પ્રશ્નપુસ્તિકા ક્રમાંક

M

સમય :120 મિનિટ	Time : 120 Minutes
કુલ પ્રશ્નો : 200	Total Ques. : 200
કુલ ગુણ : 200	Total Marks : 200

This Question Booklet Contains 48 Printed Pages

ઉમેદવારનો Roll બેઠક નંબર No:

BVR

ઉમેદવારોને સૂચના

સૂચના ન મળે ત્યાં સુધી પ્રશ્નપુસ્તિકા ખોલવી નહીં

(1) પ્રત્યેક પ્રશ્નનો ઉત્તર A, B, C અને D પૈકી કોઈ એક છે અને ઉમેદવાર જો જવાબ ન આપવા માંગતા હોય તો તેમના માટે વિકલ્પ E OMR ઉત્તરપત્રમાં આપેલ છે. તમારે બધાજ પ્રશ્નોના ઉત્તર આપવા ફરજીયાત છે. તમારે આ સાથે **અલગ** OMR **ઉત્તરપત્રમાં જ ઉત્તર આપવાના છે.**

ઉદાહરણ તરીકે:

ભારતના રાષ્ટ્રપિતા તરીકે કોણ ઓળખાય છે?

(A) સરદાર પટેલ (B) સુભાષચંદ્ર બોઝ

(C) મહાત્મા ગાંધી (D) વિનોબા ભાવે

ઉત્તરપત્ર (OMR SHEET) માં

(A) (B) ● (D) (E)

ઉપર્યુક્ત ઉદાહરણનો જવાબ "C" છે. આથી "C" નું વર્તુળ કાળું (encode) કરેલ છે. સાચી અને ખોટી પદ્ધતિથી વર્તુળ ઘાટું કરવા બાબતની સૂચના OMR ની પાછળ આપેલ છે જેની નોંધ લેવી

(2) આ પાના ઉપર આપનો રોલ નંબર લખો.

(3) બધા જ પ્રશ્નો પૂરેપૂરા છપાયેલા છે કે કેમ તેની પ્રથમ ખાતરી કરી લો. જો પ્રશ્નો પૂરા છપાયા ન હોય અથવા કોઈ પૃષ્ઠ ફાટેલું હોય કે કોઈ પૃષ્ઠ સામેલ ન હોય અથવા તો અન્ય કોઈ ક્ષતિ જણાય તો તરત જ પ્રશ્નપુસ્તિકા નિરીક્ષક પાસેથી અચૂક બદલાવી લેવી.

ઉમેદવારને OMR ઉત્તરપત્ર મળ્યા બાદ જો તેઓ દ્વારા તેનો નાશ કરવામાં આવશે કે ગુમ કરવામાં આવશે તો તે ઉમેદવાર ગેરલાયક ઠેરાવવામાં આવશે તેમજ ભવિષ્યની પરીક્ષાઓમાં બેસવા માટે પ્રતિબંધ મુકવા ઉપરાંત ફોજદારી ગુનાને પણ પાત્ર બનશે.

(4) પરીક્ષા શરૂ થયેથી પૂરી થાય તે દરમ્યાન ઉમેદવાર પરીક્ષાર્થીએ પરીક્ષાખંડ છોડવાની મનાઈ છે.

(5) ઉમેદવારે પોતાના બેઠક ક્રમાંકની પ્રશ્નપુસ્તિકા અને OMR ઉત્તરપત્ર મળેલ છે તેની ખાતરી કરી લેવી અન્યથા ખંડ નિરીક્ષકનું તરત જ ધ્યાન દોરવું. ઉમેદવારને OMR ઉત્તરપત્ર મળે કે તરત જ તેમાં નિયત કરેલ જગ્યાએ પોતાનો બેઠક નંબર સ્વચ્છ અક્ષરે લખવાનો રહેશે. તેમજ બેઠક ક્રમાંક નીચે આપેલ વર્તુળ પણ ઘાટું કરવાનું રહેશે. મળેલ પ્રશ્નપત્રની સીરીઝ નિયત જગ્યાએ લખીને તેની નીચે તે સીરીઝ સામે આપેલ વર્તુળ પણ ઘાટું કરવાનું રહેશે. લખેલી વિગતો અને ઘાટું કરેલ વર્તુળની વિગતો યોગ્ય રીતે ભરાયેલ છે તેની ખાતરી કરી લેવી.

(6) પ્રત્યેક સાચા જવાબદીઠ 1 (એક) ગુણ મળવાપાત્ર થશે. આયોગ દ્વારા ગુણાંકન પદ્ધતિમાં માઈનસ પદ્ધતિ દાખલ કરવામાં આવી છે. જે મુજબ-

(i) પ્રત્યેક ખોટા જવાબદીઠ, ખાલી છોડેલ જવાબદીઠ તથા છેકછાક, ખોટી પદ્ધતિથી એક કરતાં વધુ વિકલ્પ દર્શાવેલ જવાબદીઠ 0.3 ગુણ કાપવામાં આવશે. પરંતુ જો ઉમેદવાર જવાબ આપવા માંગતા ન હોય અને વિકલ્પ (E) ઘાટું કરશે તો 0.3 ગુણ કાપવામાં આવશે નહીં.

(ii) આન્સર કી ફાઈનલ કરતી વખતે જો આયોગ દ્વારા એક પ્રશ્નના એકથી વધુ વિકલ્પો સાચા છે તેમ જાહેર કરવામાં આવે ત્યારે સાચા વિકલ્પ પૈકી કોઈપણ જવાબ માટે એક (1) ગુણ મળવાપાત્ર થશે.

(7) OMR ઉત્તરપત્રમાં નિશ્ચિત જગ્યા સિવાય ઉમેદવારે પોતાનો બેઠક ક્રમાંક લખવો નહીં તથા પોતાની ઓળખ છતી થાય તેવી નામ સહિતની અન્ય કોઈ પણ પ્રકારની નિશાની કરવાની સખત મનાઈ છે. તેમ છતાં પણ કોઈ પણ નિશાની કે ઓળખ માલૂમ પડશે તો તેને સંપૂર્ણ ગેરશિસ્ત ગણવામાં આવશે અને પરીક્ષા માટે ગેરલાયક ગણવામાં આવશે.

(8) OMR ઉત્તરપત્રના પ્રમાણપત્રમાં ઉમેદવાર તથા નિરીક્ષક બંનેની વાદળી / કાળી બોલપોઈન્ટ પેનથી સહી તથા ઉમેદવારના ડાબા હાથના અંગુઠાનું નિશાન ફરજિયાત છે. ઉમેદવારની સહી તથા ડાબા હાથના અંગુઠાના નિશાન વિનાની OMR ઉત્તરપત્રવાળા ઉમેદવાર ગેરલાયક ઠરશે.

(9) પરીક્ષા દરમ્યાન ઉમેદવાર પાસેથી કોઈ પણ સાહિત્ય, ગાઇડ, માર્ગદર્શિકા, કાપલી, સ્લીપો, અન્ય હસ્તલિખિત કે પ્રિન્ટેડ સાહિત્ય, મોબાઇલ ફોન, પેજર, કેલ્ક્યુલેટર કે અન્ય વીજાણુ ઉપકરણો હોવાનું જણાશે તો ઉમેદવારને ગેરલાયક ગણવામાં આવશે. તેમજ ભવિષ્યની પરીક્ષાઓમાં બેસવા માટે પ્રતિબંધ મુકવા પણ પગલાં લેવાશે.

(10) ચાલુ પરીક્ષા દરમ્યાન અંદરોઅંદર ગુસપુસ કરવી, અવાજ કરવો કે નિરીક્ષકની સૂચનાઓનું ઉલ્લંઘન કરવું તે ગેરશિસ્ત ગણાશે. કોઇ પણ પ્રકારની ગેરશિસ્ત બદલ પગલા લેવાશે.

(11) ઉમેદવારે વાદળી / કાળી બોલપોઈન્ટ પેનથી ઉત્તરો લખવાના છે. અન્ય શાહી કે પેન કે પેન્સિલ તથા સફેદ શાહીનો ઉપયોગ કરી શકશે નહીં તથા સફેદ શાહી (White Ink), બ્લેડ કે રબ્બરથી કે અન્ય કોઈ પણ રીતે કરેલા સુધારા માન્ય ગણાશે નહીં.

(12) આ જવાબવહી કમ્પ્યુટર દ્વારા તપાસવાની હોવાથી તે વળે, ફાટે કે બગડે નહીં તેની ખાસ કાળજી રાખવી તથા જવાબ વહીની ઘડી વાળવી નહીં.

