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 Test

Knowledge Tests held on 08.02.2025

Position	**Mechanical Engineering (ME): Assistant Professor Grade II (Pay Level 10) (On Contract Basis)**
Date	**08.02.2025 (Saturday)**
Examination Time	**11:00 AM – 12:00 Noon**

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 11.02.2025 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 10)

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.

Q. No.	Questions
1.	In the vicinity of the triple point, the equation of the liquid-vapor boundary in the P – T phase diagram for ammonia is ln P = 24.38- 3063/ T, where P is pressure (in Pa), and T is the temperature (in K). Similarly, the solid-vapor boundary is given by ln P = 27.92 – 3754/ T. The temperature at the triple point is _____K. (A)170.26 (B)195.19 (C)181.23 (D)123.02
2.	Customers arrive at a shop according to the Poisson distribution with a mean of 10 customers/hour. The manager notes that no customer arrives for the first 3 minutes after the shop opens. The probability that a customer will arrive within the next 3 minutes is (A) 0.86 (B) 0.61 (C) 0.50 (D) 0.39

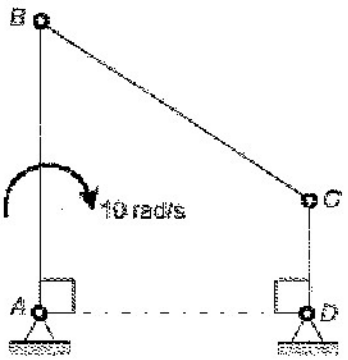
3.	The correct sequence of machining operations to be performed to finish a large diameter through hole is (A) drilling, reaming, boring (B) drilling, boring, reaming (C) boring, reaming, drilling (D) boring, drilling, reaming
4.	A resistance spot welding of two 1.55 mm thick metal sheets is performed using a welding current of 10000 A for 0.25 seconds. The contact resistance at the interface of the metal sheets is 0.0001Ω. The volume of weld nugget formed after welding is 70 mm^3. Considering the heat required to melt a unit volume of metal is 12 J/mm^3, the thermal efficiency of the welding process is_____ %. (A) 20.6 (B) 18.30 (C) 10.50 (D) 33.60
5.	A hot steel spherical ball is suddenly dipped into a low-temperature oil bath. Which of the following dimensionless parameters are required to determine the instantaneous center temperature of the ball using a Heisler chart? (A) Biot number and Fourier number (B) Reynolds number and Prandlt number (C) Nusselt number and Grashoff number (D) Biot number and Froude number
6.	In which of the following pairs of cycles, both cycles have at least one isothermal process? (A) Bell-Coleman cycle and Vapour compression refrigeration cycle (B) Carnot cycle and Stirling cycle (C) Brayton cycle and Rankine cycle (D) Diesel cycle and Otto cycle
7.	In grinding operation of metal, specific energy consumption is 15 J/mm^3. If a grinding wheel with a diameter of 200 mm is rotating at 3000 rpm to obtain a material removal rate of 6000 mm^3 / min, then the tangential force on the wheel is _____N. (A) 27.84 (B) 22.02 (C) 47.74 (D) 21.65
8.	In modern CNC machine tools, the backlash has been eliminated by (A) ratchet and pinion (B) rack and pinion (C) preloaded ballscrews (D) slider crank mechanism

