राष्ट्रीय प्रौद्योगिकी संस्थान दिल्ली

NATIONAL INSTITUTE OF TECHNOLOGY DELHI

(शिक्षा मंत्रालय, भारत सरकार के अधीन एक स्वायत्त संस्थान)

(An autonomous Institute under the aegis of Ministry of Education (Shiksha Mantralaya), Govt. of India)

Plot No. FA7, Zone P1, GT Karnal Road, Delhi-110036, INDIA

दूरभाष/Tele: +9111-33861000, 1001, 1005 फैक्स/ Fax: +9111-27787503,

वेबसाइट/Website: www.nitdelhi.ac.in

NOTICE

Advt. No. 08/ 2024: Answer Key and Representations Invited for the Domain

Knowledge Tests held on 07.02.2025.

Position	**Mechanical Engineering (ME): Assistant Professor Grade I (Pay Level 12)**
Date	**07.02.2025 (Friday)**
Examination Time	**4:00 Pm – 5:00 PM**

Following is the attached answer key. If any appeared candidate for the domain knowledge test has any representations against the questions, may submit by filling up the **following Google Form on or before 10.02.2025 11:59 PM**. After that no representations will be considered.

Google Form Link:
https://docs.google.com/forms/d/e/1FAIpQLSdSL0LirlHEwHuM5H3WDc2ls6hztZlKe_SeUZG1XVxWfACQ7Q/viewform?usp=preview

राष्ट्रीय प्रौद्योगिकी संस्थान दिल्ली

NATIONAL INSTITUTE OF TECHNOLOGY DELHI

(शिक्षा मंत्रालय, भारत सरकार के अधीन एक स्वायत्त संस्थान)

(An autonomous Institute under the aegis of Ministry of Education (Shiksha Mantralaya), Govt. of India)
Plot No. FA7, Zone P1, GT Karnal Road, Delhi-110036, INDIA
दूरभाष/Tele: +9111-33861000, 1001, 1005 फैक्स/ Fax: +9111-27787503
वेबसाइट/Website: www.nitdelhi.ac.in

QUESTION PAPER FOR THE POST OF ASSISTANT PROFESSOR ME (PAY LEVEL 12)

Maximum Marks: 50 **Time: 60 Minutes**

Name of Candidate: _____ **Roll No:** _____

INSTRUCTIONS TO CANDIDATES

1. This question paper has 50 questions. Each question carries one mark. There are four choices for answer (A, B, C, D) to each question. Choose the correct answer (one only) for each question and write the answer in the space provided against each question.
2. Candidate must write Name, Roll No. and sign on each page of this booklet.
3. The candidate should check that the booklet does not have any unprinted or torn or missing pages or questions etc. If so, get it replaced with another question paper, before question paper starts.
4. One (1) mark will be awarded for each correct answer. There will be negative marking and (- ¼) mark will be awarded for each incorrect answer.
5. The unanswered questions will not attract negative marking
6. Return the Question Paper cum Answer Sheet to the invigilator after the examination is over.
7. **Mobile, Electronic Watch** and other **Electronic Gadgets** are prohibited in the examination.
8. There should not be any cutting or overwriting in the Answer.
9. Use of Unfair Means in Examination will lead to cancellation of candidature.

अभ्यर्थियों के लिए अनुदेश

1. इस प्रश्न पत्र में 50 प्रश्न हैं. प्रत्येक प्रश्न एक अंक का है। प्रत्येक प्रश्न के उत्तर के लिए चार विकल्प (A, B, C, D) हैं। प्रत्येक प्रश्न के लिए सही उत्तर (केवल एक) चुनें और प्रत्येक प्रश्न के सामने दिए गए स्थान पर उत्तर लिखें।
2. अभ्यर्थी को इस पुस्तिका के प्रत्येक पृष्ठ पर अपना नाम, रोल नंबर लिखना होगा तथा हस्ताक्षर करना होगा।
3. अभ्यर्थी को यह जांचना चाहिए कि पुस्तिका में कोई भी बिना छपा हुआ या फटा हुआ या गायब पृष्ठ या प्रश्न आदि नहीं है। यदि ऐसा है, तो प्रश्न पत्र शुरू होने से पहले इसे दूसरे प्रश्न पत्र से बदल लें।
4. प्रत्येक सही उत्तर के लिए एक (1) अंक दिया जाएगा। नकारात्मक अंकन होगा और प्रत्येक गलत उत्तर के लिए (- ¼) अंक दिया जाएगा।
5. अनुत्तरित प्रश्न नकारात्मक अंकन को आकर्षित नहीं करेंगे
6. परीक्षा समाप्त होने के बाद प्रश्न पत्र सह उत्तर पुस्तिका पर्यवेक्षक को लौटा दें।
7. मोबाइल, इलेक्ट्रॉनिक घड़ी और अन्य इलेक्ट्रॉनिक गैजेट्स परीक्षा में वर्जित हैं.
8. उत्तर में कोई कटिंग या ओवरराइटिंग नहीं होनी चाहिए.
9. परीक्षा में अनुचित साधनों का प्रयोग करने पर उम्मीदवारी रद्द कर दी जाएगी।

