

प्रश्न पत्र/QUESTION PAPER

**अनुकम्पा नियुक्ति परीक्षा (स्तर-II- बैचलर ऑफ इंजीनियर मेकेनिकल)
Compassionate Ground Appointment Examination (Level-II – BE Mechanical)**

परीक्षा तिथि / Examination Date : 10.03.2021

पूर्णांक / Max Marks – 85

समय /Time : 10:00 to 13:00 बजे/Hrs

अवधि /Duration – 3:00 घंटे/Hrs

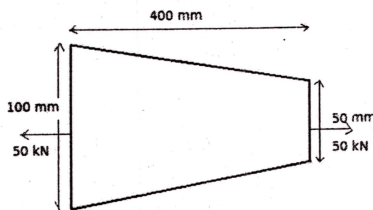
अनुदेश/Instructions

1. कृपया निर्देश तथा प्रश्न को उत्तर देने के पहले ध्यानपूर्वक पढ़ ले।
Please read the instructions and questions carefully before answering.
2. सभी प्रश्न अनिवार्य हैं।
All questions are compulsory.
3. हिन्दी एवं अंग्रेजी रूपांतरों में अंतर पाये जाने पर अंग्रेजी रूपांतर ही सही समझा जाएगा।
In case of discrepancy/mismatch in Hindi and English versions, English version will stand good.
4. यह परीक्षार्थी का उत्तरदायित्व होगा कि वे उत्तर देते समय सही प्रश्न क्रमांक तथा उसका उप प्रश्न क्रमांक एवं भाग क्रमांक यदि हो, उत्तर पुस्तिका में अंकित करें। सही प्रश्न क्रमांक न होने पर उत्तर पर कोई अंक नहीं दिया जाएगा।
It will be responsibility of the candidates to indicate the correct question number including sub question number and part number, if any and no marks will be awarded for answers without the correct question number.
5. उत्तर केवल एक रंग की स्याही में देना है। यह रंग नीला या काला होना चाहिए अन्यथा उत्तर पुस्तिका का मूल्यांकन नहीं किया जाएगा तथा उम्मीदवार को अयोग्य करार किया जा सकता है।
Answer should be given only in single colour ink blue or black otherwise answer sheet will not be evaluated and candidate may be disqualified.
6. वस्तुनिष्ठ प्रश्नों के उत्तर देते समय, उत्तर में करेक्शन मान्य नहीं है। इस तरह के उत्तरों का मूल्यांकन नहीं किया जाएगा।
While answering objective type questions no corrections in the answers is allowed. In such types of corrections the answer will not be evaluated.
7. परीक्षार्थी अपना नाम अथवा किसी प्रकार का पहचान चिह्न इत्यादि उत्तर पुस्तिका के अन्दर (आवेदन पत्र अन्य उत्तर, स्थान, जहाँ सामान्यतः नाम का उल्लेख किया जाता है वहाँ भी) न लिखें अन्यथा उनकी उम्मीदवारी निरस्त की जा सकती है।
Candidates should not write their names or leave any identification mark etc. in the answer sheet (including applications or other places/answers where generally name is mentioned) otherwise his candidature may be cancelled.

भाग-ए / PART-A

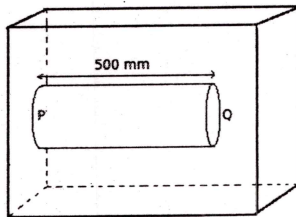
भाग-ए / PART-A		
To be answered in English Only.		[70 Marks]
Q-1.	उचित प्रस्तावों के साथ रिक्त स्थान भरें। Fill in the blanks with appropriate propositions.	[1 x 5 Marks]
	i) I know kamla.....has a ring.....ring is made of gold. ii) We read.....books.You read iii) Mohan is not.....European boy. iv) The mangoes.....rotten. v) He.....leaving for Japan when he received the call.	
Q-2.	Write the noun forms of the following : -	[1 x 5 mark]
	i) Enable ii) add iii) beautify iv) compare v) decide	
Q-3.	Write the past tense form.	[1 x 5 mark]
	i) make ii) mean iii) meet iv) mistake v) overcome	
Q-4.	Write a paragraph of about 200 words "Dr. A P J Abdul Kalam"	[1 x 5 mark]
Q-5	Choose the Correct Answer	[1 x 50 mark]
1. Which of the following stresses can be determined using Mohr's circle method? a. Torsional stress b. Bending stress c. Principal stress d. All of the above		
2. In simple tensile test, when maximum principle stress reaches the value of yield point, the material subjected to complex stresses fail. This theory is called as _____. a. Coulumb's theory b. Rankine's theory c. Venant's theory d. Von Mises theory		
3. Which theory gives satisfactory results for brittle materials? a. Maximum shear stress theory b. Maximum principle stress theory c. Shear strain energy theory d. None of the above		
4. Modulus of rigidity is the ratio of _____. a. Lateral strain and linear strain b. Linear stress and lateral strain c. Shear stress and shear strain d. Shear strain and shear stress		