9.	Consider a reciprocating engine with crank radius R and connecting rod of length L. The secondary unbalance force for this case is equivalent to primary unbalance force due to a virtual crank of_____ (A) radius L/2 rotating at twice the engine speed (B) radius R^2/ 4L rotating at twice the engine speed (C) radius R/4 rotating at half the engine speed (D) radius L^2/4 R rotating at half the engine speed
10.	A solid sphere of radius 10 mm is placed at the centroid of a hollow cubical enclosure of side length 30 mm. The outer surface of the sphere is denoted by 1 and the inner surface of the cube is denoted by 2. The view factor F_{22} for radiation heat transfer is _____. (A) 0.965 (B) 0.764 (C) 0.693 (D) 0.232
11.	Superheated steam at 1500 kPa, has a specific volume of 2.75 m^3 /kmol and compressibility factor (Z) of 0.95. The temperature of steam is _____ ^{0}C. (A) 522 (B) 471 (C) 249 (D) 198
12.	A mould cavity of 1200 cm^3 volume has to be filled through a sprue of 10 cm length feeding a horizontal runner. Cross-sectional area at the base of the sprue is 2 cm^2. Consider acceleration due to gravity as 9.81 m/s^2. Neglecting frictional losses due to molten metal flow, the time taken to fill the mold cavity is _____seconds. (A) 1.25 (B) 4.28 (C) 2.50 (D) 6.39
13.	A true centrifugal casting operation needs to be performed horizontally to make copper tube section with outer diameter of 250 mm and inner diameter of 230 mm. The value of acceleration due to gravity, g = 10 m/s^2. If a G-factor (ratio of centrifugal force to weight) of 60 is used for casting the tube, the rotational speed required is_____ rpm. (A) 230.02 (B) 661.59 (C) 250.36 (D) 650.25
14.	A box contains 15 blue balls and 45 black balls. If 2 balls are selected randomly, without replacement, the probability of an outcome in which the first selected is a blue ball and the second selected is a black ball, is _____. (A) 3/16 (B) 45/236 (C) 3/4 (D)1/4
15.	In a turning process using orthogonal tool geometry, a chip length of 100 mm is obtained for an uncut chip length of 250 mm. The cutting conditions are: Cutting speed = 30 m/ min, rake length = 20^0. The shear plane angle is _____ degree. (A) 23.53 (B) 43.54 (C) 0.435 (D) 82
16.	A column with one end fixed and one end free has a critical buckling load of 100 N. For the same column if free end is replaced with a pinned end then critical buckling load will be _____ N. (A) 500 (B) 610 (C) 800 (D) 390

17.	An object is moving with a mach number of 0.6 in an ideal gas environment, which is at a temperature of 350 K. The gas constant is 320 J/kgK and ratio of specific heats is 1.3. The speed of object is _____ m/s. (A) 256.25 (B) 228.94 (C) 185.3 (D) 325.35
18.	A PERT network has 9 activities on its critical path. The standard deviation of each activity on critical path is 3. The standard deviation of critical path is_____. (A) 27 (B) 81 (C) 3 (D) 9
19.	The thickness, width and length of a metals slab are 50 mm., 250 mm. and 3600 mm. respectively. A rolling operation on this slab reduces the thickness by 10% and increases the width by 3%. The length of the rolled slab is _____ mm. (A) 3883.49 (B) 1865.23 (C) 3600.00 (D) 5898.94
20.	The size distribution of powder particles used in Powder Metallurgy process can be determined by (A) Laser absorption (B) Laser reflection (C) Laser penetration (D) Laser scattering
21.	Consider adiabatic flow of air through a duct. At a given point in the duct, the air velocity is 300 m/s, the temperature is 330K, and the pressure is 180 kPa. Assume that the air behaves as a perfect gas with constant C_p =1.005 kJ/kgK. The stagnation temperature at this point is _____ K. (A) 374.77 (B) 245.35 (C) 654.32 (D) 147.23
22.	The allowance provided in between a hole and a shaft is calculated from the difference between (A) lower limit of the shaft and upper limit of the hole (B) upper limit of the shaft and upper limit of the hole (C) upper limit of the shaft and lower limit of the hole (D) lower limit of the shaft and lower limit of the hole
23.	The Cast Iron which possesses all the carbon in combined form as cementite is known as (A) Malleable Cast Iron (B)White Cast Iron (C) Grey Cast Iron (D) Spheroidal Cast Iron
24.	Which of the following is responsible for eddy viscosity (or turbulent viscosity) in a turbulent boundary layer on a flat plate? (A) Reynolds stresses (B) Nikuradse stresses (C) Prandtl stresses (D) Boussinesq equation stresses