1. What are the eigen values of $\begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$?

A. 0, 0, 0 B. 1, 1, 1 C. 0, 1, 3 D. 0, 0, 3

2. According to Simpson's 1/3 rule, the value of $\int_1^7 \frac{dx}{x}$ is

A. 1.458 B. 1.658 C. 1.958 D. 2.258

3. How many iterations are required using bisection method to obtain a real root that lies in between 1 and 25 of the function f(x); $x^4 - x^3 - x^2 - 176 = 0$?

A. 2 B. 3 C. 4 D. 5

4. Evaluate the integral $\int_0^3 \int_0^1 (x^2 + 3y^2)\, dy\, dx.$

A. 12 B. 24 C. 36 D. 06

5. A card to be drawn from a well-shuffled playing card set. What is the probability that the drawn-out card is either a spade or an ace?

A. 13/52 B. 4/52 C. 9/52 D. 4/13

6. The pressure, temperature and the Mach number at a location of flow passage are 2.5 bar, 32 °C and 1.4, respectively. What would be the velocity of fluid flow, where the Mach number is 2.5? Assume that flow is adiabatic, $\gamma = 1.3$ and R = 0.469 kJ/kg-K.

A. 799.2 m/s B. 905.6 m/s C. 648.8 m/s D. 735.2 m/s

7. If the efficiency of a heat engine that operates on Carnot cycle is 60 % and the temperature of the cold reservoir is 10 °C, what is the temperature of the hot source?

A. 707.5 °C B. 434.5 K C. 434.5 °C D. 424.5 °C

8. What is the function of flash chamber in vapour compression refrigeration system?

A. The flash chamber is used for doing subcooling of refrigerant, thereby refrigerating effect would be increased.

B. The flash chamber is used for removing the dry vapour after the throttling process.

C. The flash chamber is used for removing the liquid particles after the evaporator, thereby the entry of liquid particles would be avoided.

D. The flash chamber is used for heating the refrigerant vapour after the evaporator, thereby the entry of liquid particles would be avoided.

9. A composite wall comprises three slabs of different materials with the thermal conductivities of k, 2k, and k/2, respectively. If all the slabs are with same thickness, what would be order of temperature drop across the individual slab?

A. 1 : 1 : 1 B. 1 : 2 : 8 C. 4 : 2 : 8 D. 1 : 1 : ½

10. Two solid shafts; X and Y are made-up of different materials. If the diameter of the shaft X is 1.5 times of that of Y and the shear strength of material of Y is 1.5 times of that of X, then the torque transmitting capacity of shaft X is:

A. same as that of Y.

B. 100 % more than the capacity of shaft Q.

C. 125 % less than the capacity of shaft Y.

D. 125 % more than the capacity of shaft Y.

11. The product of the efficiency of a reversible heat engine that works on the temperature limits of T_h and T_c and the coefficient of performance of a reversible heat pump that works on the same temperature limits of T_h and T_c is:

A. equal to 1.0 C. more than 1.0

C. less than 1.0 D. equal to 2.0

12. Consider a piston-cylinder arrangement that contains a gas and the gas is allowed to expand from 0.06 m^3 to 0.08 m^3 at a constant pressure of 2 MPa and it receives 100 kJ of heat during the expansion process. What is the change in internal energy of the gas?

A. 20 kJ B. 70 kJ C. 060 kJ D. 100 kJ

13. If the cut-off happens at 8 % of the stroke in a compression ignition internal combustion engine with a compression ratio of 16, what is the cut-off ratio of the engine?

A. 1.08 B. 2.08 C. 1.20 D. 2.20

14. Fin efficiency defined as _____.

A. the ratio between the actual amount of heat transfer with fins and the amount of heat transfer without fin.

B. the ratio between the actual amount of heat transfer with fins and the amount of heat transfer when the entire surface of the fin is maintained at the average of base and tip temperatures.

C. the ratio between the actual amount of heat transfer with fins and the amount of heat transfer when the entire surface of the fin is maintained at base temperature.

D. the ratio between the actual amount of heat transfer with fins and the amount of heat transfer when the entire surface of the fin is maintained at tip temperature.

