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Previous Year Paper
Mechanical 2013 Paper I

UPPSC-AG-2013

जब तक आपको यह परीक्षण पुस्तिका खोलने को न कहा जाए तब तक न खोलें।

सीरीज़

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अपना अनुक्रमांक सामने बॉक्स के अन्दर लिखें

अंकों में →

शब्दों में Exam - April - 2014

प्रश्नों के उत्तर के लिये केवल काले बॉल-प्वाइंट पेन का प्रयोग करें।

अभ्यर्थी उत्तर-पत्रक पर उत्तर देने से पहले सभी अनुदेशों को सावधानीपूर्वक पढ़ लें।

आपको अपने सभी उत्तर केवल उत्तर-पत्रक पर ही देने हैं। परीक्षा के उपरांत उत्तर-पत्रक निरीक्षक को सौंप दें।

महत्त्वपूर्ण अनुदेश

1. सभी प्रश्नों के उत्तर दें। सभी प्रश्नों के अंक समान हैं।
2. **उत्तर-पत्रक पर अभ्यर्थी अपना अनुक्रमांक, विषय, प्रश्न-पत्र का सही कोड एवं सीरीज़ अंकित करें अन्यथा उत्तर-पत्रक का मूल्यांकन नहीं किया जाएगा और उसकी जिम्मेदारी स्वयं अभ्यर्थी की होगी।**
3. **इस परीक्षण पुस्तिका में 100 प्रश्न हैं।** प्रत्येक प्रश्न के चार (4) वैकल्पिक उत्तर दिए गए हैं। अभ्यर्थी सही उत्तर निर्दिष्ट करते हुए उनमें से केवल एक गोले अथवा बबल को उत्तर-पत्रक पर **काले बॉल-प्वाइंट पेन से पूरा गहरा कर दें। एक से अधिक उत्तर देने की दशा में प्रश्न के उत्तर को गलत माना जाएगा एवं उसे जाँचा नहीं जाएगा।**
4. अनुक्रमांक के अलावा परीक्षण पुस्तिका के कवर पेज पर कुछ न लिखें। इसके अलावा परीक्षण पुस्तिका के अन्दर और कुछ न लिखें। यदि आप रफ़ कार्य करना चाहते हैं, तो आप निरीक्षक से वर्किंग शीट माँग लें व इस पर वांछित सूचनाएँ भर लें।
5. **परीक्षण पुस्तिका खोलने के तुरन्त बाद जाँच करके देख लें कि परीक्षण पुस्तिका के सभी पेज भली-भाँति छपे हुए हैं। यदि परीक्षण पुस्तिका में कोई कमी हो, तो निरीक्षक को दिखाकर उसी सीरीज़ व कोड की दूसरी पुस्तिका प्राप्त कर लें।**

जब तक आपको यह परीक्षण पुस्तिका खोलने को न कहा जाए तब तक न खोलें।

***Note :** English version of the instructions is printed on the back cover of this Booklet.*

MECHANICAL ENGINEERING – I

1. 3-2-1 principle is related with
   (a) design of locating devices.
   (b) tool design
   (c) plant layout design
   (d) work sampling

2. Which of the following non-conventional machining methods does not cause tool wear ?
   (a) Anode mechanical machining
   (b) Ultrasonic machining
   (c) Electro-discharge machining
   (d) Electro-Chemical machining

3. In a blanking operation, the clearance is provided
   (a) 50% on punch and 50% on die
   (b) only on die
   (c) only on punch
   (d) clearance not needed

4. The relationship between blank diameter D and cup diameter d during deep drawing process is given as
   (a) $D = \sqrt{d^2 + 4dh}$
   (b) $D = \sqrt{d^2 + 2dh}$
   (c) $D = \sqrt{d^2 + \frac{dh}{2}}$
   (d) $D = \sqrt{d^2 + dh}$
   Where h = height of the cup.

5. The force F required to cut a sheet metal is given by
   (a) $F = \tau_s p/t$ (b) $F = \tau_s pt^2$
   (c) $F = \tau_s pt$ (d) $F = \tau_s/pt$
   Where τ_s = shear strength of sheet metal.
   p = perimeter of the cut
   t = thickness of the sheet metal

6. In a tool life test, doubling the cutting speed reduces the tool life to $1/8^{th}$ of the original value. The Taylor's tool life index is
   (a) 1 (b) 1/2
   (c) 1/3 (d) 1/4

7. The chip thickness ratio 'r' is given by
   (a) $\frac{\cos\phi}{\sin(\phi-\alpha)}$ (b) $\frac{\sin(\phi-\alpha)}{\cos\phi}$
   (c) $\frac{\cos(\phi-\alpha)}{\sin\alpha}$ (d) $\frac{\sin\phi}{\cos(\phi-\alpha)}$
   Where ϕ = shear plane angle, and
   α = rake angle

8. In Electro Discharge Machining better surface finish is obtained at
   (a) low frequency and low discharge current.
   (b) low frequency and high discharge current.
   (c) high frequency and low discharge current.
   (d) high frequency and high discharge current.

9. Which of the following statements is incorrect about the continuous chip ?
   (a) It is formed while machining ductile materials at high cutting speeds.
   (b) It is formed when feed and depth of cut are low.
   (c) It results in good surface finish.
   (d) None of the above.

10. Consider the following work piece materials :
    (i) Carbides (ii) Glass
    (iii) Copper and (iv) Ceramics
    Which of the above material/s are best suited for ultrasonic Machining.
    (a) (ii) only (b) (ii) and (iii)
    (c) (i), (ii) and (iv) (d) (ii), (iii) and (iv)

11. To prolong the life of shaper tools, after they are ground they should be undergone through the following operation
(a) sand blasting (b) shot peening
(c) lapping (d) hardening

12. An Operating Characteristics curve (OC-curve) is a plot between
(a) consumer's risk and producer's risk.
(b) probability of acceptance and probability of rejection.
(c) percentage of defective and probability of acceptance.
(d) average outgoing quality and probability of acceptance.

13. An $\bar{X}$ chart uses the following data
(a) count data
(b) attribute measurement data
(c) variable measurement data
(d) None of the above

14. Which of these would not be a reason for using acceptance sampling ?
(a) a very high inspection cost
(b) boredom and fatigue
(c) a process needing statistical control
(d) destructive testing

15. For a M/M/I/∞/∞/FCFS queue model, the mean arrival rate is equal to 10 per hour and the mean service rate is 15 per hour. The expected queue length is
(a) 1.33 (b) 1.53
(c) 2.75 (d) 3.20

16. ABC analysis, as an input, requires
(a) annual usage and cost of the items.
(b) cost and criticality of the items.
(c) criticality and availability of the items.
(d) availability and annual usage of items.