25.	Daily production capacity of a bearing manufacturer company is 30000 bearings. The daily demand of the bearing is 15000. The holding cost per year of keeping a bearing in the inventory is Rs. 20. The setup cost for the production of a batch is Rs. 1800. Assuming 300 working days in a year, the economic batch quantity in number of bearings is_____. (A) 40250 (B) 30269 (C) 56020 (D) 25639
26.	A cantilever beam with a uniform flexural rigidity ($EI = 200 \times 10^6$ Nm^2) is loaded with a concentrated force at its free end. The area of the bending moment diagram corresponding to the full length of the beam is 10000 Nm^2. The magnitude of the slope of the beam at its free end is _____ micro radian. (A) 20 (B) 60 (C) 50 (D) 90
27.	The machining process that involves ablation is (A) Abrasive Jet Machining (B) Chemical Machining (C) Laser Beam Machining (D) Electrochemical Machining
28.	In a CNC machine tool, the function of an interpolator is to generate (A) error signal for tool radius compensation during machining (B) reference signal prescribing the shape of the part to be machined (C) NC code from the part drawing during post-processing (D) signal for lubrication pump during machining
29.	The Von-Mises stress at a point in a body subjected to forces is proportional to the square root of the (A) plastic strain energy per unit volume (B) distortional strain energy per unit volume (C) total strain energy per unit volume (D) dilatational strain energy per unit volume
30.	Consider an ideal vapour compression refrigeration cycle working on R-134a refrigerant. The COP of the cycle is 10 and the refrigeration capacity is 150 kJ/kg. The heat rejected by the refrigerant in the condenser is _____kJ/kg. (A) 120 (B) 150 (C) 165 (D) 130
31.	A square threaded screw is used to lift a load W by applying a force F. The efficiency of square threaded screw is expressed as (A) The ratio of work done by W per revolution to work done by F per revolution (B) W/F (C) F/W (D) The ratio of work done by F per revolution to work done by W per revolution

32.	A CNC worktable is driven in a linear direction by a lead screw connected directly to a stepper motor. The pitch of the lead screw is 5 mm. The stepper motor completes one full revolution upon receiving 600 pulses. If the worktable speed is 5 m/minute and there is no missed pulse, then the pulse rate being received by the stepper motor is (A) 20 kHz (B) 10 kHz (C) 3 kHz (D) 15 kHz
33.	Which one of the following is NOT a form of inventory? (A) Raw materials (B) Work-in-process materials (C) Finished goods (D) CNC Milling Machines
34.	The Clausius inequality holds good for (A) any process (B) any cycle (C) only reversible process (D) only reversible cycle
35.	A polytropic process is carried out from an initial pressure of 110 kPa and volume of 5 m^3 to a final volume of 2.5 m^3. The polytropic index is given by n = 1.2. The absolute value of the work done during the process is _____ kJ. (A) 154.23 (B) 584.25 (C) 205.32 (D) 408.91
36.	Which one of the following CANNOT impart linear motion in a CNC machine? (A) Linear motor (B) Ball screw (C) Lead screw (D) Chain and sprocket
37.	Which one of the following is an intensive property of a thermodynamic system? (A) Mass (B) Density (C) Energy (D) Volume
38.	The compressor of a gas turbine plant, operating on an ideal intercooled Brayton cycle, accomplishes an overall pressure ratio of 6 in a two stage compression process. Intercooling is used to cool the air coming out from the first stage to the inlet temperature of the first stage, before its entry to the second stage. Air enters the compressor at 300 K and 100 kPa. If the properties of gas are constant, the intercooling pressure for minimum compressor work is _____ kPa. (A) 244.9 (B) 144.3 (C) 205.2 (D) 187.4
39.	For an ideal Rankine cycle operating between pressure of 30 bar and 0.04 bar the work output from the turbine is 903kJ/kg and the work input to the feed pump is 3kJ/kg. The specific steam consumption is _____ kg/kWh. (A) 3 (B) 6 (C) 5 (D) 4