(13) પ્રશ્નપુસ્તિકામાં કોરી જગ્યામાં રફકામ કરવું. તે માટે અલગ કાગળ આપવામાં આવશે નહીં. જવાબવહી માં કઈ પણ રફવર્ક કરવું નહીં. પ્રશ્નપુસ્તિકામાં જવાબો લખવાની મનાઈ છે. પરીક્ષાખંડ છોડતા પૂર્વે જવાબવહી (OMR Answer Sheet) નિરીક્ષકને સોંપવી, જ્યારે પ્રશ્નપુસ્તિકા ઉમેદવારો લઈ જઈ શકશે.

પરીક્ષા પૂરી થયા બાદ OMR ઉત્તરપત્ર વર્ગ નિરીક્ષકને સોંપ્યા બાદ જ વર્ગખંડ છોડવાનો રહેશે. તેમ કરવામાં કસૂર થયેથી ઉમેદવારને ગેરલાયક ઠેરવવામાં આવશે. તે ભવિષ્યની પરીક્ષાઓમાં બેસવા માટે પ્રતિબંધ મૂકવા તથા ફોજદારી પગલા લેવાને પણ પાત્ર થશે.

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1. **Consider the following statements for comparison of heat and work:**

   1. Both heat and work are transient phenomena.

   2. Both heat and work are boundary phenomena.

   3. Both heat and work are path functions and inexact differentials.

   Which of the above statements are correct?

   (A) 1 and 2 only **(B) 1, 2 and 3**

   (C) 2 and 3 only **(D) 1 and 3 only**

2. **A stationary mass of gas is compressed without friction from an initial state of 0.3 m^3 and 0.105 MPa to a final state of 0.15 m^3 and 0.105 MPa, the pressure remaining constant during the process. There is a transfer of 40 kJ of heat from the gas during the process. How much does the internal energy of the gas change?**

   (A) – 24.25 kJ **(B) – 19.62 kJ**

   (C) – 15.19 kJ **(D) – 12.72 kJ**

3. **A refrigerator operates on reversed Carnot cycle. What is the power required to drive the refrigerator between temperatures of 42° C and 4° C, if heat at the rate of 2 kJ/s is extracted from the low temperature region?**

   (A) 0.174 kW **(B) 0.374 kW**

   (C) 0.274 kW **(D) 0.474 kW**

4. **Entropy generated (S_{gen}) can be taken as a criterion to indicate feasibility of process. Which of the following conditions are correct?**

   If $S_{gen} = 0$, then the process is a reversible process.

   If $S_{gen} > 0$, then the process is an irreversible process.

   If $S_{gen} < 0$, then the process is impossible.

   (A) 1 and 2 only **(B) 2 and 3 only**

   (C) 1 and 3 only **(D) 1, 2 and 3**

5. A certain amount of gas of volume V at 27° C temperature and pressure 2×10^7 Nm^{-2} expands isothermally until its volume gets doubled. Later it expands adiabatically until its volume gets redoubled. The final pressure of the gas will be _____ (Use $\gamma = 1.5$)

(A) 3.536×10^5 Pa (B) 3.536×10^6 Pa

(C) 1.25×10^6 Pa (D) 1.25×10^5 Pa

6. The heat supplied to an ideal gas under isothermal conditions is used for

(i) Increasing the temperature of the gas

(ii) Increasing the internal energy of the gas

(iii) Doing external work by the gas

Which of the above statements is/are correct?

(A) Only (i) (B) Only (ii)

(C) Only (iii) (D) Both (i) and (iii)

7. Consider a cyclic device that is claimed to operate with no effect other than extracting heat from a single thermal reservoir and converting it completely into an equivalent amount of work. Another device is claimed to transfer heat from a low-temperature reservoir to a high-temperature reservoir without any external work input.

(i) The first claim violates the Kelvin-Planck statement of the second law.

(ii) The second claim violates the Clausius statement of the second law.

(iii) Violation of either the Kelvin-Planck statement or the Clausius statement implies violation of the second law.

(iv) Both claims could become possible if the processes are made reversible.

Which of the above statements is/are correct?

(A) Only (i) and (ii) (B) Only (i), (ii) and (iii)

(C) Only (ii), (iii) and (iv) (D) (i), (ii), (iii) and (iv)

8. For the isothermal expansion of an ideal gas in a piston-cylinder system, the net heat supplied during the process is equal to the net work. Which one of the following statements is correct for the given process?

(A) The process is possible.

(B) The process is not possible as it violates the second law of thermodynamics.

(C) The process is not possible as it violates the first law of thermodynamics.

(D) The process is possible, however, it violates the second law of thermodynamics.

9. Two rectangular surfaces, each having an area of 1 m^2, are placed perpendicular to each other with a common edge. One surface is hot, having a temperature of 1000 K with an emissivity of 0.4, while other surface is insulated and in radiant balance with a large surrounding room at 300 K. If the fraction of radiation leaving hot surface which reaches the cold surface is 0.2, then the equivalent overall resistance for the radiation heat loss from the hot surface is

(A) 1.50 m^{-2} (B) 2.54 m^{-2}

(C) 3.25 m^{-2} (D) 6.25 m^{-2}

10. Which of the following statements regarding the gas laws is/are correct?

(i) At constant temperature, the pressure of a fixed amount of gas varies inversely with its volume, as stated by Boyle's law.

(ii) At constant pressure, the volume of a fixed amount of gas varies directly with its absolute temperature, as stated by Charles' law.

(iii) At constant temperature and pressure, the volume of a gas varies directly with the number of moles, as stated by Avogadro's law.

(iv) At constant temperature, the pressure of a gas varies directly with its volume, as stated by Dalton's law.

(A) Only (i) and (ii) (B) Only (i) and (iii)

(C) Only (i), (ii) and (iii) (D) (i), (ii), (iii) and (iv)

11. For a dual combustion cycle, for a fixed value of heat addition, consider the following statements regarding mean effective pressure:

(i) Mean effective pressure will be greater with an increase in pressure ratio and a decrease in compression ratio.

(ii) Mean effective pressure will be greater with a decrease in pressure ratio and an increase in compression ratio.

(iii) Mean effective pressure will remain the same with an increase in pressure ratio and a decrease in compression ratio.

Which of the above statements is/are correct?

(A) Only (i) (B) Only (ii)

(C) Both (i) and (iii) (D) Both (ii) and (iii)

12. Ratio of advection to conduction heat transfer rate is

(A) Grashof number
(B) Lewis number
(C) Prandtl number
(D) Peclet number

13. "The wavelength at which a black body radiates its maximum energy is inversely proportional to temperature". The given statement belongs to which of the following basic radiation laws?

(A) Rayleigh's law
(B) Planck's law
(C) Stefan-Boltzmann law
(D) Wien's displacement law

14. A sphere of radius 5 mm is initially in equilibrium at 400° C in a furnace. It is suddenly removed from the furnace and dipped in a well-stirred water bath at 20° C, with a convection heat transfer coefficient of 500 W/(m^2K). For the given range of temperatures, the thermophysical properties of the material of the sphere are: density p = 3000 kg/m^3, thermal conductivity k =10 W/(m K) and specific heat c = 1000 J/(kg K). Neglecting radiation heat transfer, the time required for the centre of the sphere to cool from 400° C to 50° C is _____ seconds.

(A) 22.35
(B) 25.39
(C) 27.33
(D) 20.21

15. If the exit temperatures of hot and cold fluids are equal, in case of parallel flow heat exchanger, then which of the following will be the LMTD?

(A) Zero
(B) Cannot be determined
(C) Highest
(D) Lowest

16. In the boiling curve, Leidenfrost point is the point where

(A) The heat flux reaches a minimum
(B) The heat flux reaches a maximum
(C) Nucleate boiling is prevailing
(D) Burnout phenomenon occurs

17. The centre of buoyancy of a submerged body

(A) Coincides with the center of gravity of body

(B) is always above the centroid of the displaced volume of liquid

(C) is always below the center of gravity of the body

(D) Coincides with the centroid of displaced volume of fluid

18. In a river carrying a discharge of 142 m^3/s, the stage at a station A is 3.6 m and the surface slope is 1 in 6000. If during a flood, the stage at A is 3.6 m and the surface slope is 1 in 3000, what was the flood discharge approximately?

(A) 284 m^3/s (B) 200 m^3/s

(C) 164 m^3/s (D) 96 m^3/s

19. For a flat plate in a steady incompressible flow, consider the following statements about boundary layer thickness:

(i) The boundary layer thickness decreases with increasing Reynolds number.