15. Related to refrigeration system, a hermetically sealed unit implies:

A. Compressor is perfectly sealed.

B. Compressor motor is perfectly sealed.

C. Refrigerant cycle is sealed.

D. Compressor and motor are sealed as single unit.

16. A venturimeter with inlet and throat diameters of 150 mm and 75 mm respectively is connected along a vertical (Vertical distance between the inlet and throat pressure tapings = 180 mm) pipeline, which carries an oil of specific gravity of 0.82. If the reading of the differential mercury U-tube manometer connected to the inlet and the throat of the venturimeter is 220 mm, determine the oil flow rate. Take: C_d of venturimeter = 0.96

A. 5.36 kg/s B. 3.36 kg/s C. 6.36 kg/s D. 4.36 kg/s

17. Two large water reservoirs which are 2.5 km apart are connected by a pipe of 300 mm diameter and the water level difference between the reservoirs is 10 m. Determine the diameter of suitable pipe that would provide twice the water transfer rate of the first. Assume f is same in both the cases and neglect the minor loses.

A. 424 mm B. 600 mm C. 520 mm D. 345 mm

18. What is the meaning of regeneration in a steam power plant?

A. It means doing some useful work by the steam after its complete expansion in the turbine.

B. Bypassing a desired quantity of steam during the expansion in the turbine to control the speed.

C. Extraction of some useful steam during the expansion in the turbine stage and use the extracted steam to heat the feed water.

D. Heating of steam after the expansion in high pressure turbine.

19. The analysis of a coal sample is given as (by weight), carbon = 85 %, hydrogen = 6 %, Oxygen = 6 % and the remainder being incombustible products. What is the minimum quantity of air required per kg of coal to achieve complete combustion?

A. 09.69 kg B. 11.70 kg C. 13.70 kg D. 15.70 kg

20. If the unbalanced force developed by an eccentric mass that is rotating at 3000 rpm is X times more than the 50 % of the unbalanced force that is developed by the same mass rotates at 1000 rpm, what is the value of X?

A. X = 27 B. X = 03 C. X = 09 D. X = 18

21. Three rotors are mounted on a shaft and the transverse frequencies, considering each of the rotor separately, are 40, 110 and 70 cycles per second. What is the lowest critical speed with all three rotors are mounted on the shaft?

A. 1987 rpm B. 1240 rpm C. 0432 rpm D. 2237 rpm

22. Consider a mechanical transmission system using a solid shaft and the maximum shear stress induced in the shaft is measured as 45 MPa. If the solid shaft is replaced by a hollow shaft ($D_{inner} = 0.5 \times D_{outer}$), whose outer diameter is 20 % more than the diameter of the solid shaft and it is made up of same material, what would be maximum induced shear stress (for same torque) in the hollow shaft?

A. 38 MPa B. 64 MPa C. 73 MPa D. 56 MPa

23. The materials which exhibit same elastic properties in all directions are called as:

A. Homogeneous B. isentropic.

C. isotropic. D. visco-elastic

24. The shaft of a motor starts from rest and attains full speed of 1800 rpm in 10 seconds. The shaft has an angular acceleration of:

A. $3\ \pi$ rad/s^2 B. $6\ \pi$ rad/s^2 C. $12\ \pi$ rad/s^2 D. $24\ \pi$ rad/s^2

25. Density of LPG is:

A. 0.25 times lighter than air. B. 1.5 times lighter than air.

C. 1.5 times heavier than air D. 3.0 times heavier than air.

26. Metals are good conductor of heat, because:

A. they have high density. B. their atoms collide frequently.

C. their atoms are relatively far apart. D. they contain free electrons.

27. Impulse is defined as:

A. force × time B. mass × velocity

C. mass × acceleration D. mass × time

28. The Reynolds number for flow of a certain fluid in a circular tube is specified as 2500. What will be the Reynolds number when the tube diameter is increased by 20% and the fluid velocity is decreased by 40% by keeping fluid the same?

A. 1200 B. 1800 C. 3600 D. 200

29. In a S.I. engine, the spark lasts roughly for:

A. 1 Second B. 0.1 Second

C. 0.01 Second D. 0.001 Second

30. Which gas has a major share in biogas?

A. N_2 B. CH_4 C. CO_2 D. H_2

31. Two venturimeters having different area ratio are connected in a pipe line at different locations and they are employed with identical differential manometers to measure the flow rate. The manometer connected with the first venturimeter with the area ratio of 2.0 shows a head difference of H,

whereas the manometer of the second venturimeter with the area ratio of X indicates the head difference as (2H). What is the value of X?

A. 2.6458 B. 3.6458 C. 4.6458 D. 5.6458

32. In a crank and slotted lever quick return mechanism, the distance between the fixed centres is 250 mm and the length of the driving crank is 100 mm. What is the ratio of timings of cutting and return strokes?

