 123
- (B) 321
- (C) 632
- (D) 211

35. Slow plastic deformation of metals under a constant stress is known as

- (A) Fatigue
- (B) Creep
- (C) Endurance
- (D) Ductility

36. Isotropic materials are those which have the same
- (A) stresses induced in all direction.
 - (B) elastic properties in all direction.
 - (C) magnetic properties in all direction.
 - (D) density in all direction.
37. Which of the following steel is softest ?
- (A) Ferrite
 - (B) Cementite
 - (C) Pearlite
 - (D) Austenite
38. Following is a unique property of cast iron :
- (A) Malleability
 - (B) Ductility
 - (C) Surface finish
 - (D) Damping characteristic
39. Corrosion resistance of steel is increased by addition of
- (A) Cr & Ni
 - (B) Sulphure, Phosphorous, lead
 - (C) Zinc
 - (D) Tungsten, Vanadium
40. German silver is an alloy of
- (A) Silver and gold
 - (B) Silver and some impurities
 - (C) Nickel, copper and zinc
 - (D) None of the above

41. Babbitts are used for
- (A) Gears
 - (B) Bearings
 - (C) Bolts
 - (D) Clutch liners
42. Cold working is done below a certain temperature of material known as
- (A) Critical temperature
 - (B) Recrystallization temperature
 - (C) Transition temperature
 - (D) None of the above
43. The process of pulling a wire or bar through a die opening is called
- (A) Rolling process
 - (B) Open die forging process
 - (C) Drawing process
 - (D) None of the above
44. An annealed copper strip, 9 inch (228 mm) wide and 1 inch (25 mm) is rolled to a thickness of 0.80 inch (20 mm) in one pass.
- The absolute value of true strain that the strip undergoes is
- (A) 0.20
 - (B) 0.25
 - (C) 0.223
 - (D) 0.225
45. Periodic circumferential cracks on the surface is known as
- (A) Bamboo defect
 - (B) Pipe defect
 - (C) Fir tree defect
 - (D) Centre crack

46. Distorsion allowance is not provided in the following shape of casting :

- (A) U
- (B) T
- (C) C
- (D) O

47. Low permeability in sand can cause following defects in casting :

- (A) Rough surface
- (B) Blow holes
- (C) Hot tears
- (D) Drop

48. Powders of two or more pure metals are mixed in a ball mill. The process is known as

- (A) Electrolytic deposition
- (B) Reduction
- (C) Communication
- (D) Mechanical Alloying

49. Which of the following structure of steel is magnetic in nature ?

- (A) δ
- (B) γ
- (C) α
- (D) None of the above

50. Hypoeutectoid steels on cooling during annealing process converts to

- (A) Pearlite
- (B) Cementite
- (C) Austenite
- (D) None of the above

51. Thermoplastics are

- (A) Non-linear polymers in which rise in temperature increases plasticity.
- (B) Linear polymers in which rise in temperature increases plasticity.
- (C) Linear polymers in which temperature has no effect on plasticity.
- (D) None of the above

52. Thermit welding is a form of

- (A) Resistance welding
- (B) Gas welding
- (C) Fusion welding
- (D) Arc welding

53. The most commonly used flame is gas welding is

- (A) Neutral
- (B) Oxidising
- (C) Carburising
- (D) None of the above

54. In reverse polarity welding

- (A) Electrode holder is connected to negative and work to positive.
- (B) Electrode holder is connected to positive and work to negative.
- (C) Electrode holder is connected to positive and work is earthed.
- (D) Electrode holder is earthed and work is connected to negative.

55. The time period between placing an order and its receipt in stock is known as

- (A) Carrying time
- (B) Shortage time
- (C) Over time
- (D) Lead time

56. Given annual usage, $U = 50$ units, Procurement cost, $P = ₹ 15$ per order, cost per piece, $C_1 = ₹ 100$ per item and C_2 , a percentage including insurance, taxes, etc = 10%, the economic order quantity EOQ will be

- (A) $\sqrt{15}$
- (B) $\sqrt{100}$
- (C) $\sqrt{150}$
- (D) $\sqrt{105}$

57. Inventory carrying cost

- (A) Increases with quantity ordered.
- (B) Is a fixed cost with reference to quantity ordered.
- (C) Decreases with quantity ordered.
- (D) First increases than decreases with quantity ordered.