17. The finite production rate inventory model relaxes which of the following EOQ assumptions ?
(a) instantaneous replenishment
(b) constant lead time
(c) fixed deterministic demand
(d) no variation in unit time

18. In a time study the observed time is 0.75 min, performance rating factor is 110% and allowances are 20% of the normal time. The standard time is
(a) 0.82 min (b) 0.975 min
(c) 0.99 min (d) 1.03 min

19. 'Value engineering' is used in
(a) understanding customer's requirements.
(b) designing products according to the customer's requirements.
(c) producing products according to the customer's requirements.
(d) providing products to customer with enhanced functionality at no additional cost.

20. Which type of control chart should be used to directly monitor the number of defectives in a process for making iron castings ?
(a) $\bar{X}$ - chart (b) P - chart
(c) C - chart (d) R - chart

21. A production line is to be designed to make 2400 items/week for atleast the next 3 months. The line operates 40 hours/week. The standard time required to assemble each item is 244 second. What is the smallest number of work station required ?

(a) 5 (b) 6

(c) 7 (d) 8

22. A basic feasible solution in a linear programming problem with m constraints and n variables will have

(a) at the most m variables with non zero values.

(b) atleast m variables with non zero values.

(c) at the most n variables with non zero values.

(d) atleast n variables with non zero values.

23. The maximum value of the average outgoing quality for all possible values of proportion defective is called

(a) Average Outgoing Quality (AOQ)

(b) Acceptable Quality Level (AQL)

(c) Average Outgoing Quality Limit (AOQL)

(d) Lot Tolerance Proportion Defective (LTPD)

24. 20 samples of size 100 are taken. The total number of defective items is 200. What is the upper control limit of 3-sigma P-chart ?

(a) 0.13

(b) 0.16

(c) 0.19

(d) None of the above

25. Which of the following is not an underlying assumption of the basic EOQ model ?

(a) Stochastic demand

(b) Instant replenishment

(c) Fixed lead time

(d) No shortages

26. The error estimate (e) in work sampling varies with sample size (n) as

(a) $e \propto \frac{1}{n}$ (b) $e \propto \frac{1}{\sqrt{n}}$

(c) $e \propto \sqrt{n}$ (d) $e \propto \frac{1}{n^2}$

27. The producer's risk is the probability with which a consumer will

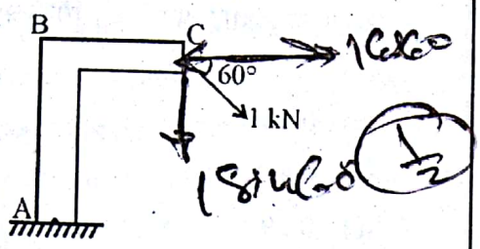
(a) reject a bad lot

(b) reject a good lot

(c) accept a good lot

(d) accept a bad lot

28. What is the thrust at the point 'A' in the post shown in the figure ?



(a) 0.866 kN (b) 0.5 kN

(c) 1.388 kN (d) 1 kN

29. The possible loading in various members framed structure are

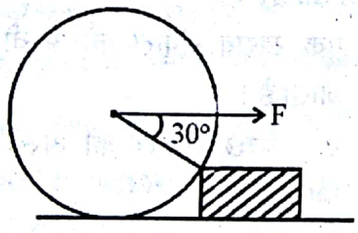
(a) buckling or shear

(b) compression or tension

(c) shear or tension

(d) bending

30. A roller of weight W is to be rolled over a wooden block as shown in the figure. The pull F required to just cause the said motion



(a) $\frac{W}{2}$ (b) W

(c) $\sqrt{3}W$ (d) 2 W

31. In virtual work equation some forces are neglected. Select the most appropriate answer from the following :

(a) Reaction of a rough surface on a body which rolls on it without slipping.

(b) Reaction of any smooth surface with which the body is in contact.

(c) Reaction at a point or on an axis, fixed in space, around which a body is constrained to turn.

(d) All of the above.

32. A circular disc rolls down without slipping on an inclined plane. The ratio of its rotational kinetic energy to the total kinetic energy is

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$

(c) $\frac{1}{3}$ (d) $\frac{2}{3}$

33. Two masses 2 kg and 8 kg are moving with equal kinetic energy. The ratio of magnitude of their momentum is

(a) 0.25 (b) 0.50

(c) 0.625 (d) 1.00

34. The efficiency of a screw jack is maximum, when

(a) $\alpha = 45° + \frac{\phi}{2}$ (b) $\alpha = 45° - \frac{\phi}{2}$

(c) $\alpha = 90° + \phi$ (d) $\alpha = 90° - \phi$

Where α = Helix angle and ϕ = Angle of friction.

35. When two bodies collide without the presence of any other force or force fields ?
(a) Their total kinetic energy must be conserved.
(b) Their total momentum must be conserved.
(c) Their collision must be direct.
(d) Both (a) and (b)

36. The tension in the cable supporting a lift is more when the lift is
(a) moving downwards with uniform velocity.
(b) moving upwards with uniform velocity.
(c) moving upwards with acceleration.
(d) moving downwards with acceleration.

37. The angle between two forces P and Q is α. The resultant of these forces is
(a) $\sqrt{P^2 + Q^2 + 2PQ \sin \alpha}$
(b) $\sqrt{P^2 + Q^2 + 2PQ \cos \alpha}$
(c) $\sqrt{P^2 + Q^2}$
(d) $\sqrt{P^2 + Q^2 - 2PQ \cos \alpha}$

38. A fixed gear having 200 teeth is in mesh with another gear having 50 teeth. The two gears are connected by an arm. The number of turns made by the smaller gear for one revolution of arm about the centre of the bigger gear is
(a) 2 (b) 3
(c) 4 (d) 5

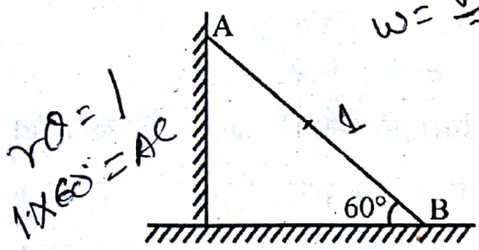
39. For high speed engines, the cam follower should move with
(a) uniform velocity
(b) simple harmonic motion
(c) uniform acceleration and retardation
(d) cycloidal motion

40. A flywheel is fitted to the crank shaft of an engine having W amount of indicated work per revolution. Permissible limits of coefficient of fluctuation of energy and speed are C_E and C_S respectively. The kinetic energy of the flywheel is given by
(a) $2\frac{W \cdot C_E}{C_S}$ (b) $\frac{W \cdot C_E}{2C_S}$
(c) $\frac{W \cdot C_E}{C_S}$ (d) $\frac{W \cdot C_S}{2C_E}$

41. If the ratio of length of connecting rod to crank radius increases, then
(a) primary unbalanced force increases.
(b) primary unbalanced force decreases.
(c) secondary unbalanced force increases.
(d) secondary unbalanced force decreases.