A. 2.71 B. 2.21 C. 1.71 D. 1.21

33. A stationery spur gear with 120 teeth is in mesh with a (freely rotating) pinion having 24 teeth. The gear and the pinion are connected by an arm and the arm with the pinion is rotated with the reference to the gear. What is number of revolutions made by the pinion for one complete rotation of the connected arm?

A. 5.5 B. 6.0 C. 6.5 D. 5.0

34. A flywheel that is made-up of a material with the allowable shear stress of 25 MPa and the density of 700 kg/m^3. What is the maximum peripheral velocity?

A. 90 m/s B. 75 m/s C. 60 m/s D. 45 m/s

35. The speed of an engine with a mechanical governor fluctuates continuously above and below the mean speed. Then the governor is said to be:

A. unstable. B. isochronous.

C. in faulty condition. D. hunting.

36. Which one of the following loadings is considered for designing of axles?

A. Twisting moment only.

B. Bending moment only.

C. Combined effects of twisting and bending moments

D. Combined effects of twisting and axial thrust.

37. In a mechanical transmission system that comprises shaft, pulley and key, the weakest member is:

A. the shaft.
B. the pulley.
C. the key.
D. None of above.

38. What would be the effect on the life of a ball bearing when the load on the bearing is halved?

A. The life would be remains same.
B. The life would be increased to two times of the initial condition.
C. The life would be increased to four times of the initial condition.
D. The life would be increased to eight times of the initial condition.

39. What is the purpose of tempering in martensitic steel?

A. To improve the hardness of metal
B. To improve the surface texture of metal.
C. To improve corrosion of metal
D. To improve the ductility of metal.

40. Resilience of a material becomes important when it is subjected by:

A. Fatigue.
B. Thermal stresses.
C. Pure static loading.
D. Shock loading.

41. Consider the lists I and II and choose the correct pairs with the given codes.

List I		List II	
1	Silicon	5	Hardness
2	Nickel	6	Magnetic permeability
3	Tungsten	7	Corrosion resistance
4	Chromium	8	Heat resistance

A. 1-5, 2-6, 3-7, 4-8
B. 1-8, 2-7, 3-6, 4-1
C. 1-6, 2-5, 3-8, 4-7
D. 1-6, 2-5, 3-7, 4-8

42. Another name of aluminium bronze is:

A. White metal
B. Imitation gold
C. Duraluminium
D. None of the above.

43. Which (one) of the following stresses is/are involved with wiredrawing operation?

A. Tensile stress
B. Compressive stress
C. Both tensile and compressive stresses
D. Both tensile and shear stresses

44. Which one of the following materials is employed as bonding material in the case of grinding wheels?

A. Silicon carbide
B. Boron carbine
C. Aluminium oxide
D. Sodium silicate

45. In the case of CPM, the critical path of a network is the path that:

A. has highest number of activities (irrespective of time).
B. has lowest number of activities (irrespective of time).
C. takes the longest time.
D. takes the shortest time.

46. In the case of PERT, the optimistic, pessimistic and the most-likely times to complete and activity are estimated as 3 days, 10 days and 8 days, respectively. What is the expected time to complete the activity?

A. 7.0 days
B. 9.0 days
C. 7.5 days
D. 8.5 days

47. Which one of the following layouts is more suitable for an organization that manufacture large systems like ship building?

A. Process layout
B. Fixed position layout
C. Product layout
D. Combination of process and product layouts.

48. In which the of following welding procedures, vacuum environment is required?

A. Ultrasonic welding
B. Laser beam welding
C. Plasma arc welding
D. Electron beam welding

49. The ratio of Nusselt number and the product of Reynolds number and Prandtl number is called as:

A. Biot number
B. Peclet number

C. Stanton number

D. None of the above

50. The capacity of a domestic refrigerator is in the range of _____ .

A. 7 to 9 TR

B. 4 to 6 TR

C. 1 to 3 TR

D. 0.1 to 0.3 TR

Question No.	Answer	Question No.	Answer
1.	D	26.	B
2.	C	27.	C
3.	B	28.	B
4.	B	29.	D
5.	D	30.	B
6.	A	31.	A
7.	C	32.	C
8.	B	33.	B
9.	C	34.	C
10.	D	35.	D
11.	A	36.	B
12.	C	37.	C
13.	D	38.	D
14.	C	39.	D
15.	D	40.	D
16.	D	41.	C
17.	D	42.	B
18.	C	43.	A
19.	B	44.	D
20.	D	45.	C
21.	A	46.	C
22.	C	47.	B
23.	C	48.	D
24.	B	49.	C
25.	C	50.	D