58. At Break Even Point there is

- (A) Profit
- (B) Loss
- (C) No profit or no loss
- (D) None of the above

59. The Break Even quantity for an industry selling a product for ₹ 10/unit, with fixed cost for assets ₹ 40,000 and variable cost of ₹ 6 per unit will be

- (A) 8,000
- (B) 10,000
- (C) 12,000
- (D) 14,000

60. Short term regular variations related to the calender or time of day is known as

- (A) Seasonality
- (B) Trend
- (C) Cycles
- (D) Random variations

61. A dummy activity

- (A) is artificially introduced.
- (B) is represented by a dotted line.
- (C) does not consume time.
- (D) All of the above

62. PERT analysis is based on

- (A) Optimistic time
- (B) Pessimistic time
- (C) Most likely time
- (D) All of the above

63. The performance of a specific task in CPM is known

- (A) Dummy
- (B) Event
- (C) Activity
- (D) Control

64. The critical activity has
- Maximum float
 - Minimum float
 - Zero float
 - None of the above
65. For completion of a project, the critical path of the network represents
- Minimum time
 - Maximum time
 - Maximum cost
 - Minimum cost
66. Which one of the following represents an event ?
- Concrete cured
 - Fixing of door
 - Plastering of walls
 - Selecting sites
67. The tool life equation is given by $VT^{0.5} = \text{const.}$ If tool life is reduced to one-fourth of its initial life, the percentage increase in cutting velocity is
- 100%
 - 200%
 - 125%
 - 80%
68. Word Robot was coined by a Czech novelist from a Czech word
- Rabota
 - Rebota
 - Ribota
 - Robota
69. The Robotic manipulator designed with Cartesian co-ordinate systems has
- three linear movements
 - three rotational movements
 - two linear and one rotational movements
 - two rotational and one linear movement
70. The PUMA 560, a Programmable Universal Machine for assembly robot has the 6 degrees of freedom from
- 3 revolute joints and 3 prismatic joints
 - 2 revolute joints and 4 prismatic joints
 - 4 revolute joints and 2 prismatic joints
 - 6 revolute joints
71. Given the joint variables, q_i , determination of end effector's position and orientation is known as
- Inverse kinematics
 - Forward kinematics
 - Backward kinematics
 - None of the above
72. What is the name for space inside which a robotic manipulator operates ?
- Environment
 - Spatial base
 - Work envelope
 - Exclusion zone

73. The number of moveable joints in the base, arm and end effector of the robot determines

- (A) degrees of freedom
- (B) payload capacity
- (C) operational limits
- (D) flexibility

74. Which part of the Robot provides motion to the manipulator and end effectors ?

- (A) Controller
- (B) Sensor
- (C) Actuator
- (D) None of the above

75. θ_i in a serial robotic manipulator according to Denavit-Hartenberg notation is

- (A) Rotation about X axis
- (B) Rotation about Y axis
- (C) Rotation about Z axis
- (D) None of the above

76. According to Denavit-Hartenberg notations joint axis is taken as

- (A) X axis of the frame
- (B) Y axis of the frame
- (C) Z axis of the frame
- (D) None of the above

77. If $Z = x_1 + x_2$ is subjected to constraints $x_1 + x_2 \leq 1$, $-3x_1 + x_2 \leq 3$ and $x_1 \leq 0$, $x_2 \geq 0$, then the maximum value of Z occurs at

- (A) $\left(\frac{1}{2}, \frac{1}{2}\right)$
- (B) (0, 5)
- (C) Infeasible solution
- (D) None of these

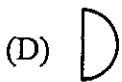
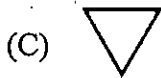
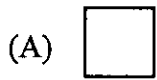
78. ABC analysis helps segregating the items and helps the organization to control them. Amongst all items, A items are

- (A) low valued and constitute about 75% of total items.
- (B) account for 15-20% of the total inventory and constitute about 15-20% of total items.
- (C) account for 70-80% of the total inventory and constitute about 10% of total items.
- (D) None of these

79. The value of standard deviations v , are used to decide the upper and lower control limits, 1σ , limits occupy

- (A) 99.73% of the area of the normal curve
- (B) 95.45% of the area of the normal curve
- (C) 100% of the area of the normal curve
- (D) 68.27% of the area of the normal curve