42. A system in dynamic balance implies that
(a) the system is critically damped.
(b) the system is at its critical speed.
(c) the system is also statically balanced.
(d) there will be no wear of bearings.

43. A rod AB of length 1 m is sliding as shown in the figure. At an instant when the rod makes 60° angle with the horizontal plane, the downwards velocity of point A is 1 m/s. What is the angular velocity of the rod at that instant ?

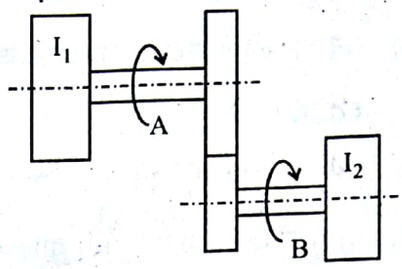


(a) 2.0 rad/s (b) 1.5 rad/s
(c) 0.5 rad/s (d) 0.75 rad/s

44. Isochronism in a governor is desirable when
(a) the engine operates at low speeds.
(b) the engine operates at high speeds.
(c) only one speed is desired to be kept at all loads.
(d) the engine operates at variable speeds.

45. A rigid body can be replaced by two masses placed at fixed distance apart. The two masses form an equivalent dynamic system, if (select the most appropriate answer).
(a) the sum of the two masses is equal to the total mass of the body.
(b) the centre of gravity of two masses coincide with that of the body.
(c) the sum of the mass moment of inertia of the masses about their centre of gravity is equal to the mass moment inertia of the body.
(d) All of the above.

46. A torsional system with discs of moment of inertia I_1 and I_2 are shown in figure, which are gear driven. The ratio of speed of shaft B to shaft A is G. The equivalent moment of inertia of disc on shaft B at the speed of shaft 'A' is equal to



(a) GI_2 (b) G^2I_2
(c) I_2/G (d) I_2/G^2

47. Identify lower pair/s. Select the most appropriate answer.
(a) ball and socket
(b) cam and follower
(c) piston and cylinder
(d) both (a) and (c)

48. In a spring dash pot, mass system if m = mass, k = spring stiffness and ω_n = natural frequency of vibration, then critical damping is equal to
(a) $2\sqrt{km}$
(b) $2\ m\cdot\omega_n$
(c) both (a) and (b)
(d) neither (a) nor (b)

49. An imaginary circle which by pure rolling action gives the same motion as the actual gear is called
(a) addendum circle
(b) dedendum circle
(c) pitch circle
(d) base circle

50. The pressure angle in a cam depends on
(a) the angle of ascent
(b) the lift of the follower
(c) offset between centre lines of cam and follower
(d) All of the above

51. The centrifugal tension in belt drive.
(a) increases power transmitted.
(b) decreases power transmitted.
(c) has no effect on the power transmitted.
(d) increases power transmitted upto a certain speed and then decreases.

52. If there are several unbalanced masses in a rotor in different planes, the minimum number of balancing masses required is
(a) 1 (b) 2
(c) 3 (d) 4

53. The tractive force is maximum or minimum when the angle of inclination of the crank to the line of stroke is equal to
(a) 90° and 225° (b) 135° and 180°
(c) 180° and 225° (d) 135° and 315°

54. The number of instantaneous centres of rotation in a quick return motion mechanism are
(a) six (b) eight
(c) twelve (d) fifteen

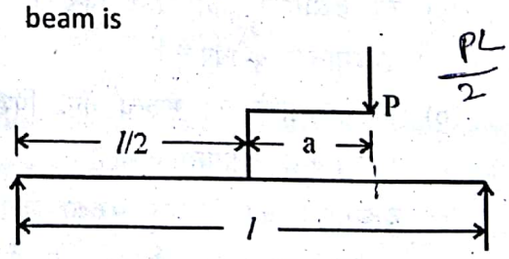
55. In a forced vibration system, for which value of frequency ratio $\left(\frac{\omega_f}{\omega_n}\right)$, the transmissibility is same for all the values of damping factors
(a) 1 (b) 2
(c) $\sqrt{2}$ (d) $\frac{1}{2}$
Where ω_f = forced frequency and
ω_n = natural frequency

56. Constant velocity ratio between two shafts can be obtained, if they are connected by
(a) V-belts and pulleys
(b) Sprocket and chains
(c) Gears
(d) Universal joint

57. Differential gear is used in an automobile to
(a) transmit power from the engine to driving wheels.
(b) multiply the available engine torque.
(c) enable the vehicle negotiate curves properly.
(d) serves all the three functions as mentioned in (a), (b) and (c) above.

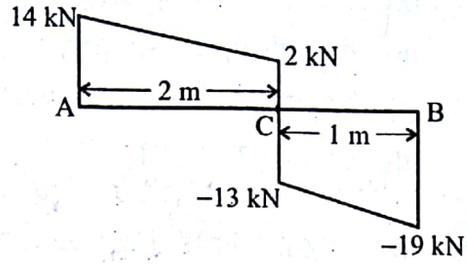
58. The point of contraflexure is a point where,
(a) shear force changes sign
(b) bending moment is zero or changes sign.
(c) shear force is maximum
(d) bending moment is maximum

59. A simply supported beam carries a load 'P' through a bracket as shown in figure. The maximum bending moment in the beam is



(a) $P\frac{l}{2}$ (b) $P\frac{l}{2}+\frac{a\cdot P}{2}$
(c) $P\frac{l}{2}+a\cdot P$ (d) $P\frac{l}{2}-a\cdot P$

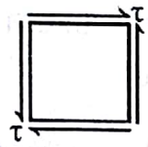
60. The shear force diagram of a loaded beam is shown in the following figure. The maximum bending moment in the beam is

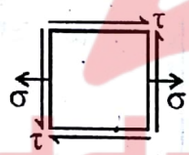


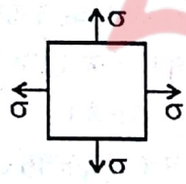
(a) 16 kN-m (b) 11 kN-m

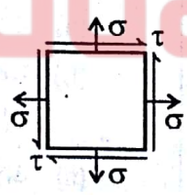
(c) 28 kN-m (d) 8 kN-m

61. In which of the following two dimensional state of stress, Mohr's stress circle takes the shape of a point.

(a) 

(b) 

(c) 

(d) 

62. If the shear force diagram for a beam is triangle with length of the beam as its base, the beam is

(a) a cantilever with a point load at its free end.

