# M.Phil./Ph.D. Entrance Examination, May - 2019 (Special Drive) MECHANICAL ENGINEERING 

Day and Date : Tuesday, 21-05-2019
Total Marks : 100
Time : 1.00 p.m. to 3.00 p.m.
Instructions: 1) All questions are compulsory.
2) Each question carries 2 marks.
3) Answers should be marked in the given OMR answer sheet by darkening the appropriate option.
4) Use black ball point pen only for marking the circle. Do not make any stray mark on the OMR Answer Sheet.
5) Follow the instructions given on OMR Sheet.
6) Rough work shall be done on the sheet provided at the end of question paper.
7) Only non programmable calculators are allowed.

1) $\qquad$ which concerns with the question of how many items are to be observed and how the information and data gathered are to be analyzed
A) Statistical design
B) Observational design
C) Operational design
D) Sampling design
2) $\qquad$ involve random selection
A) Probability sampling
B) Non-probability sampling
C) Purposive sampling
D) None of these
3) Parametric test, unlike the non-parametric tests, make certain assumptions about
A) The population size
B) The underlying distribution
C) The sample size
D) None of the above
4) A research which follows case study method is called
A) Clinical or diagnostic
B) Causal
C) Analytical
D) Qualitative

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5) What does a significant result in a chi-square test imply?
A) That homogeneity of variance has not been established
B) That there is a significant difference between the three categorical variables included in the analysis
C) It implies that the sample is not representative of the population
D) All of these are possible
6) Research method is a part of $\qquad$
A) Problem
B) Experiment
C) Research Techniques
D) Research methodology
7) Identifying causes of a problem and possible solution to a problem is
A) Field Study
B) Diagnostic study
C) Action study
D) Pilot study
8) What is the function of a post-test in ANOVA?
A) Determine if any statistically significant group differences have occurred
B) Describe those groups that have reliable differences between group means
C) Set the critical value for the F test (or chi-square)
D) None of the above
9) The first step in formulating a problem is
A) Statement of the problem
B) Gathering of Data
C) Measurement
D) Survey
10) What does a descriptive study seek to accomplish?
A) Attempts to capture a population's characteristics by making inferences from a sample's characteristics and testing resulting hypotheses
B) Emphasizes a full contextual analysis of a few events or conditions and their interrelations
C) Discovers answers to the questions who, what, when, where, or how much
D) Attempts to reveal why or how one variable produces changes in another

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11) Last step in problem formulation is
A) Survey
B) Discussion
C) Literature survey
D) Rephrasing the Research problem
12) Which ONE of these is the best description of secondary data?
A) Ordinary data
B) Existing data
C) Omnibus data
D) Ordinal data
13) What level of measurement would be used if participants were asked to choose their favorite picture from a set of six?
A) Ordinal
B) Nominal
C) Ratio
D) Interval
14) Concepts which cannot be given operational definitions are $\qquad$ concepts
A) Verbal
B) Oral
C) Hypothetical
D) Operational
15) The $\qquad$ is not used as a measure of association for nominal, nonparametric variables.
A) Chi-square
B) Phi
C) Cramer's v
D) Z score
16) A Hypothesis from which no generalization can be made is
A) Null Hypothesis
B) Barren Hypothesis
C) Descriptive Hypothesis
D) Analytical Hypothesis
17) A Hypothesis contributes to the development of $\qquad$
A) Theory
B) Generalization
C) Evolution
D) Concept