(ii) The boundary layer thickness is independent of the Reynolds number.

(iii) The boundary layer thickness increases with increasing distance from the leading edge of the plate and depends on the Reynolds number.

(iv) The boundary layer thickness increases linearly with distance from the leading edge.

Which of the above statements is/are correct?

(A) Only (i) (B) Only (ii)

(C) Only (iii) (D) Both (iii) and (iv)

20. An inward flow reaction turbine, having an outer diameter of 1 m, runs at 600 rpm. The normal component of absolute velocity at the inlet is 10 m/s. If the guide blade angle is 15°, then the inlet vane angle of the runner is

(A) 59.44° (B) 55.23°

(C) 67.14° (D) 49.88°

21. For a fluid flow, consider the following statements regarding the Froude number:

(i) It represents the ratio of inertia force to gravity force.

(ii) It is important in flows where gravitational effects, such as free-surface waves, are significant.

(iii) It represents the ratio of inertia force to viscous force.

(iv) It is used to assess the relative importance of inertia and gravity forces in free-surface flows.

Which of the above statements is/are correct?

(A) Only (i) and (ii)
(B) Only (ii) and (iii)
(C) Only (i), (ii) and (iv)
(D) Only (ii), (iii) and (iv)

22. The loss of head in a pipe of certain length carrying a flow rate Q is found to be H. If a pipe of twice the diameter but the same length is to carry a flow rate of 2Q, then the head loss will be

(A) H/8
(B) H/4
(C) H/2
(D) H

23. The hydraulic efficiency of a Pelton wheel turbine is _____ when the bucket speed is _____ the velocity of the jet.

(A) Minimum, half
(B) Maximum, half
(C) Maximum, equal
(D) Maximum, twice

24. Tweddell's differential hydraulic accumulator can store liquid at a _____ by a comparatively _____ on the ram.

(A) High pressure, small load
(B) Low pressure, small load
(C) High pressure, high load
(D) Low pressure, high load

25. For a gravity dam, consider the following statements regarding the elementary profile under full reservoir condition:

(i) Providing a top width for roadway and freeboard shifts the resultant force towards the heel.

(ii) Providing a top width for roadway and freeboard shifts the resultant force towards the toe.

(iii) Providing a top width for roadway and freeboard does not shift the resultant force.

Which of the above statements is/are correct?

(A) Only (i)
(B) Only (ii)
(C) Only (iii)
(D) Both (i) and (ii)

26. A centrifugal pump, driven by a directly coupled 2 kW motor of speed 1400 rpm, is proposed to be connected to a motor of speed 2800 rpm. The power of the motor should be

(A) 24 kW
(B) 4 kW
(C) 8 kW
(D) 16 kW

27. An accumulator has a ram of 0.2 m diameter and lift of 6 m. Water is supplied at a pressure of 5900 kN/m^2. The capacity of the accumulator is

(A) 185.35 kN-m
(B) 1112.1 kN-m
(C) 185.35 kW hour
(D) 1112.1 kW hour

28. For vortex flow of irrotational motion, without any external torque, the rate of change of angular momentum must be

(A) Zero
(B) Two
(C) One
(D) Three

29. _____ is defined as a scalar function of space and time such that its negative derivative with respect to any direction gives the fluid velocity in that direction.

(A) Stream function
(B) Velocity potential
(C) Streak function
(D) Rotational component

[Contd.

30. Which one is NOT a reason behind the fact that the ideal regenerative cycle is practically not possible?

(A) The reversible heat transfer takes infinite time

(B) It is mechanically impossible to exchange heat in the turbine

(C) The moisture content in the turbine will be high

(D) The steam specific volume will be too high

31. The power developed by a turbine in a certain steam power plant is 1206 kW. The heat supplied to boiler is 3500 kJ/kg. The heat rejected by steam to cooling water is 2900 kJ/kg. The feed pump work required to condensate back into the boiler is 6 kW. What will be the mass flow rate of cycle?

(A) 2 kg/s

(B) 0.002 kg/s

(C) 6.22 kg/s

(D) 0.00622 kg/s

32. What happens on bleeding steam to reheat feed water to boiler?

(A) It does not affect the thermal efficiency of the cycle

(B) It drops the thermal efficiency of the cycle

(C) It improves the thermal efficiency of the cycle

(D) It may improve or drop the thermal efficiency of the cycle based on point of extraction of steam

33. Which type of boilers are suitable for low-maintenance cost, small size and low-pressure plants?

(A) High-pressure boilers

(B) Supercritical boilers

(C) Water tube boilers

(D) Fire tube boilers

34. In nuclear power plant, for a breeder reactor, the conversion ratio is

(A) Above unity

(B) Below unity

(C) Equal to unity

(D) Between 0 and 1

35. Alum, as a coagulant, is found to be most effective when the pH range of water is

(A) 3.5 to 4.5 (B) 4.5 to 6

(C) 7 to 8 (D) 8 to 9

36. Slack of an event in PERT is _____.

(A) Latest Allowable Time minus Early Expected Time

(B) Early Expected Time minus Latest Allowable Time

(C) Early Allowable Time minus Latest Expected Time

(D) Latest Expected Time minus Early Allowable Time

37. In which of the following pairs of cycles, both cycles have at least one isothermal process?

(A) Diesel cycle and Otto cycle

(B) Carnot cycle and Stilling cycle

(C) Brayton cycle and Rankine cycle

(D) Bell-Coleman cycle and Vapour compression refrigeration cycle

38. Consider the following types of nuclear reactors:

(i) Boiling Water Reactor (BWR)

(ii) Pressurized Heavy Water Reactor (PHWR)

(iii) Advanced Gas-cooled Reactor (AGR)

(iv) Pressurized Water Reactor (PWR)

Which of the following represents the correct order of these reactors in increasing order of thermal efficiency?

(A) BWR < PHWR < PWR < AGR

(B) PHWR < BWR < PWR < AGR

(C) BWR < PWR < PHWR < AGR

(D) BWR < PHWR < AGR < PWR

39. Which of the following is one of the principal advantages of using a solar cell?

(A) It shows oscillatory motion.

(B) It has metal in the outer area.

(C) It has moving parts.

(D) It has no moving parts.

40. Photovoltaic cells are _____ materials.

(A) superconductor (B) conductor

(C) semiconductor (D) bad conductor

41. Which of the following is a characteristic of a clean fuel?

(A) Pollution free

(B) Non-renewable

(C) Generates a lot of smoke

(D) Generates too many greenhouse gases

42. Benefits of KVIC biogas plant are

(i) Supplies clean and high calorific fuel.

(ii) Provides anaerobically digested slurry.

(iii) Reduces the destruction of forests.

(iv) Reduces the pathogenic load of night soil.

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

(A) (i), (ii) and (iv) (B) (ii), (iii) and (iv)

(C) (i), (ii), (iii) and (iv) (D) (i), (ii) and (iii)

43. The load curve is useful in deciding

(i) The operating schedule of generating units

(ii) The total installed capacity

Which of the above statements is/are correct?

(A) Only (i) (B) Only (ii)

(C) Either (i) or (ii) (D) Both (i) and (ii)

44. Which of the following pollutants is majorly found in the automobile exhaust and causes eyes and lung irritation?

(A) Carbon dioxide

(B) Lead

(C) Suspended dust

(D) Nitrogen compound

45. Stages of combustion in CI engine are given

(1) First stage	(a) Uncontrolled (rapid) combustion
(2) Second stage	(b) Ignition delay period
(3) Third stage	(c) Controlled combustion
(4) Fourth stage	(d) After burning

The correct match is:

(A) 1 – b, 2 – a, 3 – c, 4 – d

(B) 1 – a, 2 – b, 3 – c, 4 – d

(C) 1 – a, 2 – b, 3 – d, 4 – c

(D) 1 – b, 2 – a, 3 – d, 4 – c

46. Read the following statements:

(i) For same compression ratio and same heat input, Diesel cycle is less efficient than Otto cycle.

(ii) For same maximum pressure and temperature, Diesel cycle is more efficient than Otto cycle.

(A) Both (i) and (ii) are incorrect

(B) Both (i) and (ii) are correct

(C) (i) is correct but (ii) is incorrect

(D) (i) is incorrect but (ii) is correct

47. Which of the following is NOT a requirement of an ignition system in a spark-ignition engine?

(A) Timing the spark to coincide with the compression stroke

(B) Mixing air and fuel in the intake manifold

(C) Maintaining consistent spark duration across all RPMs

(D) Generating sufficient voltage to jump the spark plug gap

48. Shape of piston head in a two-stroke engine is

(A) Curved (B) Contoured

(C) Flat (D) Crown

49. What is the action taken by Woodward governor in case of low lube oil pressure?

(A) Makes the engine idle

(B) Makes the engine shut down

(C) Restricts the rpm at forth notch

(D) None of the above

50. _____ lubrication technique is used for lubrication of the cylinder of a scooter engine.