(b) a cantilever with uniformly distributed load over its whole span.

(c) a simply supported beam with a point load at its mid-point.

(d) a simply supported beam with uniformly distributed load over its whole span.

63. The torque transmitted by a solid shaft of diameter d and maximum allowable shear stress τ is

(a) $\frac{\pi}{4}\tau d^3$ (b) $\frac{\pi}{16}\tau d^3$

(c) $\frac{\pi}{32}\tau d^3$ (d) $\frac{\pi}{64}\tau d^3$

64. A thick cylinder, having r_o and r_i as outer and inner radii, is subjected to an internal pressure P. The maximum tangential stress at the inner surface of the cylinder is

(a) $\frac{P\left(r_o^2+r_i^2\right)}{r_o^2-r_i^2}$ (b) $\frac{P\left(r_o^2-r_i^2\right)}{r_o^2+r_i^2}$

(c) $\frac{2Pr_i^2}{\left(r_o^2-r_i^2\right)}$ (d) $\frac{P\left(r_o^2-r_i^2\right)}{r_i^2}$

65. A thin cylindrical shell of diameter d and thickness t is subjected to an internal pressure P. The Poisson's ratio is ν. The ratio of longitudinal strain to volumetric strain is

(a) $\frac{1-\nu}{2-\nu}$ (b) $\frac{2-\nu}{1-\nu}$

(c) $\frac{1-2\nu}{3-4\nu}$ (d) $\frac{1-2\nu}{5-4\nu}$

66. In a compression test, the fracture in cast iron specimen would occur along

(a) the axis of the load

(b) an oblique plane

(c) at right angle to the axis of specimen

(d) None of the above

67. The Erichsen cupping number of a metal sheet indicates its
(a) ductility (b) hardenability
(c) toughness (d) drawing ability

68. In an I-section of a beam subjected to transverse shear force, the maximum shear stress is developed at
(a) the bottom edges of the top flange.
(b) the top edges of the top flange.
(c) the centre of the web.
(d) the upper edges of the bottom flange.

69. The equivalent length of a column supported firmly at both ends is (l = length of the column)
(a) 0.5 l (b) 0.707 l
(c) l (d) 2 l

70. A circular shaft is subjected to a twisting moment T and a bending moment M. The ratio of maximum bending stress to maximum shear stress is given by
(a) 2M/T (b) M/T
(c) 2T/M (d) M/2T

71. The strain energy in a beam subjected to bending moment M is
(a) $\int \frac{M^2}{2EI}dx$ (b) $\int \frac{M^2}{4EI}dx$
(c) $\int \frac{M^2}{EI}dx$ (d) $\int \frac{2M^2}{EI}dx$
where the terms have their usual meaning.

72. Maximum deflection in a cantilever due to pure bending moment M at its end is
(a) $\frac{Ml^2}{2EI}$ (b) $\frac{Ml^2}{3EI}$
(c) $\frac{Ml^2}{4EI}$ (d) $\frac{Ml^2}{8EI}$
The terms have their usual meaning.

73. The expression $EI\frac{d^3y}{dx^3}$ at a section of a beam represents
(a) shear force
(b) rate of loading
(c) bending moment
(d) slope

74. Compound tubes are used in internal pressure cases, for following reasons
(a) For increasing the thickness.
(b) For increasing the outer diameter of the tube.
(c) The strength is more.
(d) It evens out stresses.

75. Normal stress on a plane, the normal to which is inclined at an angle θ with the line of action of applied uniaxial stress σ is given by
(a) $\sigma/\sin^2\theta$ (b) $\sigma/\cos^2\theta$
(c) $\sigma\cos^2\theta$ (d) $\sigma\sin^2\theta$

76. A shaft of 20 mm diameter and length 1 m is subjected to a twisting moment, due to which shear strain on the surface of the shaft is 0.001. The angular twist in the shaft is
(a) 0.1 radian (b) 0.01 radian
(c) 0.05 radian (d) 0.5 radian

77. A beam of uniform strength is one in which
(a) bending moment is same throughout the beam.
(b) deflection is the same throughout the length.
(c) bending stress is same in every section along the longitudinal axis.
(d) shear stress is uniform throughout the beam.

78. Increase in ferrite phase in steel increases
(a) strength (b) hardness
(c) ductility (d) brittleness

79. The co-ordination number for FCC crystal structure is
(a) 4 (b) 8
(c) 12 (d) 16

80. Which of the following elements determine maximum attainable hardness in the steel ?
1. Chromium 2. Manganese
3. Carbon 4. Molybdenum
Select the correct answer using codes given below :
(a) 1 only (b) 1 and 2
(c) 3 only (d) 2 and 4

81. How many space lattices does the Bravis lattices consist of ?
(a) 3 (b) 7
(c) 9 (d) 14

82. Schottky imperfection is a
(a) Point imperfection
(b) Line imperfection
(c) Surface imperfection
(d) Volume imperfection

83. Match the List – I with the List – II and select the correct answer using the codes given below :

List – I (Crystal Structure)	List – II (Packing Efficiency)
A. Simple cubic	1. 34
B. Diamond cubic	2. 74
C. Body centred cubic	3. 52
D. Face centred cubic	4. 68

Select the correct answer using the codes given below :
Codes :

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

84. Which of the following tests is also called 'Micro hardness Test' ?
(a) Brinell test (b) Rockwell test
(c) Knoop test (d) Vickers test

85. S-N curves are connected with
(a) toughness (b) hardness
(c) creep (d) fatigue

86. Which one of the following is a basic refractory material ?
(a) Dolomite (b) Quartz
(c) Sand (d) Silicon carbide

87. Creep plays an important role in the design of which of the followings ?
(a) boiler tubings
(b) I.C. Engine cylinders
(c) Gas turbine blades
(d) Steam turbine blades

88. Babbit metal is an alloy of
(a) Sn and Cu
(b) Sn, Cu, Sb and Pb
(c) Sn, Cu and Pb
(d) Sn, Cu and Sb

89. Thermoplastic polymers are
(i) formed by addition polymerization.
(ii) formed by condensation polymerization.
(iii) softened on heating and hardened on cooling for any number of times.
(iv) moulded by heating and cooling.
Of these statement, select the correct answer from the options given below :
(a) (ii) and (iii) are true
(b) (ii) and (iv) are true
(c) (i) and (iv) are true
(d) (i) and (iii) are true