40.	In a four-bar planar mechanism shown in the figure, AB = 5 cm, AD = 4 cm and DC = 2 cm. In the configuration shown, both AB and DC are perpendicular to AD. The bar AB rotates with an angular velocity of 10 rad/s. The magnitude of angular velocity (in rad/s) of bar DC at this instant is  (A) 10 (B) 25 (C) 15 (D) 0
41.	Consider incompressible laminar fluid flow of constant property Newtonian fluid in an isothermal circular tube. Flow is steady with fully developed temperature and velocity profiles. The Nusselt number for this flow depends on (A) Neither the Reynold number nor the Prandtl number (B) Both the Reynold number and Prandtl number (C) The Reynold number but not the Prandtl number (D) The Prandtl number but not the Reynold number
42.	A linear spring-mass-dashpot system with a mass of 2 kg is set in motion with viscous damping. If the natural frequency is 15 Hz, and the amplitudes of two successive cycles measured are 7.75 mm and 7.20 mm, the coefficient of viscous damping (in N.s/m) is. (A) 4.41 (B) 7.51 (C) 2.52 (D) 6.11
43.	The value of enthalpies at the stator inlet and rotor outlet of a hydraulic turbomachine stage are h_1 and h_3 respectively, the enthalpy at the stator outlet (or, rotor inlet) is h_2. The condition $(h_2-h_1) = (h_3-h_2)$ indicates that the degree of reaction of this stage is (A) 75% (B) 50% (C) Zero (D) 100%
44.	A bolt head has to be made at the end of a rod of diameter d =12 mm by localized forging (upsetting) operation. The length of the unsupported portion of the rod is 40 mm. To avoid buckling of the rod, a closed forging operation has to be performed with a maximum die diameter of _____ mm. (A) 20 (B) 61 (C) 40 (D) 18

45.	The spectral distribution of radiation from a black body at $T_1 = 3000K$ has a maximum at wavelength λ_{max}. The body cools down to a temperature T_2. If the wavelength corresponding to the maximum of the spectral distribution at T2 is 1.2 times of the original wavelength λ_{max} then the temperature T_2 is _____K. (A) 1200 (B) 6500 (C) 2500 (D) 3500
46.	Moist air at 105kPa,30^{0}C and 80 % relative humidity flows over a cooling coil in an insulated air conditioning duct. Saturated air exists the duct at 100 kPa and 15^{0}C. The saturation pressure of water at 30^{0}C and 15^{0}C are 4.24 kPa and 1.7 kPa respectively. Molecular weight of water is 18g/mol and that of air is 28.94 g/mol. The mass of water condensing out from the duct is _____ g/kg of dry air. (A) 10 (B) 20 (C) 50 (D) 30
47.	A helical spring has spring constant k. If the wire diameter, spring diameter and the number of coils are all doubled then the spring constant of the new spring becomes (A) k/2 (B) k (C) 8 k (D) 16 k
48.	One kg of air in a closed system undergoes an irreversible process from an initial state of 1 p =1 bar (absolute) and $T_1 = 27\ ^0C$, to a final state of $p_2 = 3$ bar (absolute) and $T_2 = 127\ ^0C$. If the gas constant of air is 287 J/kg K and the ratio of specific heats $\gamma = 1.4$, then the change in the specific entropy (in J/kg K) of the air in the process is__ (A) 172.0 (B) indeterminate, as the process is irreversible (C) 28.4 (D) –26.3
49.	Consider the matrix $P = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$ The number of distinct eigenvalues of P is (A) 2 (B) 0 (C) 1 (D) 3
50.	If a reversed Carnot cycle operates between the temperature limits of 27 ^{0}C and −3 ^{0}C, then the ratio of the COP of a refrigerator to that of a heat pump (COP of refrigerator/ COP of heat pump) based on the cycle is _____. (A) 0.9 (B) 0.1 (C) 0.6 (D) 0.2

8/2/2025

ANSWER KEY FOR THE POST OF ASSISTANT PROFESSOR ME , Level-10

1	B	26	C
2	D	27	C
3	B	28	B
4	D	29	B
5	A	30	C
6	B	31	A
7	C	32	B
8	C	33	D
9	B	34	B
10	B	35	D
11	C	36	D
12	B	37	B
13	B	38	A
14	B	39	D
15	A	40	B
16	C	41	A
17	B	42	A
18	D	43	B
19	A	44	D
20	D	45	C
21	A	46	A
22	C	47	B
23	B	48	D
24	A	49	C
25	A	50	A