(A) Petroil (B) Splash

(C) Gravity feed (D) Forced feed

51. The lowest temperature at which the oil ceases to flow when cooled is known as _____.

(A) Flash point (B) Fire point

(C) Cloud point (D) Pour point

52. A diesel engine develops a brake power of 4.5 kW. Its indicated thermal efficiency is 30% and the mechanical efficiency is 85%. Considering calorific value of the fuel as 40,000 kJ/kg, the fuel consumption will be

(A) 2.1 kg/hr (B) 3.9 kg/hr

(C) 1.6 kg/hr (D) 4.6 kg/hr

53. Air lock in fuel line will cause

(A) Engine idling high

(B) Injector pressure too high

(C) Late starting and erratic running

(D) Excess delivery from FI pump

54. Which one of the following is suitable reason for engine overheat?

(A) Clogged radiator core

(B) Low idle speed setting

(C) Excessive valve clearance

(D) Too high viscosity of oil

55. Read the following:

Statement: The COP of air refrigeration system is lower than the COP of vapor compression refrigeration system.

Reasoning: Air is not changing its phase throughout the cycle.

(A) Both statement and reasoning are correct

(B) Both statement and reasoning are incorrect

(C) Statement is correct but reasoning is incorrect

(D) Statement is incorrect but reasoning is correct

56. In a simple vapour compression refrigeration cycle, the enthalpies at different state points are: Before compression = 375 kJ/kg, After compression = 425 kJ/kg, After throttling = 125 kJ/kg. Then the C.O.P will be

(A) 3.4

(B) 3

(C) 6

(D) 5

57. How is absolute humidity in the psychrometric process defined?

(A) Mass of actual vapor pressure at wet bulb temperature

(B) Mass of saturated vapor pressure at dry bulb temperature

(C) Mass of water vapor present in 1 cubic metre of dry air

(D) Mass of water vapor present in 1 cubic metre of wet air

58. Which of the following couplings is better for transmitting high power at lower speed?

(A) Flange coupling
(B) Sleeve coupling
(C) Universal coupling
(D) Split coupling

59. A pair of spur gears is required to maintain a velocity ratio of 1:2. The module of the gears is 10 mm and the addendum is 10 mm. If the operating pressure angle is 15°, the minimum number of teeth required on the pinion to ensure NO interference/undercutting is

(A) 15
(B) 20
(C) 25
(D) 35

60. Worm gearsets are used for transmitting rotary motion between

(i) Non-parallel shafts
(ii) Non-intersecting shafts
(iii) Intersecting shafts
(iv) Parallel shafts

Which of the above is/are correct?

(A) Only (i)
(B) Only (i) and (ii)
(C) Only (iii)
(D) Only (ii) and (iv)

61. In heavy vehicles, the suspension springs provided on rear wheels are

(A) Leaf spring
(B) Torsion bar
(C) Coil springs
(D) Shock absorber

62. Ball bearing type screws are found in which of the following applications?

(A) Screw jack
(B) Aeroplane engines
(C) Crane
(D) Steering mechanism

63. In rear axle, what is used between the axle retainer plate and the housing to limit axle end play?

(A) Spring washers
(B) Shims
(C) Thrust washers
(D) Spring

64. Which one of the following is the definition of ultimate tensile strength (UTS) obtained from a stress-strain test on a metal specimen?

(A) Stress value where the stress-strain curve transitions from elastic to plastic behavior

(B) The maximum load attained divided by the original cross-sectional area

(C) The maximum load attained divided by the corresponding instantaneous cross-sectional area

(D) Stress where the specimen fractures

65. How can Mohr's circle be represented for analyzing the stress state at a point on a steel plate subjected to tensile stress in the horizontal direction and shear stress in the vertical direction?

(A) The relationship between tension and shear stress at different planes in the element.

(B) The relationship between normal and compression stress at different planes in the element.

(C) The relationship between normal and shear stress at different planes in the element.

(D) The relationship between compression and shear stress at different planes in the element.

66. A cantilever 2 m long beam carries point loads of 300, 500 and 800 N respectively at 0.5, 1.2 and 2 m from the fixed end. What will be the shear force (in N units) at the fixed end and bending moment (in N-m units) at the free end?

(A) 500, 2350 (B) 800, 640

(C) 1600, 0 (D) 800, 0

67. Which of the following statements are true/false regarding shear force and bending moment?

Statements:

1. The rate of change of bending moment along the length of the beam is equal to the shear force.
2. There is an abrupt change (equal to the applied point load) in the shear force at the point where a point load is applied.

(A) Both the statements are false.

(B) Both statements are true.

(C) Statement 1 is true and Statement 2 is false.

(D) Statement 2 is true and Statement 1 is false.

68. Consider the following assumptions for pure bending theory:

1. The material is heterogeneous and isotropic.
2. The stress is purely longitudinal and local effects near concentrated loads will be neglected.
3. The radius of curvature is large compared with the dimensions of the cross-section.

Which of the above statements are correct?

(A) 1 and 2 only
(B) 2 and 3 only
(C) 1 and 3 only
(D) 1, 2 and 3

69. Circular beam of uniform strength can be made by varying the diameter in such a way that

(A) M/Z is constant
(B) σ/Y is constant
(C) M/R is constant
(D) E/R is constant

70. A right solid circular cone standing on its base on a horizontal surface is of height H and base radius R. The cone is made of a material with specific weight w and elastic modulus E. The vertical deflection at the mid-height of the cone due to self-weight is given by

(A) $\frac{wH^2}{8E}$
(B) $\frac{wH^2}{6E}$
(C) $\frac{wRH}{6E}$
(D) $\frac{wRH}{8E}$

71. Maxwell's reciprocal theorem is based on the

(i) Principle of conservation of energy
(ii) Principle of conservation of mass
(iii) Principle of superposition

(A) (i), (ii) and (iii)
(B) (i) and (iii)
(C) (i) only
(D) (i) and (ii)

72. A hollow shaft has an outer diameter twice its inner diameter of a solid shaft, both constructed from the same material and having identical outer diameters. The ratio of their torsional strength is

(A) $\frac{15}{16}$ (B) $\frac{5}{19}$

(C) $\frac{13}{14}$ (D) $\frac{2}{3}$

73. Find the stress acting on the surface of a thin sphere of diameter 15 cm, thickness 0.25 cm and the internal pressure 2 MPa

(A) 15 MPa (B) 60 MPa

(C) 25 MPa (D) 30 Mpa

74. Which of the following is NOT an assumption in Euler's theory?

(A) Column will fail by buckling only.

(B) The self-weight of the column is negligible.

(C) The cross-section of a column is uniform throughout the length.

(D) The direct stress is very large as compared to the bending stress.

75. Which NDT technique plays a crucial role in detecting hidden defects in aircraft engines and structures by using high-frequency sound waves?

(A) Eddy Current Testing

(B) Magnetic Particle Testing

(C) Ultrasonic Testing

(D) Aviation Testing

76. A superstructure has

(A) no degree of freedom

(B) infinite degrees of freedom

(C) positive degree of freedom

(D) negative degree of freedom

77. A slotted head screw is torqued to 4 N-m using a screw driver having a blade of 5 mm width. The couple force exerted by the blade edges on the screw slot is

(A) 4 N
(B) 800 N
(C) 400 N
(D) 20 N

78. In the context of the virtual work principle in continuum mechanics, which of the following statements is true about a system in equilibrium?

(A) Neither conservative nor non-conservative forces do virtual work.
(B) Only non-conservative forces do virtual work.
(C) Both conservative and non-conservative forces can do virtual work.
(D) Only conservative forces do virtual work.

79. Two shafts of same length and material are joined in series. If the ratio of their diameter is 2, then the ratio of their angles of twist will be

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

80. A steel plate of width 80 mm and thickness 15 mm is bent into a circular arc of radius 8 m. What will be the maximum stress induced in plate?

(A) 150 N/mm^2
(B) 187.5 N/mm^2
(C) 200 N/mm^2
(D) 189.5 N/mm^2

81. A cantilever beam of width 120 mm, depth 240 mm and span 2 m is subjected to a UDL of 2 kN/m till a span of 1 m from its fixed end and a point load of 1 kN at its free end. The deflection at the free end of the beam (E = 10 GPa) will be

(A) 2.5 mm
(B) 2.35 mm
(C) 2 mm
(D) 1.75 mm

82. A simply supported circular shaft of 4 m length can sustain a maximum load of 100 kN at its mid-point. The bending stress is 1.5 times of the shear stress. What is the value of the twisting moment in the beam?