90. The true strain $\in_t$ and the engineering strain $\in$ relationship is

(a) $\in_t = \log_n (1 - \in)$

(b) $\in_t = \log_n (1 + \in)$

(c) $\in_t = \log_n (1 - 2\in)$

(d) $\in_t = \log_n \frac{1}{(1 + \in)}$

91. The metal powder used in a thermite welding of steel.

(a) Al (b) Cu

(c) Pb (d) W

92. Which of the following material is used for manufacturing of extrusion nozzles ?

(a) Grey cast iron

(b) Malleable cast iron

(c) White cast iron

(d) Nodular cast iron

93. The main purpose of Chaplet is

(a) to support core

(b) to ensure directional solidification

(c) to provide efficient venting

(d) to align the mould box parts

94. Which is the main reason for poor surface finish ?

(a) heavy depth of cut

(b) high cutting speed

(c) high feed

(d) low side rake angle

95. In a machining operation chip thickness ratio is 0.3 and tool back rake angle is 10°. The value of shear strain is

(a) 0.86 (b) 2.24

(c) 3.10 (d) 3.34

96. Grinding of hard materials requires

(a) fine grit size and hard grades.

(b) fine grit size and soft grades.

(c) coarse grit size and hard grades.

(d) coarse grit size and soft grades.

97. Crater wear occurs mainly on the

(a) nose part, front and side relief faces of the cutting tool.

(b) face of the cutting tool at a short distance from the cutting edge only.

(c) cutting edge only.

(d) front face only.

98. High speed steel contains carbon

(a) 0.15 to 0.3% (b) 0.6 to 1.0%

(c) 4 to 6% (d) 6 to 10%

99. The rake angle required for machining brass by high speed steel tool is

(a) 0° (b) 10°

(c) – 5° (d) – 10°

100. Consider the following statements :

(i) Mechanical comparators are used for higher accuracy.

(ii) Optical comparators use both optical and mechanical means to get magnification.

(iii) Pneumatic comparators are used for very high magnification.

(iv) Dial indicator is the most widely used mechanical comparator.

Of these statements :

(a) (ii), (iii) and (iv) are true.

(b) (iii) is true.

(c) (i), (ii) and (iii) are true.

(d) (i) and (ii) are true.

UPPSC - AE-2013

जब तक आपको यह परीक्षण पुस्तिका खोलने को न कहा जाए तब तक न खोलें।

सीरीज़

D

क्रमांक : 1148400

कोड : KNTCRA-58

2013

विषय : यांत्रिक अभियांत्रिकी, प्रश्न-पत्र – II

UPPSC - combined state Engg service 2013

समय : 2 घण्टे **पूर्णांक : 100**

अपना अनुक्रमांक सामने बॉक्स के अन्दर लिखें — अंकों में → शब्दों में Exam April-2016

प्रश्नों के उत्तर के लिये केवल काले बॉल-प्वाइंट पेन का प्रयोग करें।

अभ्यर्थी उत्तर-पत्रक पर उत्तर देने से पहले सभी अनुदेशों को सावधानीपूर्वक पढ़ लें।

आपको अपने सभी उत्तर केवल उत्तर-पत्रक पर ही देने हैं। परीक्षा के उपरांत उत्तर-पत्रक निरीक्षक को सौंप दें।

महत्त्वपूर्ण अनुदेश

1. सभी प्रश्नों के उत्तर दें। सभी प्रश्नों के अंक समान हैं।
2. **उत्तर-पत्रक पर अभ्यर्थी अपना अनुक्रमांक, विषय, प्रश्न-पत्र का सही कोड एवं सीरीज़ अंकित करें अन्यथा उत्तर-पत्रक का मूल्यांकन नहीं किया जाएगा और उसकी जिम्मेदारी स्वयं अभ्यर्थी की होगी।**
3. **इस परीक्षण पुस्तिका में 100 प्रश्न हैं।** प्रत्येक प्रश्न के चार (4) वैकल्पिक उत्तर दिए गए हैं। अभ्यर्थी सही उत्तर निर्दिष्ट करते हुए उनमें से केवल एक गोले अथवा बबल को उत्तर-पत्रक पर **काले बॉल-प्वाइंट पेन से पूरा गहरा कर दें। एक से अधिक उत्तर देने की दशा में प्रश्न के उत्तर को गलत माना जाएगा एवं उसे जाँचा नहीं जाएगा।**
4. अनुक्रमांक के अलावा परीक्षण पुस्तिका के कवर पेज पर कुछ न लिखें। इसके अलावा परीक्षण पुस्तिका के अन्दर और कुछ न लिखें। यदि आप रफ़ कार्य करना चाहते हैं, तो आप निरीक्षक से वर्किंग शीट माँग लें व इस पर वांछित सूचनाएँ भर लें।
5. **परीक्षण पुस्तिका खोलने के तुरन्त बाद जाँच करके देख लें कि परीक्षण पुस्तिका के सभी पेज भली-भाँति छपे हुए हैं। यदि परीक्षण पुस्तिका में कोई कमी हो, तो निरीक्षक को दिखाकर उसी सीरीज़ व कोड की दूसरी पुस्तिका प्राप्त कर लें।**

जब तक आपको यह परीक्षण पुस्तिका खोलने को न कहा जाए तब तक न खोलें।

***Note :** English version of the instructions is printed on the back cover of this Booklet.*

KNTCRA-58

MECHANICAL ENGINEERING – II

1. Water at 42 °C is sprayed into a stream of air at atmospheric pressure, dry bulb temperature of 40 °C and a wet bulb temperature of 20 °C. The air leaving the spray humidifier is not saturated. Which of the following statements is true ?
   (a) Air gets cooled and humidified.
   (b) Air gets heated and humidified.
   (c) Air gets heated and dehumidified.
   (d) Air gets cooled and dehumidified.

2. In an ideal vapour compression refrigeration cycle, the specific enthalpy of refrigerant (kJ/kg) at the following stages is given as
   Inlet of condenser = 283
   Outlet of condenser = 116
   Exit of evaporator = 232
   The CoP is
   (a) 2.27 (b) 2.75
   (c) 3.27 (d) 3.75

3. During the chemical dehumidification process of air
   (a) dry bulb temperature and specific humidity decreases.
   (b) dry bulb temperature increases and specific humidity decreases.
   (c) dry bulb temperature decreases and specific humidity increases.
   (d) dry bulb temperature and specific humidity increases.