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18) One or two tail test will determine
A) If the two extreme values (min or max) of the sample need to be rejected
B) If the hypothesis has one or possible two conclusions
C) If the region of rejection is located in one or two tails of the distribution
D) None of the above
19) The null hypothesis for the Mann-Whitney $U$ test is used to test that
A) Two samples are from different populations
B) Two samples are from different populations but have the same mean
C) Two samples are from the same population and have the same mean
D) Two samples are from the same population and have the same median
20) Surveys on the basis of subject matter are of two types (1) Social survey and (2)
A) Economic Survey
B) Deep survey
C) Intensive Survey
D) Extensive Survey
21) In a Three year Research Programme $\qquad$ time can be devoted for preliminary works
A) $20 \%$
B) $50 \%$
C) $17 \%$
D) $25 \%$
22) What is the function of a post-test in ANOVA?
A) Determine if any statistically significant group differences have occurred
B) Describe those groups that have reliable differences between group means
C) Set the critical value for the F test (or chi-square)
D) None of the above
23) A comprehensive full Report of the research process is called
A) Thesis
B) Summary Report
C) Abstract
D) Article
24) When analyzing nominal data, which measure of central tendency is appropriate?
A) Mean
B) Mode
C) Median
D) Range
25) Using the $\qquad$ sampling technique can result in a skewed sample if periodicity exists in the population.
A) Simple random
B) Systematic
C) Stratified
D) Cluster
26) Critical damping is the
A) Largest amount of damping for which no oscillation occurs in free vibration
B) Smallest amount of damping for which no oscillation occurs in free vibration
C) Largest amount of damping for which the motion is simple harmonic in free vibration
D) Smallest amount of damping for which the motion is simple harmonic in free vibration
27) Biot number signifies the ratio of
A) Convective resistance in the fluid to conductive resistance in the solid
B) Conductive resistance in the solid to convective resistance in the fluid
C) Inertia force to viscous force in the fluid
D) Buoyancy force to viscous force in the fluid
28) The maximum theoretical work obtainable, when a system interacts to equilibrium with a reference environment, is called
A) Entropy
B) Enthalpy
C) Exergy
D) Rothalpy
29) Which one of the following is a CFC refrigerant?
A) R 744
B) R 290
C) R 502
D) $\quad \mathrm{R} 718$
30) Which one of the following instruments is widely used to check and calibrate geometric features of machine tools during their assembly?
A) Ultrasonic probe
B) Coordinate Measuring Machine (CMM)
C) Laser interferometer
D) Vernier callipers
31) The major difficulty during welding of aluminium is due to its
A) High tendency of oxidation
B) High thermal conductivity
C) Low melting point
D) Low density
32) The process of reheating the martensitic steel to reduce its brittleness without any significant loss in its hardness is
A) normalising
B) annealing
C) quenching
D) tempering
33) In vibration isolation, which one of the following statements is NOT correct regarding Transmissibility (T)?
A) $T$ is nearly unity at small excitation frequencies
B) $\quad T$ can be always reduced by using higher damping at any excitation frequency
C) $\quad T$ is unity at the frequency ratio of $\sqrt{2}$
D) $\quad T$ is infinity at resonance for undamped systems

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34) A thin plate of uniform thickness is subject to pressure as shown in the figure below


Under the assumption of plane stress, which one of the following is correct?
A) Normal stress is zero in the z-direction
B) Normal stress is tensile in the $z$-direction
C) Normal stress is compressive in the z-direction
D) Normal stress varies in the z-direction
35) For Laminar forced convection over a flat plate, if the free stream velocity increases by a factor of 2 , the average heat transfer coefficient
A) remains same
B) decreases by a factor of $\sqrt{2}$
C) rises by a factor of $\sqrt{2}$
D) rises by a factor of 4
36) In a heat exchanger, it is observed that $\Delta T_{1}=\Delta T_{2}$ where $\Delta T_{1}$ is the temperature difference between the two single phase fluid streams at one end and $\Delta T_{2}$ is the temperature difference at the other end. This heat exchanger is
A) a condenser
B) an evaporator
C) a counter flow heat exchanger
D) a parallel flow heat exchanger
37) Match the Machine Tools (Group A) with the probable Operations (Group B):

| Group A | Group B |
| :--- | :--- |
| P) Centre lathe | 1) Slotting |
| Q) Milling | 2) Counter-boring |
| R) Grinding | 3) Knurling |
| S) Drilling | 4) Dressing |

A) P-1, Q-2, R-4, S-3
B) P-2, Q-1, R-4, S-3
C) $\mathrm{P}-3, \mathrm{Q}-1, \mathrm{R}-4, \mathrm{~S}-2$
D) P-3, Q-4, R-2, S-1