5. In the diagram shown below, a tensile load of 50 kN is applied axially. What is the increase in length of the rectangular tapered plate of width 10 mm. (Assume $E = 220 \text{ GPa}$)



- a. 0.10 mm
- b. 0.161 mm
- c. 0.126 mm
- d. 0.56 mm

6. In a circuit box, a copper rod at room temperature of 25°C has a gap of 0.3 mm between the end of the rod Q and the rigid wall. If temperature of the rod increases to 70°C , then what is the compressive stress acting on the rod PQ? (Assume Young's modulus = 100 GPa & $\alpha = 15 \times 10^{-6} / ^\circ \text{C}$)



- a. 6 Mpa
- b. 7.5 Mpa
- c. 8.2 Mpa
- d. None of the above

7. What is the product of sectional modulus and allowable bending stress called as?

- a. Moment of inertia
- b. Moment of rigidity
- c. Moment of resistance
- d. Radius of gyration

8. Which of the following methods is most efficient method of design of experiments (DOE)?

- a. Factorial design
- b. Fractional factorial design
- c. Taguchi method
- d. All of the above

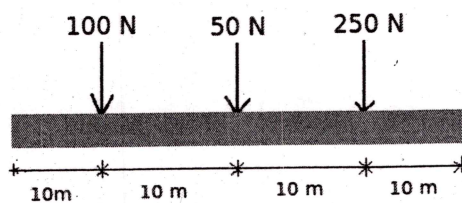
9. What is the geometric progression ratio if maximum and minimum spindle speeds are 500 r.p.m and 300 r.p.m respectively? (Number of speed steps = 7)

- a. 0.91
- b. 1.5
- c. 1.08
- d. 2.0

10. What does Ψ mean in Lagrange's equation ($LE = U + \lambda \Psi$)?

- a. Lagrange's multipliers
- b. Functional constraints
- c. Multiple variable objective
- d. None of the above

11. What is the maximum shear force acting on the beam shown below.



- a. 125 N
- b. 200 N
- c. 4000 N
- d. 8000 N

12. In Euler's theory, long columns having the ratio of $(L_e / LLD) \geq 12$ fail due to _____

- a. crushing
- b. buckling
- c. both a. and b.
- d. none of the above

13. The relation between modulus of elasticity (E), modulus of rigidity (G) and bulk modulus (K) is given as _____

- a. $K+G / (3K+ G)$
- b. $3 KG / (3K+ G)$
- c. $3 KG / (9K+ G)$
- d. $9 KG / (3K+ G)$

14) When a rectangular bar is uniaxially loaded, the volumetric strain (e_v) is given as _____

- a. $\sigma_x / E(1- \mu)$
- b. $\sigma_x / E(1+ \mu)$
- c. $\sigma_x / E(1- 2\mu)$
- d. $\sigma_x / E(1+2\mu)$

15) The value of elasticity increases, when temperature _____

- a. increases
- b. decreases
- c. remains constant
- d. none of the above

16. The ratio of effective length and least lateral dimension for short column is _____

- a. > 12
- b. < 12
- c. ≥ 12
- d. none of the above

17. Euler's formula is applicable only _____

- 1. for short columns
- 2. for long columns
- 3. if slenderness ratio is greater than $\sqrt{(\pi^2 E / \sigma_c)}$
- 4. if crushing stress $<$ buckling stress
- 5. if crushing stress $\geq$ buckling stress