4. Dew point temperature is the temperature at which condensation begins when the air is cooled at constant
   (a) volume (b) entropy
   (c) pressure (d) enthalpy

5. For air with a relative humidity of 80%
   (a) the dry bulb temperature is less than the wet bulb temperature.
   (b) the dew point temperature is less than the wet bulb temperature.
   (c) the dew point and wet bulb temperatures are equal.
   (d) the dry bulb and dew point temperatures are equal.

6. In window air-conditioner the expansion device used is
   (a) capillary tube
   (b) thermostatic expansion valve
   (c) automatic expansion valve
   (d) float valve

7. One ton of refrigeration is equivalent to SI unit of
   (a) 1 kW (b) 2.5 kW
   (c) 3.5 kW (d) 5 kW

8. Efficiency of a Carnot engine is 75%. If the cycle direction is reversed, CoP of the reversed Carnot cycle is
   (a) 1.33 (b) 0.75
   (c) 0.33 (d) 1.75

9. As an index of comfort, the temperature of saturated air at which a person would experience the same feeling of Comfort as experienced in the actual unsaturated environment is called
   (a) Comfort temperature
   (b) Effective temperature
   (c) Wet bulb temperature
   (d) Soothing temperature

10. If the specific humidity of moist air remains the same but its DBT increases, its DPT
(a) remains the same
(b) increases
(c) decreases
(d) may increase or decrease depending on its relative humidity.

11. In a vapour compression cycle, a good refrigerator should have a
(a) large latent heat of vaporization at condenser pressure.
(b) large latent heat at evaporator pressure.
(c) condenser pressure close to critical pressure.
(d) low critical pressure.

12. R-12 is preferred over R-22 in deep freezer, because
(a) it has lower operating pressure.
(b) it gives higher CoP.
(c) it is miscible with oil over a large range of temperature.
(d) All of the above.

13. Low grade fuels have
(a) low moisture content
(b) low ash content
(c) low calorific value
(d) high carbon content

14. Which of the following does not use ambient air for propulsion ?
(a) Turbo jet (b) Pulse jet
(c) Turbo-prop (d) Rocket

15. Humidity ratio can be given in terms of partial pressures of dry air (P_a) and water vapour (P_v) as
(a) $0.622\left(\frac{P_a}{P_v}\right)$
(b) $0.622\left(\frac{P_v}{P_a}\right)$
(c) $0.622\left(\frac{P_v}{P_v - P_a}\right)$
(d) None of the above

16. If the air is passed over the cooling coils then this process is termed as
(a) sensible heating
(b) cooling with humidification
(c) cooling with dehumidification
(d) None of the above

17. CoP of air refrigerator is related with CoP of vapour compression refrigerator as
(a) $(CoP)_{air} > (CoP)_{vap.c.}$
(b) $(CoP)_{air} < (CoP)_{vap.c.}$
(c) $(CoP)_{air} = (CoP)_{vap.c.}$
(d) None of the above

18. In an air craft refrigeration system the pressure at the cooling turbine outlet is equal to
(a) ambient pressure
(b) cabin pressure
(c) pressure at inlet to compressor
(d) None of the above

19. The relative humidity, during sensible heating
(a) can increase or decrease
(b) increases
(c) decreases
(d) remains constant

20. Kelvin Planck law deals with
(a) conversion of work into heat
(b) conversion of heat into work
(c) conservation of work
(d) conservation of heat

21. Thermodynamic work is the product of
(a) Two intensive properties
(b) Two extensive properties
(c) An intensive property and change in an extensive property
(d) An extensive property and change in an intensive property

22. Air is compressed adiabatically in a steady flow process with negligible change in potential and kinetic energy. The work done in the process in given by

(a) $-\int pdv$ (b) $+\int pdv$

(c) $-\int vdp$ (d) $+\int vdp$

23. A heat engine is supplied with 250 kJ/s of heat at constant fluid temperature of 227 °C. The heat is rejected at 27 °C. The cycle is reversible, if the amount of heat rejected is
(a) 273 kJ/s (b) 200 kJ/s
(c) 180 kJ/s (d) 150 kJ/s

24. The sequence of processes that eventually returns the working substance to its original state is known as
(a) Event
(b) Process
(c) Thermodynamic property
(d) Thermodynamic cycle

25. If the dryness fraction of a sample by throttling calorimeter is 0.8 and that by separating calorimeter is also 0.8, then the actual dryness fraction of sample will be taken as
(a) 0.8 (b) $\sqrt{0.8}$
(c) 0.64 (d) 0.5

26. Thermodynamic equilibrium is completely defined by the specifications of
(a) Internal energy
(b) Enthalpy
(c) Generalized displacements
(d) All of the above

27. Gas expands for a definite volume in a closed vessel. The maximum work will be done when the process is at constant
(a) Volume
(b) Temperature
(c) Pressure
(d) Enthalpy

28. Which conversion is incorrect ?
(a) 1 kWh = 3.6×10^6 Nm
(b) 1 Nm = 0.238×10^{-3} kcal
(c) 1 HP hr = 0.746 kWh
(d) 1 kcal = 4.1868 Nm

29. In an air standard Diesel cycle at fixed compression ratio and fixed value of adiabatic index (ν)
(a) thermal efficiency increases with increase in heat addition cut-off ratio.
(b) thermal efficiency decreases with increase in heat addition cut-off ratio.
(c) thermal efficiency remains same with increase in heat addition cut-off ratio.
(d) None of the above.

30. In Rankine cycle, the work output from the turbine is given by
(a) change in internal energy between inlet and outlet.
(b) change in enthalpy between inlet and outlet.
(c) change in entropy between inlet and outlet.
(d) change of temperature between inlet and outlet.

31. For a closed system, undergoing an expansion process according to the law PV^n = constant, the work output.
(a) increases with increase in 'n'
(b) increases with decrease in 'n'
(c) is maximum when n = 0
(d) is independent of 'n'

32. Law of degradation of energy says that unavailable energy is gradually decreasing due to
(a) increase in reversible processes.
(b) increase in irreversible processes.
(c) increase in unavailable energy.
(d) None of these

33. For the same compression ratio, the efficiency of Brayton cycle is
(a) equal to that of Diesel cycle
(b) equal to that of Otto cycle
(c) equal to that of Dual cycle
(d) greater than that of Diesel cycle

34. If the temperature at the turbine inlet is kept constant, the net output of a simple gas turbine plant would
(a) increase with increasing pressure ratio.
(b) decrease with increasing pressure ratio.
(c) first increase and then decrease with increasing pressure ratio.
(d) remains unaffected with changes in pressure ratio.