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38) The following four unconventional machining processes are available in a shop floor. The most appropriate one to drill a hole of square cross section of $6 \mathrm{~mm} \times 6 \mathrm{~mm}$ and 25 mm deep
A) is abrasive Jet Machining
B) is Plasma Arc Machining
C) is Laser Beam Machining
D) is Electro Discharge Machining
39) Consider a single degree-of-freedom system with viscous damping excited by a harmonic force. At resonance, the phase angle (in degree) of the displacement with respect to the exciting force is
A) 0
B) 45
C) 90
D) 135
40) Consider the turbulent flow of a fluid through a circular pipe of diameter, D. Identify the correct pair of statements.
I. The fluid is well-mixed
II. The fluid is unmixed
III. $\operatorname{Re}_{\mathrm{D}}<2300$
IV. $\mathrm{Re}_{\mathrm{D}}>2300$
A) I, III
B) II, IV
C) II, III
D) $\mathrm{I}, \mathrm{IV}$
41) For a gas turbine power plant, identify the correct pair of statements.
P) Smaller in size compared to steam power plant for same power output
Q) Starts quickly compared to steam power plant
R) Works on the principle of Rankine cycle
S) Good compatibility with solid fuel
A) $P, Q$
B) $\mathrm{R}, \mathrm{S}$
C) $Q, R$
D) $\mathrm{P}, \mathrm{S}$

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42) The hot tearing in a metal casting is due to
A) high fluidity
B) high melt temperature
C) wide range of solidification temperature
D) low coefficient of thermal expansion
43) Which one of the following is used to convert a rotational motion into a translational motion?
A) Bevel gears
B) Double helical gears
C) Worm gears
D) Rack and pinion gears
44) Jobs arrive at a facility at an average rate of 5 in an 8 hour shift. The arrival of the jobs follows Poisson distribution. The average service time of a job on the facility is 40 minutes. The service time follows exponential distribution. Idle time (in hours) at the facility per shift will be
A) $\frac{5}{7}$
B) $\frac{14}{3}$
C) $\frac{7}{5}$
D) $\frac{10}{3}$
45) A cantilever beam of length, $L$, with uniform cross-section and flexural rigidity, $E I$, is loaded uniformly by a vertical load, w per unit length. The maximum vertical deflection of the beam is given by
A) $\frac{w L^{4}}{8 E I}$
B) $\frac{w L^{4}}{16 E I}$
C) $\frac{w L^{4}}{4 E I}$
D) $\frac{w L^{4}}{24 E I}$
46) What is the natural frequency of the spring mass system shown below? The contact between the block and the inclined plane is frictionless. The mass of the block is denoted by m and the spring constants are denoted by $\mathrm{k}_{1}$ and $\mathrm{k}_{2}$ as shown below.

A) $\sqrt{\frac{k_{1}+k_{2}}{2 m}}$
B) $\sqrt{\frac{k_{1}+k_{2}}{4 m}}$
C) $\sqrt{\frac{k_{1}-k_{2}}{m}}$
D) $\sqrt{\frac{k_{1}+k_{2}}{m}}$
47) Consider the two states of stress as shown in configurations I and II in the figure below. From the stand point of distortion energy (von-Mises) criterion, which one of the following statements is true?

A) I yields after II
B) II yields after I
C) Both yield simultaneously
D) Nothing can be said about their relative yielding
48) A rectangular hole of size $100 \mathrm{~mm} \times 50 \mathrm{~mm}$ is to be made on a 5 mm thick sheet of steel having ultimate tensile strength and shear strength of 500 MPa and 300 MPa , respectively. The hole is made by punching process. Neglecting the effect of clearance, the punching force $($ in kN$)$ is
A) 300
B) 450
C) 600
D) 750
49) Match the casting defects (Group A) with the probable causes (Group B):

| Group A | Group B |
| :--- | :--- |
| P) Hot tears | 1) Improper fusion of two streams of liquid metal |
| Q) Shrinkage | 2) Low permeability of the sand mould |
| R) Blow holes | 3) Volumetric contraction both in liquid and solid stage |
| S) Cold Shut | 4) Differential cooling rate |

A) $\mathrm{P}-1, \mathrm{Q}-3, \mathrm{R}-2, \mathrm{~S}-4$
B) $\mathrm{P}-4, \mathrm{Q}-3, \mathrm{R}-2, \mathrm{~S}-1$
C) P-3, Q-4, R-2, S-1
D) P-1, Q-2, R-4, S-3
50) It is desired to avoid interference in a pair of spur gears having a $20^{\circ}$ pressure angle. With increase in pinion to gear speed ratio, the minimum number of teeth on the pinion
A) increases
B) decreases
C) first increases and then decreases
D) remains unchanged

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## Rough Work