- a. 1, 2 and 3
- b. 2, 3 and 5
- c. 3 and 4
- d. all of the above

18. Slenderness ratio is the ratio of effective length of column and _____

- a. lateral dimension of a column
- b. least radius of gyration of a column
- c. maximum radius of gyration of a column
- d. none of the above

19. When a component is subjected to axial stress the normal stress σ_n is maximum, if $\cos \theta$ is _____. ($\sigma_n = \sigma_x \cos^2 \theta$)

- 1. maximum
- 2. minimum
- 3. always one
- 4. always zero

- a. 1 and 4
- b. 1 and 3
- c. 2 and 3
- d. 2 and 4

20. The graphical method of Mohr's circle represents shear stress (τ) on _____

- a. X-axis
- b. Y-axis
- c. Z-axis
- d. None of the above

21. St. Venant's theory is also known as maximum _____

- a. principle stress theory
- b. shear stress theory
- c. principle strain theory
- d. strain energy theory

22. According to Coulomb's theory, material subjected to complex stresses fails, if _____ shear stress induced in the material exceeds _____ shear stress at the yield point.

- a. minimum, maximum
- b. maximum, minimum
- c. maximum, maximum
- d. minimum, minimum

23) In maximum principle strain theory, maximum principal strain for no failure condition is _____

- a. $e = (\sigma_x - \sigma_y) / E + \tau^2$
- b. $e = q_{\max} \geq q_{yp}$
- c. $e = \sigma_{yp} / E$
- d. none of the above

24. What is the bulk modulus of a material, if a cube of 100 mm changes its volume to 4000 mm³ when subjected to compressive force of 2.5×10^6 N? a. 62.5 Gpa b. 65 Gpa c. 67.5 Gpa d. 70 Gpa
25. If a composite bar of copper and steel is heated at 120°C, the stress induced in copper bar is _____ a. compressive stress b. shear stress c. tensile stress d. thermal stress
26. Thermal stress is not a function of _____ a. change in temperature b. coefficient of linear expansion c. modulus of elasticity d. none of the above
27. What is the value of thermal stress, if a rod of 3 m is heated at 50 °C and is fixed at both the ends? (Take $\alpha = 10 \times 10^{-6}$ /°C & $E = 200 \times 10^3$ Mpa) a. 25 Mpa b. 50 Mpa c. 100 Mpa d. 150 Mpa
28. The graphical representation of variation of axial load on y axis and position of cross section along x axis is called as _____ a. Bending moment diagram b. Shear force diagram c. Stress-strain diagram d. Trust diagram
29. A uniformly distributed load of 20 kN/m acts on a simply supported beam of rectangular cross section of width 20 mm and depth 60 mm. What is the maximum bending stress acting on the beam of 5m? a. 5030 Mpa b. 5208 Mpa c. 6600 Mpa d. Insufficient data
30. The bending formula is given as _____ a. $(M/E) = (\sigma/y) = (R/I)$ b. $(M/y) = (\sigma/I) = (E/R)$ c. $(M/I) = (\sigma/y) = (E/R)$ d. none of the above
31. Which of the following laminas have same moment of inertia ($I_{xx} = I_{yy}$), when passed through the centroid along x-x and y-y axes? a. Circle b. Semi-circle c. Right angle triangle d. Isosceles triangle
32. A circular pipe is subjected to maximum shear force of 60 kN. What is the diameter of the pipe if maximum allowable shear stress is 5 Mpa? a. 27.311 mm b. 75.56 mm c. 142.72 mm d. 692.10 mm
33. What is the shear stress acting along the neutral axis of triangular beam section, with base 60 mm and height 150 mm, when shear force of 30 kN acts? a. 15.36 N/mm² b. 10.6 N/mm² c. 8.88 N/mm² d. Insufficient data
34) What is the average shear stress acting on a rectangular beam, if 50 N/mm² is the maximum shear stress acting on it? a. 31.5 N/mm² b. 33.33 N/mm² c. 37.5 N/mm² d. 42.5 N/mm²
35. What is the weld joint efficiency if pressure vessel is fabricated with single full fillet lap joint? a. 1.0 b. 0.55 c. 0.65 d. 0.85
36. Which of the following is not an unfired pressure vessel? a. Heat exchanger