35. When the relationship between Reynolds number and the friction factor is represented by a straight line, the flow is said to be
(a) isentropic (b) laminar
(c) turbulent (d) vortex

36. At the point of separation
(a) velocity is maximum.
(b) shear stress is zero.
(c) shear stress is maximum.
(d) pressure gradient is zero.

37. A potential function exists for
(a) steady flow only
(b) two dimensional irrotational flow only.
(c) irrotational flow of fluid whether compressible or incompressible.
(d) irrotational flow of incompressible fluids only.

38. Which property of mercury is the main reason for use in barometers ?
(a) High density
(b) Negligible capillary effect
(c) Very low vapour pressure
(d) Low compressibility

39. In case of fluid flow through pipes, cavitation is caused by
(a) high pressure
(b) high velocity
(c) low pressure below a limit
(d) weak material of pipe

40. A stream function
(a) is a mathematical function which has no physical equivalence.
(b) is defined only for steady and incompressible flow.
(c) satisfies Laplace equation for rotational motion.
(d) may not remain constant for a streamline.

41. For the flow to occur between two points in a pipeline, the differential pressure between these points should be more than
(a) surface friction
(b) viscosity force
(c) frictional force
(d) All of the above

42. Fluid is flowing in a curved path without any external impressed contact force. This flow is known as
(a) free vortex flow
(b) forced vortex flow
(c) radial flow
(d) spiral flow

43. In fluid flow through pipes, transition from laminar to turbulent flow, does not depend on
(a) length of pipe
(b) density of fluid
(c) diameter of pipe
(d) velocity of flow

44. In the region of boundary layer on a flat plate surface where velocity is not zero, the viscous force is
(a) less than inertial force
(b) more than inertial force
(c) equal in magnitude
(d) not predictable

45. The magnitude of water hammer in the flow of a liquid through a pipe does not depend upon
(a) length of pipe
(b) elastic properties of pipe material
(c) temperature of liquid
(d) time of valve closure

46. Compressibility effect can be treated as negligible when Mach number is
(a) upto 0.2 (b) upto 0.5
(c) less than 1 (d) 1

47. A body is called streamline body when
(a) it is symmetrical about the axis along the free stream.
(b) surface of the body coincides with the streamlines.
(c) flow is laminar around it.
(d) it produces no drag for flow around it.

48. Mach number is the ratio of
(a) elastic force to gravity force
(b) viscous force to elastic force
(c) inertial force to surface tension
(d) inertial force to elastic force

49. For a linear distribution of velocity in the boundary layer on a flat plate, the ratio of displacement thickness to nominal thickness is
(a) $\frac{1}{4}$ (b) $\frac{1}{3}$
(c) $\frac{1}{2}$ (d) $\frac{2}{3}$

50. In case of laminar flow through pipe, the ratio of total kinetic energy of fluid passing per second to the energy value obtained on the basis of average velocity is
(a) 1.2 (b) 1.54
(c) 2.0 (d) 2.37

51. Sonic velocity will have a low value in the medium having
(a) low value of coefficient of compressibility.
(b) high value of coefficient of compressibility.
(c) high bulk modulus of elasticity.
(d) homogeneous composition.

52. An isentropic flow is one which is
(a) adiabatic and reversible
(b) isothermal only
(c) adiabatic only
(d) adiabatic and irreversible

53. The size of a venturimeter is specified by
(a) fluid pressure
(b) discharge
(c) pipe diameter and throat diameter
(d) length of venturimeter

54. In a flow field at the stagnation point
(a) pressure is zero.
(b) total energy is zero.
(c) pressure head is equal to velocity head.
(d) All the velocity head is converted into pressure head.

55. Which two forces are most important in laminar flow between parallel plates ?

(a) Inertial and viscous
(b) Viscous and pressure
(c) Gravity and pressure
(d) Pressure and inertial

56. A high value of thermal diffusivity represents

(a) high storage, less conduction of heat.
(b) less storage, more conduction of heat.
(c) There is always equal amount of conduction and storage since it is a property.
(d) It has no relevance.

57. What happens when the thickness of insulation on a pipe exceeds the critical value ?

(a) Heat transfer rate increases
(b) Heat transfer rate decreases
(c) Heat transfer rate remains constant
(d) None of these

58. For flow of fluid over a heated plate, the following fluid properties are known :

Viscosity = 0.001 Pa.s, sp. heat at constant pressure = 1 kJ/kg-K, thermal conductivity = 1W/mK.

The hydrodynamic boundary layer thickness at a specified location on the plate if 1 mm, the thermal boundary layer thickness at the same location is

(a) 0.001 mm (b) 0.01 mm
(c) 1 mm (d) 10 mm

59. Which one of the following configuration has the highest fin effectiveness ?

(a) thin, close spaced
(b) thin, widely spaced
(c) thick, widely spaced
(d) thick, close spaced

60. In a condenser of a power plant, the steam condenses at a temperature of 60 °C. The cooling water enters at 30 °C and leaves at 45 °C. Logarithmic Mean Temperature Difference (LMTD) of the condenser is

(a) 16.2 °C (b) 21.6 °C
(c) 30 °C (d) 37.5 °C

61. In a heat exchanger, the temperature of the hot fluid decreases while the temperature of the cold fluid increases. The increase and decrease following :

(a) A quadratic law
(b) A linear law
(c) A cubic law
(d) An exponential law

62. Which substance has the minimum value of thermal conductivity ?

(a) Air (b) Water
(c) Plastic (d) Rubber

63. Lumped parameter analysis for transient heat conduction is essentially valid of

(a) $B_i < 0.1$ (b) $0.1 < B_i < 0.5$
(c) $1 < B_i < 10$ (d) $B_i \to \infty$

64. Cork is a gold thermal insulator because
(a) Its density is low.
(b) It is porous.
(c) It can be powdered.
(d) It is flexible.

65. Unsteady state of heat flow occurs in
(a) Flow of heat through furnace walls.
(b) Flow of heat through insulated pipe with constant surface temperature.
(c) Annealing of castings.
(d) Flow of heat through refrigerator walls.