(A) 1000 kN-m
(B) 10 kN-m
(C) 100 kN-m
(D) 1 kN-m

83. Which parameter does not affect the polar moment of inertia for a solid shaft?

(A) Length
(B) Outer radius
(C) Diameter
(D) Shape

84. A closely coiled helical spring of 20 cm mean diameter is having 25 coils of 2 cm diameter rod. The modulus of rigidity of the material is 107 N/cm^2. What is the stiffness for the spring in N/cm?

(A) 50
(B) 100
(C) 250
(D) 500

85. The strain energy stored in a shaft due to torsion is given by

(A) $(\tau^2 V/2G)$
(B) $(\tau^2 V/4G)$
(C) $(\tau^2 V/8G)$
(D) $(\tau^2 V/16G)$

86. A cantilever beam having square cross-section of side a is subjected to an end load. If a is increased by 19%, the tip deflection decreases approximately by

(A) 19%
(B) 29%
(C) 41%
(D) 50%

87. A car is moving on a curved horizontal road of radius 100 m with a speed of 20 m/s. The rotating masses of the engine have an angular speed of 100 rad/s in clockwise direction when viewed from the front of the car. The combined moment of inertia of the rotating masses is 10 kg-m^2. The magnitude of the gyroscopic moment (in N-m) is

(A) 100
(B) 200
(C) 300
(D) 380

88. Match the following:

Column I	Column II
(P) Higher kinematic pair	(1) Grubler's equation
(Q) Lower kinematic pair	(2) Line contact
(R) Quick return mechanism	(3) Euler's equation
(S) Mobility of a linkage	(4) Planer
	(5) Shaper
	(6) Surface contact

(A) P – 2, Q – 6, R – 4, S – 3
(B) P – 6, Q – 2, R – 4, S – 1
(C) P – 6, Q – 2, R – 5, S – 3
(D) P – 2, Q – 6, R – 5, S – 1

[Contd.

89. Consider the following statements regarding joints:

1. A joint is the connection between two or more links at their nodes.
2. If a joint connects only two links, the entity is also called a kinematic pair.
3. If a one degree of freedom joint imposes a translation motion, it is called a prismatic joint.

Which of the above statements are correct?

(A) 1 and 2 only
(B) 1 and 3 only
(C) 2 and 3 only
(D) 1, 2 and 3

90. Match the following:

Group-I (Kinematic Pair)	Group-II (Example)
(P) Revolute pair	(1) Ball-bearing
(Q) Helical pair	(2) Ball and socket
(R) Rolling pair	(3) Lathe spindle in the headstock
(S) Globular pair	(4) Motion between the bolt and fixed nut

(A) P – 4, Q – 1, R – 3, S – 2
(B) P – 2, Q – 4, R – 1, S – 3
(C) P – 3, Q – 4, R – 1, S – 2
(D) P – 1, Q – 3, R – 4, S – 2

91. Which of the following are lower kinematic pairs?

(i) Ball and socket
(ii) Cam and follower
(iii) Piston and cylinder

(A) Only (i)
(B) Only (ii)
(C) Both (i) and (iii)
(D) (i), (ii) and (iii)

92. A car travelling at speed V can just take a turn around a bend of radius R without skidding sideways. Under identical road conditions, if this person wants to double the speed, the minimum turn radius he can make without skidding is

(A) 4 R
(B) 2 R
(C) R/4
(D) R/2

93. Klein's construction is mainly used to

(A) determine the linear velocity of piston

(B) determine the linear acceleration of piston

(C) determine the linear displacement of piston

(D) none of the above

94. In the differential gear of a car, the pinion mounted on the propeller shaft has 20 teeth and the crown gear has 100 teeth. The propeller shaft rotates at 600 rpm. When the vehicle is taking a turn, one wheel rotates at 140 rpm. Determine the percentage change in speed of the other wheel.

(A) 10.52% (B) 16.67%

(C) 20% (D) 11.67%

95. In a Hartnell governor, if a spring of lower stiffness is used, then the governor will be

(A) isochronous (B) more sensitive

(C) less sensitive (D) none of the above

96. A disc spinning on its axis at 20 rad/s will undergo precession when a torque 100 Nm is applied about an axis normal to it. If the mass moment of inertia is 1 kg m^2, then angular velocity of precession is

(A) 1 rad/s (B) 5 rad/s

(C) 2 rad/s (D) 0.1 rad/s

97. A single stage compressor with a clearance elevates the pressure from 1 bar absolute to 10 bar absolute with a compression index of 1.28. What will be the approximate clearance ratio for the volumetric efficiency of 75%?

(A) 0.042 (B) 0.05

(C) 0.036 (D) 0.014

98. The rotor of an aeroplane engine has a mass moment of inertia 1.0 kg m^2. The engine rotates at a speed of 500 rpm in the clockwise direction if viewed from the front of the aeroplane. If the aeroplane while flying at 1200 km/hr turns with a radius of 2 km at same elevation, then the magnitude of the gyroscopic moment exerted by the rotor on the aeroplane structure in N-m is

(A) 8.73 (B) 4.37

(C) 17.46 (D) 26.19

99. Which of the following elements is NOT a primary alloying element in stainless steel?

(A) Lead
(B) Chromium
(C) Carbon
(D) Nickel

100. What happens to the mechanical properties of mild steel when carbon content increases?

(A) Both strength and hardness decrease
(B) Both strength and ductility increase
(C) Strength decreases and ductility increases
(D) Strength increases and ductility decreases

101. Match the heat treatment processes (Group A) and their associated effects on properties (Group B) of medium carbon steel:

Group A	Group B
P: Tempering	I: Strengthening and grain refinement
Q: Quenching	II: Inducing toughness
R: Annealing	III: Hardening
S: Normalizing	IV: Softening

(A) P – III, Q – IV, R – II, S – I
(B) P – II, Q – III, R – IV, S – I
(C) P – III, Q – II, R – IV, S – I
(D) P – II, Q – III, R – I, S – IV

102. An orthogonal cutting operation is performed using a single-point cutting tool with a rake angle of 12° on a lathe. During turning, the cutting force and friction force are 1000 N and 600 N, respectively. If the chip thickness and uncut chip thickness are 1.5 mm and 0.75 mm, respectively, the shear force is approximately _____

(A) 527.07 N
(B) 627.07 N
(C) 727.07 N
(D) 827.07 N

103. Which of the following treatments can further increase the corrosion resistance of alloy steels?

(i) Increasing the overall carbon content in the alloy

(ii) Increasing the susceptibility of the surface to galvanic corrosion

(iii) Increasing surface roughness through mechanical treatment

(iv) Using protective coatings or chemical passivation treatment

(A) Only (i) **(B) Only (ii) and (iii)**

(C) Only (iv) **(D) All of the above**

104. Which of the following heat treatment processes are used for surface hardening of steels?

(i) Carburizing

(ii) Cyaniding

(iii) Annealing

(iv) Carbonitriding

(A) Only (i) and (ii) **(B) Only (ii) and (iii)**

(C) Only (i), (ii) and (iv) **(D) Only (iii) and (iv)**

105. Which of the following methods can improve the fatigue strength of a circular mild steel (MS) shaft?

(i) Enhancing surface finish

(ii) Shot peening of the shaft

(iii) Increasing relative humidity

(A) Only (i) **(B) Only (ii)**

(C) Both (i) and (ii) **(D) Both (ii) and (iii)**

106. Which of the following best describes the principle of parkerising?

(A) A phosphate layer forms by chemical reaction

(B) Surface roughness is increased mechanically

(C) A paint coating is applied to the surface

(D) A polymer coating is sprayed on the surface

107. Surface hardening is principally employed for

(A) low-carbon steel (B) medium-carbon steel

(C) high-carbon steel (D) cast iron

108. A steel plate having a yield strength of 550 MPa is subjected to a biaxial state of stress with the principal stresses given by $\sigma_1 = \sigma$ and $\sigma_2 = -2\sigma$. Using the distortion energy theory and considering a factor of safety of 2, the permissible value of σ that can be applied to the plate is _____.