b. Storage vessels c. Steam boilers d. None of the above
37. Which of the following is not expressed by primary design equation? a. Functional parameters b. Material parameters c. Geometrical parameters d. None of the above
38. The limit equation $s_t = S_{ut} / N_f$ is expressed as _____ a. loose limit equation b. rigid limit equation c. rigid on one side and loose on other side d. none of the above
39. Which of the following statements is/are false if separate cylinder liner is pressed inside the cylinder of large engines? a. Easy replacement of liner in case of wear and tear b. Cheap grade material cannot be used for jacket c. Liner is to be made of heat resistant cast iron d. None of the above
40. Which of the following materials are used for cylinder liners? a. Alloy cast iron b. Grey cast iron c. Both a. and b. d. None of the above
41. Which stress is induced in cylinder wall due to side thrust of the piston? a. Axial stress b. Circumferential stress c. Longitudinal stress d. Bending stress
42. Which of the following curves have the mean value equal to zero in the graph of frequency vs random variable? a. Normal distribution curve b. Standard normal distribution curve c. Both a. and b. d. None of the above
43. What is the maximum percentage loss of economic cutting speed if geometric progression ratio = 1.06 ? a. 17.0 % b. 11.5 % c. 5.7 % d. 2.9 %
44. Economic cutting speed is minimum if geometric ratio is _____ a. minimum b. maximum c. equal to economic cutting speed d. none of the above
45. What is the mass capacity of flat belt conveyor if volumetric capacity 0.55 m³/hr? ($\rho = 1500$ kg/m³) a. 825 tons/hr b. 825 kg/hr c. 2.727 tons/hr d. 2722 kg/hr
46. Which discharge method provides only intermediate discharge for low speed flat belt conveyor? a. Plow discharge b. Tripper discharge c. Both a. and b. d. None of the above
47. What will be the number of tests required in an experiment to obtain maximum information based on factorial design if, number of levels and number of factors are 2 and 5 respectively? a. 32 b. 25 c. 10 d. None of the above
48. Selection of welding process does not depend on _____ a. thickness of material b. availability of equipments c. economics of the process d. none of the above
49. Which of the following parameters are to be considered for parts with non rotational symmetry in machining process? a. Avoid long parts b. Avoid thin parts c. Machined surfaces should be parallel to each other and with the base d. All of the above
50. An inclined belt conveyor is used for loading goods. If speed of the belt having 1500 mm width is 3 m/s then what is the volumetric capacity of the conveyor? (For 210, $k = 2.35 \times 10^{-4}$)

- a. $1.19 \times 10^{-3} \text{ m}^3/\text{s}$
 b. $1.75 \times 10^{-3} \text{ m}^3/\text{s}$
 c. $1.5 \times 10^{-3} \text{ m}^3/\text{s}$
 d. $2.5 \times 10^{-3} \text{ m}^3/\text{s}$

भाग-बी / PART-B

उत्तर हिंदी में या अंग्रेजी में दें / Answer can be given either in Hindi or English.

[15 marks]

Q-6. सही उत्तर का चयन करें / Choose the Correct Answer.

[1x 10 Marks]