66. The temperature inside a furnace is generally measured by
(a) Mercury thermometer
(b) Alcohol thermometer
(c) Gas thermometer
(d) Optical pyrometer

67. Heat is transferred by conduction, convection and radiation in
(a) Insulated pipes carrying hot water
(b) Refrigerator freezer coils
(c) Melting of ice
(d) Boiler furnaces

68. The density of water is maximum at
(a) 20 °C (b) 4 °C
(c) 0 °C (d) – 4°C

69. Which non-metallic body is expected to have highest value of emissivity ?
(a) Iron oxide (b) Carbon
(c) Ice (d) Paper

70. The rate of heat transfer by conduction in pipes at critical radius is
(a) equal to the rate of heat transfer by convection and is maximum.
(b) equal to the rate of heat transfer by convection and is minimum.
(c) greater than the rate of heat transfer by convection.
(d) less than the rate of heat transfer by convection

71. The heat transfer coefficient over the surface of a pin fin decreases, then
(a) its effectiveness will decrease.
(b) its effectiveness will increase.
(c) its effectiveness will remain unchanged.
(d) its effectiveness will first increase and then decrease.

72. The critical radius of insulation for a sphere is equal to
(a) 2 kh (b) $\frac{h}{2k}$
(c) $\frac{2k}{h}$ (d) $\sqrt{2\,kh}$
Where symbols have usual meanings.

73. In a cylinder under steady state conduction with uniform heat generation, the temperature gradient at half the radius location will be
(a) one half of that at surface
(b) one fourth of that at surface
(c) twice that at surface
(d) four times that at surface

74. For the quick response of a thermocouple
(a) its wire diameter should be large.
(b) the convective heat transfer coefficient should be high.
(c) the specific heat should be high.
(d) the density should not be very small.

75. If Nusselt number is 390, Reynolds number is 39 and Prandtl number is 20, then Stanton number will be
(a) 780 (b) 200
(c) 2 (d) 0.5

76. The temperature of a solid surface is raised from 227 °C to 727 °C. The emissive power of the body will change from E_1 to E_2 such that E_2/E_1
(a) 400 (b) 16
(c) 4000 (d) 1600

77. For an opaque body sum of absorptivity and reflectivity is
(a) 0
(b) 1.0
(c) less than 1.0
(d) greater than 1.0

78. Efficiency of a Diesel cycle will approach to Otto cycle when
(a) diesel engine will operate at high speed.
(b) cut-off period of diesel cycle is reduced to zero.
(c) diesel fuel is balanced with petrol.
(d) None of these.

79. A gas turbine cycle with heat exchanger and reheating improves
(a) only the thermal efficiency.
(b) only the specific power output.
(c) both thermal efficiency and specific power output.
(d) neither thermal efficiency nor specific power output.

80. The ideal efficiency of simple gas turbine cycle depends upon
(a) pressure ratio
(b) cut-off ratio
(c) both (a) and (b)
(d) None of the above

81. The area of a p-v diagram for a Carnot cycle represents
(a) heat supplied
(b) heat rejected
(c) work done
(d) temperature drop

82. For a given set of operating pressure limits of a Rankine cycle the highest efficiency occurs
(a) Saturated cycle
(b) Superheated cycle
(c) Reheat cycle
(d) Regenerative cycle

83. Which process is responsible for production of energy in the Sun ?
(a) Nuclear fission reaction
(b) Nuclear fusion reaction
(c) Exothermal chemical reaction
(d) All of the above

84. Terrestrial radiation has a wavelength in the range of

(a) 0.2 μm to 4 μm

(b) 0.2 μm to 0.5 μm

(c) 0.380 μm to 0.760 μm

(d) 0.29 μm to 2.3 μm

85. A solar thermal collector

(a) collects the solar energy and reflects it back.

(b) absorbs the solar radiation and dissipates it to the ambient.

(c) collects and converts the solar energy into electrical energy.

(d) collects and converts the solar energy into thermal energy and delivers it to the next stage of the system.

86. A solar cell is basically

(a) a voltage source, controlled by flux of radiation.

(b) a current source, controlled by flux of radiation.

(c) an uncontrolled current source

(d) an uncontrolled voltage source

87. The working fluid used in an MHD system coupled to a fast breeder reactor is

(a) hot flue gases

(b) seeded inert gas

(c) liquid metal inert gas

(d) liquid metal only

88. For the same maximum pressure and temperature

(a) Otto cycle is more efficient than diesel cycle.

(b) Diesel cycle is more efficient than Otto cycle.

(c) Dual cycle is more efficient than Otto and Diesel cycle.

(d) Dual cycle is less efficient than Otto and Diesel cycle.

89. Consider the following emissions of an I.C. engine.

1. CO_2 2. HC

3. NO_x 4. Particulate

Which of these emissions causes photochemical smog ?

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

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

90. Consider the following statements :

Knock in the S.I. engine can be reduced by

1. Supercharging
2. Retarding the spark
3. Using a fuel of long straight chain structure.
4. Increasing the engine speed.

Of these correct statements are

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

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

91. Which of the following is considered to be superior quality coal for power plants ?

(a) Bituminous coal

(b) Peat

(c) Coke

(d) Lignite

92. A curve showing the variation of load on a power station with respect to time is known as

(a) Load curve

(b) Load duration curve

(c) Diversity factor

(d) Performance curve

93. The capacity of generators being installed in super thermal power plant is

(a) 100 MW (b) 200 MW

(c) 400 MW (d) 500 MW

94. Fuel injection pressure in solid injection system is approximately in the range of

(a) < 10.5 bar (b) 10. 5 – 21 bar

(c) 30 – 50 bar (d) 200 – 246 bar

95. The thermal efficiency of a gas turbine cycle with ideal regenerative heat exchanger is

(a) equal to work ratio

(b) less than work ratio

(c) more than work ratio

(d) unpredictable

96. The ratio of work done to the energy supplied to rotor in a turbine stage is called

(a) blade efficiency

(b) stage efficiency

(c) nozzle efficiency

(d) None of these

97. The diagram efficiency is highest for simple impulse turbine stage having smooth and symmetrical blade when blade steam speed ratio can be given as

(a) $\cos \alpha_1$ (b) $\frac{\cos \alpha_1}{4}$

(c) $\frac{\cos \alpha_1}{2}$ (d) None of these

Where α_1 is the angle of absolute velocity at inlet.

98. What will happen to the volumetric efficiency with increasing pressure ratio in case of single stage compression in compressions ?

(a) Decreases

(b) Increases

(c) Remains unaffected

(d) None of these

99. The compression work requirement is minimum in case of compression process being

(a) Adiabatic (b) Isochoric

(c) Isothermal (d) Hyperbolic

100. If a mass of moist air in an air tight vessel is heated to a higher temperature, then

(a) specific humidity of the air increases.

(b) specific humidity of the air deceases.

(c) relative humidity of the air increases.

(d) relative humidity of the air decreases.