(A) 98.2 MPa (B) 103.9 MPa

(C) 112.5 MPa (D) 118.6 MPa

109. A cylindrical shaft is subjected to an alternating stress. The fatigue strength to sustain 1000 cycles is 490 MPa and the corrected endurance strength is 70 MPa. If the fatigue strength of the shaft for N cycles is 100 MPa, then the estimated shaft life N in revolutions is _____.

(A) 181,914 revolutions (B) 231,914 revolutions

(C) 281,914 revolutions (D) 331,914 revolutions

110. In a structural member under fatigue loading, the minimum and maximum stresses developed at the critical point are 50 MPa and 150 MPa respectively. The endurance, yield and the ultimate strengths of the material are 200 MPa, 300 MPa and 400 MPa respectively. The factor of safety using modified Goodman criterion is

(A) 3/2 (B) 8/5

(C) 12/7 (D) 2

111. Which of the following statement(s) is/are correct?

(i) Soderberg line is more accurate in predicting fatigue failure than the Gerber curve.

(ii) The Gerber curve takes the mean path through failure points.

(iii) Theories are based on the Soderberg line, as failure criteria are conservative theories.

(iv) Theories are based on the Goodman line, as failure criteria are conservative theories.

(A) Only (i)

(B) Only (ii) and (iii)

(C) Only (ii), (iii) and (iv)

(D) All of the above

112. Endurance limit is related to

(A) Fatigue

(B) Creep

(C) Impact

(D) Yielding

113. The Non-Destructive Inspection (NDI) technique employed during inspection for castings of tubes and pipes to check the overall strength of a casting in resistance to bursting under hydraulic pressure is

(A) Radiographic inspection

(B) Magnetic particle inspection

(C) Fluorescent penetrant

(D) Pressure testing

114. Which of the following additive manufacturing techniques can use a wire as a feedstock material?

(i) Stereolithography

(ii) Fused deposition modeling

(iii) Selective laser sintering

(iv) Directed energy deposition processes

(A) Only (i) and (ii)

(B) Only (ii) and (iv)

(C) Only (iii) and (iv)

(D) Only (ii), (iii) and (iv)

115. A basic feasible solution of m × n transportation problem is said to be non-degenerate, if basic feasible solution contains exactly _____ number of individual allocations in _____ positions.

(A) m + n + 1, independent
(B) m + n – 1, independent
(C) m + n – 1, dependent
(D) m + n + 1, dependent

116. In a metal casting process, both patterns and moulds provide shape by defining where the material should or should not go. Which of the following statements correctly describe the mould and the pattern?

(i) Mould walls indicate boundaries within which the molten part material is allowed, while pattern walls indicate boundaries of regions where mould material is not allowed.

(ii) Moulds can be used to make patterns.

(iii) Pattern walls indicate boundaries within which the molten part material is allowed, while mould walls indicate boundaries of regions where mould material is not allowed.

(iv) Patterns can be used to make moulds.

(A) Only (i) and (ii)
(B) Only (i) and (iii)
(C) Only (ii) and (iii)
(D) Only (i), (ii) and (iv)

117. Consider the following statements about core prints:

(i) Core prints are the projections on a pattern

(ii) They are used to make recesses in the mould

(iii) Core prints provide the location and support to the mould

Which of the above statements are CORRECT?

(A) Only (i) and (ii)
(B) Only (ii) and (iii)
(C) Only (i) and (iii)
(D) All are correct

118. The shape factor for a spherical casting of diameter 20 cm is _____.

(A) 2 (B) 3

(C) 4 (D) 6

119. Which of the following options is NOT a factor in the selection of materials for making patterns in sand casting?

(A) The type of molding process

(B) The dimensional accuracy and the quantity of castings required

(C) Humidity and ambient temperature

(D) The size and shape of the casting

120. For moulding, only additives and water are added into _____ sand.

(i) Synthetic sand

(ii) Natural sand

(iii) Chemically-coated sand

Which of the above is/are correct?

(A) Only (i) (B) Only (i) and (ii)

(C) Only (ii) and (iii) (D) Only (i) and (iii)

121. Match the items in Column I with the appropriate causes in Column II.

Column I	Column II
(P) Wrinkling	(1) Yield point elongation
(Q) Orange peel	(2) Anisotropy
(R) Stretcher strains	(3) Large grain size
(S) Earing	(4) Insufficient blank holding force

(A) P – 4, Q – 3, R – 1, S – 2

(B) P – 3, Q – 4, R – 1, S – 2

(C) P – 4, Q – 2, R – 3, S – 1

(D) P – 2, Q – 3, R – 1, S – 4

122. Which of the following welding processes use a non-consumable electrode?

(A) Carbon arc welding (B) Shielded metal arc welding

(C) Gas metal arc welding (D) Flux-cored arc welding

123. Which welding method is suitable for dissimilar metals with a large difference in melting points?

(A) Gas welding
(B) TIG welding
(C) Spot welding
(D) Arc welding

124. Reaming is the operation of

(A) Enlarging the end of a hole cylindrically
(B) Cone-shaped enlargement of the end of a hole
(C) Smoothing and squaring the surface around a hole
(D) Sizing and finishing a hole

125. The operation of sharpening a grinding wheel is called

(A) truing
(B) dressing
(C) aligning
(D) balancing

126. Which pair of the following statements is correct for orthogonal cutting using a single-point cutting tool?

P: Reduction in friction angle increases cutting force
Q: Reduction in friction angle decreases cutting force
R: Reduction in friction angle increases chip thickness
S: Reduction in friction angle decreases chip thickness

(A) P and R
(B) P and S
(C) Q and R
(D) Q and S

127. Which of the following chucks in the lathe machine is known as Universal Chuck?

(A) Magnetic chuck
(B) Face plate
(C) Three jaws chuck
(D) Four jaws chuck

128. In abrasive jet machining, if the mixing ratio is constant, then the MRR is

(A) Directly proportional to the mass flow rate of gas

(B) Indirectly proportional to the mass of abrasive

(C) Indirectly proportional to the mass of gas

(D) Directly proportional to the mass flow rate of abrasive

129. A 150 mm long and 12.5 mm diameter stainless steel rod is being reduced to a diameter of 12 mm by turning operation. The lathe spindle rotates at N = 400 rpm. Calculate the cutting speed.

(A) 16 m/min

(B) 20 m/min

(C) 15.7 m/min

(D) 31.4 m/min

130. Hot extrusion is a manufacturing process commonly used to produce which of the following products?

1. Aluminium curtain rods
2. Steel pipes for the domestic water supply
3. Stainless steel tubes used in furniture
4. Large diameter pipes for city water mains

(A) 1 and 3

(B) 2 and 4

(C) 2, 3 and 4

(D) 1, 2, 3 and 4

131. Consider the following statements:

1. Forging reduces the grain size of the metal, which results in a decrease in strength and toughness.
2. A forged component can be provided with thin sections without reducing the strength.

Which of the statements given above is/are correct?

(A) 1 only

(B) 2 only

(C) Both 1 and 2

(D) Neither 1 nor 2

[Contd.

132. Assertion (A): Cold working increases the strength and hardness of metals.

Reason (R): This is because cold working decreases the total number of dislocations per unit volume in the material.

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

(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) (A) is false but (R) is true.

133. A CNC milling program uses the following line.

G17 G02 X50 Y50 I10 J0

Assuming the current position is at X40 Y50, which of the following best describes the tool motion?

(A) Clockwise circular interpolation in the XY plane with center at X50, Y50 and radius of 10 mm

(B) Counterclockwise circular interpolation in the XY plane with centre at X50, Y60

(C) Clockwise circular interpolation in the XY plane with center at X50, Y50

(D) Clockwise circular interpolation in the XZ plane with 10 mm radius

134. For the given material, if the stress concentration factor is 2 and notch sensitivity is 0.1, then the fatigue stress concentration factor is

(A) 1.0 (B) 1.2

(C) 1.1 (D) 0.9

135. Which of the following fits is classified under transition fit?

(A) Loose fit
(B) Wringing fit
(C) Side fit
(D) Running fit

136. Match the following:

P. Feeler gauge	I. Radius of an object
Q. Fillet gauge	II. Diameter within limits by comparison
R. Snap gauge	III. Clearance or gap between components
S. Cylindrical plug gauge	IV. Inside diameter of straight hole

(A) P – III, Q – I, R – II, S – IV
(B) P – III, Q – II, R – I, S – IV
(C) P – IV, Q – II, R – I, S – III
(D) P – IV, Q – I, R – II, S – III

137. A Michelson Interferometer has two equal arms. A mercury light of wavelength 546 N-m is used for the interferometer and stable fringes are found. One of the arms is moved by 1.5 μm. The number of fringes that cross the observing field is _____.