- i) निम्नलिखित में से कौन से रंग मॉडल को तीन प्राथमिक रंगों से परिभाषित किया गया है / Which of the following color models are defined with three primary colors ?
- | | | | |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| a) RGB and HSV color models | b) CMY and HSV color models | c) HSV and HLS color models | d) RGB and CMY color models |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
- ii) एक आयताकार बरामदे की लम्बाई तथा चौड़ाई क्रमशः 19.27 मी तथा 11.89 मी है। उस पर वर्गाकार मार्बल बिछाने का प्रस्ताव है। ऐसे मार्बल की न्यूनतम संख्या है / The length and breadth of a rectangular verandah are 19.27 m and 11.89 m respectively. It is proposed to lay square marble on it. The minimum number of such marbles is
- | | | | |
|---------|---------|---------|---------|
| a) 1203 | b) 1363 | c) 1459 | d) 1450 |
|---------|---------|---------|---------|
- iii) $a=4.965$, $b=2.343$ तथा $c=2.622$ हो, तो $a^2-b^3-c^3-3abc$ का मान है / $a=4.965$, $b=2.343$ and $c=2.622$, then the value of $a^2-b^3-c^3-3abc$ is
- | | | | |
|-------|-------|------|---------|
| a) -2 | b) -1 | c) 0 | d) 9.93 |
|-------|-------|------|---------|
- iv) राजेश ने एक परीक्षा में 80% प्रश्न सही किए। उसने 41 में से 37 प्रश्न सही किए तथा उसके बाद प्रत्येक 8 प्रश्न पर 5 प्रश्न का हल सही पाया। परीक्षा में कुल कितने प्रश्न पूछे गए थे / Rajesh corrected 80% of the questions in an examination. He corrected 37 questions out of 41 and then got 5 questions correct for every 8 questions. How many questions were asked in the exam in total?
- | | | | |
|-------|-------|-------|-------|
| a) 75 | b) 65 | c) 85 | d) 60 |
|-------|-------|-------|-------|
- v) $(x^2 + x - 3x^2 - 3)$ का गुणन होगा / The product of $(x^2 + x - 3x^2 - 3)$ will be
- | | | | |
|-------------------|-------------------|-------------------|-------------------|
| a) $(x-3)(x^2+1)$ | b) $(x+3)(x^2+1)$ | c) $(x+3)(x^2-1)$ | d) $(x-3)(x^2-1)$ |
|-------------------|-------------------|-------------------|-------------------|
- vi) p के किस मान के लिए $(a-2)$ व्यंजन a^2-5a+p का गुणनखण्ड है / For which value of p $(a-2)$ is the factor of the consonant a^2-5a+p
- | | | | |
|------|------|------|------|
| a) 2 | b) 5 | c) 3 | d) 6 |
|------|------|------|------|
- vii) यदि $AC \parallel MN$, $BN = 5$ सेमी एवं $NC = 2.5$ सेमी, तो $BM : AM$ का मान होगा / If $AC \parallel MN$, $BN = 5$ cm and $NC = 2.5$ cm, then the value of $BM : AM$ will be.
- | | | | |
|--------|--------|--------|--------|
| a) 1:2 | b) 2:1 | c) 1:3 | d) 3:1 |
|--------|--------|--------|--------|
- viii) $\triangle ABC$ इस प्रकार है, कि $AB = 3$ सेमी, $BC = 2$ सेमी और $AC = 2.5$ सेमी। $\triangle DEF$, $\triangle ABC$ के समरूप हैं, यदि $EF = 4$ सेमी है, तब $\triangle DEF$ का परिमाण है / $\triangle ABC$ is such that $AB = 3$ cm, $BC = 2$ cm and $AC = 2.5$ cm. $\triangle DEF$ is similar to $\triangle ABC$, if $EF = 4$ cm, then the perimeter of $\triangle DEF$ is?
- | | | | |
|---------|---------|----------|----------|
| a) 5 cm | b) 7 cm | c) 15 cm | d) 18 cm |
|---------|---------|----------|----------|
- ix) राम मनोहर ने भारतीय स्टेट बैंक में 2 वर्ष के लिए रु 4000 जमा किए। 10% प्रतिवर्ष की दर से अर्द्धवार्षिक चक्रवृद्धि ब्याज से मिश्रधन होगा / Ram Manohar deposited Rs.4000 in State Bank of India for 2 years. The compound interest at 10% per annum compounded half yearly will be
- | | | | |
|------------|------------|------------|------------|
| a) 4840.03 | b) 4410.05 | c) 4585.06 | d) 4862.03 |
|------------|------------|------------|------------|
- x) निम्नलिखित में से कौन एक अभाज्य संख्या है / What will be the average of the first 11 consecutive odd numbers?
- | | | | |
|-------|-------|-------|-------|
| a) 11 | b) 12 | c) 13 | d) 10 |
|-------|-------|-------|-------|

Q-7. क्रमानुसार रिक्त स्थानों की पूर्ति कीजिए / Fill in the blanks according of the sequence

[1 x 5 Marks]

- i) 7, 10, 8, 11, 9, 12, _____
 ii) 3, 4, 7, 8, 11, 12, _____
 iii) ELFA, GLHA, ILJA, _____, MLNA
 iv) ZA_5 , Y_4B , XC_6 , W_3D _____
 v) SCD, TEF, UGH, _____, WKL