80. Process charts are generally represented by symbols following symbol :



81. A control chart indicates whether the process is in control or not. Following is a process variability chart :

(A) $\bar{X}$ chart

(B) p chart

(C) np chart

(D) c chart

82. The cost reduction technique in comparison to the worth of a product is known as

(A) Reverse Engineering

(B) Value Engineering

(C) Material Engineering

(D) Quality Engineering

83. Value is the cost directly proportionate to

(A) Price

(B) Product material

(C) Function

(D) All of the above

84. The price paid by the buyer is

(A) Use value

(B) Cost value

(C) Esteem value

(D) Exchange value

85. Who is named as Father of Value Analysis ?

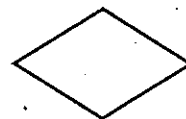
(A) Lawrence D. Miles

(B) Frank Gilberth

(C) F.W. Taylor

(D) Philip M. Morse

86. Flowchart refers to a pictorial representation of an algorithm. Various symbols are used in a flow chart. Following diamond shaped box denotes :



(A) Initiation

(B) Input

(C) Output

(D) Decision

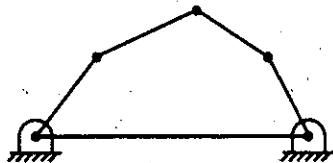
87. Numbers of instantaneous centres for a four bar planar kinematic chain are

- (A) 4
- (B) 5
- (C) 6
- (D) 7

88. If three bodies have planar motion, their instantaneous centres lie on

- (A) two parallel lines
- (B) two perpendicular lines
- (C) two intersecting non-perpendicular lines
- (D) on same straight line

89. The degrees of freedom for the given planar mechanism will be



- (A) 1
- (B) 2
- (C) 3
- (D) None of the above

90. In case of simple harmonic motion of a follower (rise – 90°, dwell – 90°, fall – 90°, rest – 90°) the maximum velocity of the follower will be

- (A) $\frac{\pi \omega s}{2\theta}$
- (B) $\frac{\pi^2 \omega^2 s}{2\theta}$
- (C) $\frac{2\omega s}{\theta}$
- (D) $\frac{4\omega^2 s}{\theta^2}$

where, s – stroke of the follower

θ – cam angle

ω – angular velocity

91. Sensitiveness of a governor is defined as

- (A) $\frac{N_1 + N_2}{N_1 - N_2}$
- (B) $\frac{N_1 - N_2}{N_1 + N_2}$
- (C) $\frac{2(N_1 - N_2)}{N_1 + N_2}$
- (D) $\frac{2(N_1 + N_2)}{N_1 - N_2}$

N_1, N_2 are maximum and minimum speed.

92. Addendum circle for a spur gear has a diameter equal to

- (A) pitch circle diameter
- (B) pitch circle diameter – 2m
- (C) pitch circle diameter + 2m
- (D) None of the above

93. Relationship between circular pitch p_c and diametral pitch p_d is
- $p_c \cdot p_d = 2\pi$
 - $p_c \cdot p_d = \pi$
 - $p_c \cdot p_d = \frac{1}{\pi}$
 - $p_c = \pi \cdot p_d$
94. If two moving elements have surface contact in motion, such a pair is known as
- Lower pair
 - Higher pair
 - Revolute pair
 - None of the above
95. A closed links mechanism will be an assemblage of minimum
- 2 links
 - 3 links
 - 4 links
 - 5 links
96. Crowning on pulley helps
- in increasing velocity ratio
 - in decreasing the slip of the belt
 - in automatic adjustment of belt position so that belts run centrally
 - None of the above
97. The locus of a point on a thread unwound from a cylinder will be
- a straight line
 - a circle
 - a helix
 - an involute
98. In viscous damping system, $m\ddot{x} + c\dot{x} + sx = 0$, overdamping occurs when
- $\frac{c^2}{2m} > \frac{s}{m}$
 - $\frac{c^2}{2m} < \frac{s}{m}$
 - $\frac{c^2}{4m^2} > \frac{s}{m}$
 - None of the above
99. The frictional torque transmitted in a flat pivot bearing considering uniform pressure is
- $\frac{1}{2} \mu WR$
 - $\frac{2}{3} \mu WR$
 - $\frac{3}{4} \mu WR$
 - μWR
100. If the rotating mass of a rim type flywheel is distributed on another rim type flywheel whose mean radius is half the mean radius of the former, then the energy stored in the latter at the same speed will be
- same as the first one
 - two times the first one
 - four times the first one
 - one fourth times the first one