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

138. The principal stresses at a point P in a solid are 70 MPa, −70 MPa and 0 MPa. The yield stress of the material is 100 MPa. Which of the following predictions about material failure at P are correct?

(i) Maximum normal stress theory predicts that the material fails.
(ii) Maximum shear stress theory predicts that the material fails.
(iii) Maximum normal stress theory predicts that the material does not fail.
(iv) Maximum shear stress theory predicts that the material does not fail.

(A) Only (i) and (iv)
(B) Only (ii) and (iii)
(C) Only (i) and (ii)
(D) Only (iii) and (iv)

139. Which one of the following failure theories is the most conservative design approach against fatigue failure?

(A) Modified Goodman line
(B) Yield line
(C) Gerber line
(D) Soderberg line

[Contd.

140. Which of the following principles states that 'the stresses always tend to concentrate in the immediate vicinity of the load and become uniform at sections farther off from the load'?

(A) Principle of Low Modulus

(B) Principle of Composite Section

(C) Principle of Superposition

(D) Saint Venant's Principle

141. A journal bearing supports a load of 150 kN from a turbine shaft with a diameter of 300 mm, running at 1800 rpm. If the allowable bearing pressure is 1.6 N/mm^2, then what is the required length of the bearing?

(A) 112.5 mm

(B) 212.5 mm

(C) 312.5 mm

(D) 412.5 mm

142. Select the correct statement from the following about hydrodynamic lubrication:

(i) It cannot be used with thrust bearings.

(ii) It is used with sliding bearings.

(iii) It does not require a pressurized supply of lubricant.

(iv) The surfaces do not contact each other during rotation.

(A) Only (i)

(B) Only (ii)

(C) Only (iii) and (iv)

(D) Only (ii), (iii) and (iv)

143. Which pulley increases the wrapping angle of pulley?

(A) V-pulley

(B) Timer pulley

(C) Rope pulley

(D) Jockey pulley

144. How is power transmission achieved in positive contact clutches?

(A) Minor part is achieved by friction

(B) Major part is achieved by friction

(C) It is achieved through friction

(D) It is achieved by shear contact

145. Statement I: In chain drives, the angle of articulation through which link rotates during engagement and disengagement is greater for a small number of teeth.

Statement II: The greater angle of articulation will increase the life of the chain.

(A) Both Statement I and Statement II are individually true and Statement II is the correct explanation of Statement I

(B) Both Statement I and Statement II are individually true but Statement II is not the correct explanation of Statement I

(C) Statement I is true but Statement II is false

(D) Statement I is false but Statement II is true

146. The stress induced in a close-coiled helical spring when subjected to a twisting moment is of which type?

(A) Bending stress

(B) Torsional stress

(C) Tensile stress

(D) Compressive stress

147. Calculate the load in a closely coiled helical spring, if the maximum shear stress in the material is 100 N/mm^2. The mean coil diameter is 100 mm or 10 cm and the wire diameter is 12 mm.

(A) 852.652 N

(B) 562.868 N

(C) 678.584 N

(D) 752.956 N

148. While designing a typical bolt having uniform strength, the stress concentration in the thread of a bolted joint in simple loading is

(A) High

(B) Low

(C) Medium

(D) Zero

149. Which device is the driven member of a clutch?

(A) Driver gear

(B) Pressure plate

(C) Driven gear

(D) Flywheel

150. The external and internal radii of the frictional faces in clutch are 100 mm and 60 mm respectively. Determine the mean radius of friction face assuming the uniform pressure condition.

(A) 60 mm

(B) 70 mm

(C) 82 mm

(D) 78 mm

[Contd.

151. Which of the following is not a function of the magnetic frame in a DC generator?

(A) It does not provide low reluctance path for flux.

(B) It carries the magnetic flux produced by the poles in the DC generator.

(C) It acts as a protective cover for the whole machine.

(D) It provides mechanical support for the poles in the DC generator.

152. Why are armature windings made on the rotor of a DC machine?

(A) For production of voltage

(B) To make rotation easy

(C) For electromechanical conversion

(D) For commutation

153. Which D.C. motor is preferred for elevators?

(A) Shunt motor

(B) Series motor

(C) Differential compound motor

(D) Cumulative compound motor

154. In a D.C. shunt motor, speed is

(A) independent of armature current

(B) directly proportional to the armature current

(C) proportional to the square of the current

(D) inversely proportional to the armature current

155. In a D.C. machine, which of the following statements is true?

(A) Compensating winding is used for neutralizing armature reaction while interpole winding is used for producing residual flux.

(B) Compensating winding is used for neutralizing armature reaction while interpole winding is used for improving commutation.

(C) Compensating winding is used for improving commutation while interpole winding is used for neutralizing armature reaction.

(D) Compensating winding is used for improving commutation while interpole winding is used for producing residual flux.

156. A 220 V, D.C. shunt motor is operating at a speed of 1440 rpm. The armature resistance is 1.0 W and armature current is 10 A. If the excitation of the machine is reduced by 10%, the extra resistance to be put in the armature circuit to maintain the same speed and torque will be

(A) 1.79 W (B) 2.1 W

(C) 3.1 W (D) 4.9 W

157. No-load test on a 3-phase induction motor was conducted at different supply voltages and a plot of input power versus voltage was drawn. This curve was extrapolated to intersect the y-axis. This intersection point yields

(A) Core loss (B) Stator copper loss

(C) Stray load loss (D) Friction and windage loss

158. The torque speed characteristic of a repulsion motor resembles with which of the following D.C. motor characteristics?

(A) Separately excited (B) Shunt

(C) Series (D) Compound

159. When the supply voltage to an induction motor is reduced by 10%, the maximum torque will decrease by approximately

(A) 5% (B) 10%

(C) 20% (D) 40%

160. The direction of rotation of a 3-phase induction motor is clockwise when it is supplied with 3-phase sinusoidal voltage having phase sequence A-B-C. For counterclockwise rotation of the motor, the phase sequence of the power supply should be

(A) B-C-A (B) C-A-B

(C) A-C-B (D) B-C-A or C-A-B

161. A 3-phase delta/star transformer is supplied 6000 V on delta connected side. The terminal voltage on the secondary side when supplying full load at 0.8 lagging power factor is 415 V. The equivalent resistance and reactance drops for the transformer are 1% and 5% respectively. The turns ratio of the transformer is

(A) 14 (B) 24

(C) 42 (D) 20

162. A 500 kVA, 3-phase transformer has iron losses of 300 W and full load copper losses of 600 W. The percentage load at which the transformer is expected to have maximum efficiency is

(A) 50.0% (B) 70.7%

(C) 141.4% (D) 200.0%

163. An alternator is supplying a load of 200 kW at 0.5 lagging. If power factor is raised to unity, then how many more kW can alternator supply for the same KVA loading?

(A) 200 kW (B) 400 kW

(C) 800 kW (D) 1600 kW

164. Which strategy reduces electricity charges under a power factor tariff system for a manufacturing plant with predominantly inductive loads?

(A) Operating all equipment at full load constantly

(B) Increasing lighting hours during low demand periods

(C) Installing capacitors to improve the power factor of inductive loads

(D) Switching to higher voltage transformers without changing load characteristics

165. When a bipolar junction transistor is operating in the saturation mode, which one of the following statements is TRUE about the state of its Collector-Base (CB) and the Base-Emitter (BE) junctions?

(A) The CB junction is forward biased and the BE junction is reverse biased

(B) The CB junction is reverse biased and the BE junction is forward biased

(C) Both CB and BE junctions are forward biased

(D) Both CB and BE junctions are reverse biased

166. A Zener diode works on the principle of

(A) Tunnelling of charge carriers across the junction

(B) Thermionic emission

(C) Diffusion of charge carriers across the junction

(D) Hopping of charge carriers across the junction

167. A 50 kVA, single-phase transformer, 4000 V to 400 V has a primary resistance of 1.2 Ω and a secondary resistance of 0.02 Ω. Calculate the full-load efficiency at 0.9 p.f, if the iron loss of the transformer is 90% of the full-load copper loss.

(A) 97.93% (B) 98.93%

(C) 96.54% (D) 99.82%

168. If a transistor is operating with both of its junctions forward biased, but with the collector-base forward bias greater than the emitter-base forward bias, then it is operating in the

(A) Forward active mode

(B) Reverse saturation mode

(C) Reverse active mode

(D) Forward saturation mode

169. As temperature is increased, the voltage across a diode carrying a constant current

(A) increases

(B) decreases

(C) remains constant

(D) may increase or decrease depending upon the doping levels in the junction

170. A diode whose terminal characteristics are related as $i_D = I_S e^{V/V_T}$ where I_S is the reverse saturation current and V_T is thermal voltage (= 25 mV) is biased at i_D = 2 mA. Its dynamic resistance is

(A) 25 Ω (B) 12.5 Ω

(C) 50 Ω (D) 100 Ω

171. A 7805 regulator receives an input of 12 V and supplies 5 V to a load drawing 200 mA. Neglecting the ground-terminal current, the approximate power dissipated in the regulator is

(A) 0.4 W (B) 1.0 W

(C) 1.4 W (D) 2.4 W

172. The machining process that involves ablation is

(A) Laser Beam Machining
(B) Electrochemical Machining
(C) Chemical Machining
(D) Abrasive Jet Machining

173. The average power delivered to an impedance $(4 - j3)\ \Omega$ by a current $5\cos(100\pi t + 100)$ A is

(A) 44.2 W
(B) 50 W
(C) 62.5 W
(D) 125 W

174. The actual demand for castings in a factory is 500 units and 635 units for January 2026 and February 2026 respectively. The forecasted demand for January 2026 is 250 units and the smoothing constant is 0.7. Using the exponential smoothing method, the forecasted demand for March 2026 is _____ units.

(A) 525
(B) 550
(C) 572
(D) 595

175. A firm is required to procure three items (P, Q and R). The prices quoted for these items (in Rs.) by suppliers S1, S2 and S3 are given in the table. The management policy requires that each item has to be supplied by only one supplier and one supplier supplies only one item. The minimum total cost (in Rs.) of procurement to the firm is

Item	Supplier		
	S1	S2	S3
P	110	120	130
Q	115	140	140
R	125	145	165

(A) 350
(B) 360
(C) 385
(D) 395

176. A company manufactures two types of shoes. The company's maximum daily production capacity is 12 units of leather shoes and 20 units of rubber shoes. Their profit per shoe is $5 for Type X and $4 for Type Y. They wish to maximize their daily profit. Which of the following is not a valid constraint for this linear programming problem?

(A) $4X + 5Y \leq 20$ (Rubber Constraint)

(B) $X + Y \leq 5$ (Production Capacity Limit)

(C) $3X + 2Y \leq 12$ (Leather Constraint)

(D) $X \geq 0, Y \geq 0$ (Non-negativity Constraints)

177. The term 'Jokeying' in queuing theory refers to

(A) Shifting from one queue to another parallel queue

(B) Not entering the long queue

(C) Leaving the queue

(D) None of the above

178. In job shop scheduling, which sequence of operations typically results in optimal resource utilization and minimization of job waiting times?

(A) First In, First Out (FIFO)

(B) Shortest Processing Time (SPT) first

(C) Earliest Due Date (EDD)

(D) Longest Processing Time (LPT) first

179. Which of the following statements regarding plant layout and facility location strategies are CORRECT?

1. The Principle of Cubic Space Utilisation emphasizes the use of vertical dimensions, including mezzanines and multitiered racks, to maximize productivity.
2. Material handling is a significant operational factor, typically accounting for 20 to 50 per cent of total manufacturing operating costs.
3. In a product layout, machines performing similar functions are grouped into departments to accommodate high-variety, low-volume production.
4. The Transportation Model is a linear programming technique designed to minimize the total cost of distributing goods from multiple supply sources to various demand destinations.

(A) 1, 2 and 3 only

(B) 1, 2 and 4 only

(C) 2, 3 and 4 only

(D) 1, 3 and 4 only

[Contd.

180. Which one of the following control charts is used for the number of defects per unit?

(A) C - chart
(B) P - chart
(C) Range
(D) Mean

181. Which of the following is often used to measure process capability in Six Sigma?

(A) Standard deviation
(B) C_p and C_{pk} indices
(C) Margin of safety
(D) Cost variance

182. 'If a defective part or equipment malfunction is discovered, the machine automatically stops and operators stop working and correct the problem rather than continuing production' - it is the principle of

(A) TPM
(B) 5S
(C) Kaizen
(D) Jidoka

183. Work study

(A) is the study of work and totally includes human work
(B) is restricted to shop floor and it may not be applicable anywhere, for example, kitchen, writing desk, gardening, etc.
(C) includes human work as well as dignity of work
(D) fails in the elimination of wasteful efforts

184. Which plant layout is most appropriate for industries requiring consistent workflows and minimal handling of materials across workstations?

(A) Process Layout groups similar operations to enhance flexibility.
(B) Fixed Position Layout accommodates large products that remain stationary.
(C) Product Layout organizes machines in sequence for smooth production flow.
(D) Combination Layout integrates multiple layout types for diverse needs.

185. Statement I: Micro and Small Scale Industries play a significant role in employment generation.

Statement II: SSI sector is capital intensive in nature.

(A) Both Statements I and II are correct

(B) Both Statements I and II are incorrect

(C) Statement I is correct, but Statement II is incorrect

(D) Statement I is incorrect, but Statement II is correct

186. Drone entrepreneurs are those who live on the

(A) Innovation and new ideas of the Government

(B) Victory of others

(C) Environmental factors

(D) Labour of others

187. Which of the following are related to 'source reduction' in integrated solid waste management?

1. Reduced toxicity
2. Composting
3. Less packaging
4. Landfill
5. More durable products

(A) 1, 2 and 3 only

(B) 1, 3 and 5 only

(C) 2, 3 and 4 only

(D) 3, 4 and 5 only

188. Which of the following is a non-conventional source of energy?

(A) Crude oil

(B) Natural gas

(C) Solar energy

(D) Coal

189. Which of the following can be generated indirectly from biomass?

(A) Heat

(B) Biofuel

(C) Electricity

(D) None of the above

[Contd.

190. Consider the following pairs with reference to the various generations of biofuels:

(i) First Generation — Non-food crops

(ii) Second Generation — Food crops

(iii) Third Generation — Algae

Which of the above pairs is/are correctly matched?

(A) (i) only
(B) (i) and (ii) only
(C) (ii) and (iii) only
(D) (iii) only

191. Consider the following statements about bioethanol:

1. Ethanol is a high octane fuel and has replaced lead as an octane enhancer in petrol.

2. Ethanol is biodegradable, low in toxicity and causes little environmental pollution.

Which of the statements given above is/are correct?

(A) 1 only
(B) 2 only
(C) Both 1 and 2
(D) Neither 1 nor 2

192. In which type of contract, the contractors have to quote rate of each item of work without reference to any schedule of rates?

(A) Item rate contract

(B) Percentage rate contract

(C) Schedule rate contract

(D) Lump sum contract

193. Micromotion study is called

(A) A methodical motion examination of a series of procedures

(B) Motion research seen with increased time intervals

(C) A concurrent study of humans and machines

(D) Analysis of a man-work approach employing a motion picture camera with a timing device in the field of vision.

194. The information to be made available for certain heavy purchases through the newspaper is called

(A) Guideline
(B) Terms and conditions
(C) Purchased notice
(D) Tender notice

195. Use of internet to connect a wide variety of devices, machines and sensors for empowering brick and mortar stores by giving them the same access to data that online stores have is a facility that falls under which of the following technologies?

(A) Artificial Intelligence
(B) Deep Learning
(C) Machine Learning
(D) Internet of Things

196. Consider the following statements regarding Additive Manufacturing (AM):

(i) Complex internal geometries can often be manufactured more easily than by conventional subtractive processes.

(ii) AM can reduce material wastage in comparison with some subtractive manufacturing processes.

(iii) AM is restricted exclusively to polymeric materials.

Which of the above statements is/are correct?

(A) (i) only
(B) (i) and (ii) only
(C) (ii) and (iii) only
(D) (i), (ii) and (iii)

197. The material that surrounds and holds the reinforcement in a composite is called

(A) Matrix
(B) Fibre
(C) Filler
(D) Laminate

198. Regenerative braking in an electric vehicle primarily

(A) Converts electrical energy from the battery into mechanical energy
(B) Converts a part of the vehicle's kinetic energy into electrical energy
(C) Converts mechanical energy directly into chemical energy in the battery
(D) Converts heat generated during braking into electrical energy

199. In Industry 4.0, which technology connects industrial devices for data exchange?

(A) Digital Twin

(B) Industrial Internet of Things (IIoT)

(C) Computer-Aided Manufacturing (CAM)

(D) Flexible Manufacturing System (FMS)

200. A digital twin is primarily a

(A) Physical prototype of a manufacturing system

(B) Digital representation of a physical asset or process

(C) Computer program for machine control

(D) Database containing only historical production data
