

THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA, VADODARA

Ph. D. ENTRANCE TEST (PET) – 7th August 2022

Signature of Invigilator

Paper - II

Roll.
No.

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Mechanical Engineering
(22/38)

Maximum Marks: 50

No. Of Printed Pages: 8

Instruction for the Candidate:

1. This paper consists of **FIFTY (50)** multiple choice type questions. Each Question carries **ONE (1)** mark.
2. There is no Negative Marking for Wrong Answer.
3. A separate OMR Answer Sheet has been provided to answer questions. Your answers will be evaluated based on your response in the OMR Sheet only. No credit will be given for any answering made in question booklet.
4. Defective question booklet or OMR if noticed may immediately replace by the concerned invigilator.
5. Write roll number, subject code, booklet type, category and other information correctly in the OMR Sheet else your OMR Sheet will not be evaluated by machine.
6. Select most appropriate answer to the question and darken appropriate oval on the OMR answer sheet, with black / blue ball pen only. **DO NOT USE PENCIL** for darkening. In case of over writing on any answer, the same will be treated as invalid. Each question has exactly one correct answer and has four alternative responses (A), (B), (C) and (D). You have to darken the circle as indicated below on the correct response against each item.
Example: (A) ● (B) ● (C) ● (D) ● where (B) is correct response.
7. Rough Work is to be done in the end of this booklet.
8. If you write your Name, Roll Number, Phone Number or put any mark on any part of the OMR Answer Sheet, except for the space allotted for the relevant entries, which may disclose your identity, or use abusive language or employ any other unfair means, such as change of response by scratching or using white fluid, you will render yourself liable to disqualification.
9. Calculators, Log tables any other calculating devices, mobiles, slide rule, text manuals etc are **NOT** allowed in the examination hall. If any of above is seized from the candidates during examination time; he/ she will be immediately debarred from the examination and corresponding disciplinary action will be initiated by the Center Supervisor as deemed fit.
10. **DO NOT FOLD** or **TEAR** OMR Answer sheet as machine will not be able to recognize torn or folded OMR Answer sheet.
11. **You have to return the OMR Answer Sheet to the invigilator at the end of the examination compulsorily** and must not carry it with you outside the Examination Hall. You are however, allowed to carry original question booklet on conclusion of examination.

Paper - II

Mechanical Engineering (22/38)

Note: This paper contains **FIFTY (50)** multiple-choice questions. Each Question carries **ONE (1)** mark.

- 01) During a steady gas metal arc welding with direct current electrode positive polarity, the welding current, voltage and welding speed are 150A, 30V and 6 m/min respectively. A metallic wire electrode of diameter 1.2mm is being fed at a constant rate of 12m/min. The density, specific heat and melting temperature of wire electrode are 7000 kg/m³, 500 J/kg and 1530°C respectively. Assume the ambient temperature to be 30°C and neglect the latent of melting. Further consider that 2/3rd of the total electric power is available for melting of the wire electrode. The melting efficiency (In percentage) of the wire electrode is
- 1.26 p
 - 12.6 p
 - 0.126 p
 - 126 p

- 02) For a 3- axes CNC table, the side along the vertical axis of the table driven by a DC servo motor via lead screw nut mechanism. The lead screw has pitch of 5mm. This lead screw is fitted with a relative (Incremental) circular encoder. The basic length unit (BLU) of the slide along the vertical axis of the table is 0.005mm. When the table moves along the vertical axis by 9mm. The corresponding number of pulse generated by the encoder is
- 1800
 - 1900
 - 2000
 - 2100

- 03) Match the items in column I and column II

Column I	Column II
1. Austempering	P. Austenite is converted into bainite
2. Tempering	Q. Austenite is converted into martensite
3. Martempering	R. Cementite is converted into globular structure
	S. Carbon is absorbed into the metal
	T. Both hardness and brittleness are reduced

- 1-R, 2-Q, 3-T
- 1-P, 2-T, 3-Q
- 1-T, 2-P, 3-S
- 1-S, 2-S, 3-P

- 04) Consider the following statements for a composite material:

- Thermosetting epoxy resin is used as matrix for some kind of composites.
- It is considered to be any multiple material that exhibits a significant proportion of the properties of both constituents.
- Constituents' phases in a composite must be chemically similar.
- Matrix combined with a reinforcing material is used in composite.

Which of these statements are NOT correct?

- 1 Only
- 2 Only
- 3 Only
- 1 and 2 Only

- 05) A mining company having three mines A, B and C supplies coal to three power plants P, Q and R located close to the mines. The daily production capacities of the three mines in tonnes are 700, 1200 and 1100 respectively. The daily requirements at the power plants in tonnes are 1000, 1000 and 1000 respectively. The transportation costs in rupees per tonne is given in the matrix below:

Power plant/Mine	P	Q	R
P	15	20	60
Q	5	40	20
R	30	10	50

The total cost of coal transportation in rupees from the three mines to three power plants using the least-cost method is _____.

- 62000/-
- 64000/-
- 66000/-
- 68000/-

- 06) **Statement (I)** : The knowledge about the nature of time series components is required for better forecasting

Statement (II): Moving average and simple exponential smoothing models are used for time series demand forecasting but they are suitable for average demand process.

- Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)
- Both Statement (I) and Statement (II) are individually true but Statement (II) is NOT the correct explanation of Statement (I)
- Statement (I) is true but Statement (II) is false
- Statement (I) is false but Statement (II) is true

07) If Taylor's equation is $V T^n = C$, t is the tool changing time, z_1 is the direct labour and over head rate, z_2 is the tool cost per grind, then the optimum tool life for minimum cost is expressed as

A) $\left(\frac{1}{n}\right)$

14) Match the following

Process	Associated Mechanism
P. Jig	1. Helps to place workpiece in the same position cycle after cycle
Q. Fixture	2. Holds the workpiece only
R. Clamp	3. Holds and position the workpiece
S. Locator	4. Holds and position the workpiece and guides the cutting tool during machining operation

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

15) The most commonly used criteria for measuring forecast error is

- A) Mean absolute deviation
- B) Mean Square error
- C) Mean absolute percentage error
- D) Mean standard error

16) If a 1 kW motor is run for 10 hours, how much energy it would consume?

- A) 10 kWh
- B) 36 MJ
- C) 8570 kCal
- D) All of above

17) Which one is the wrong sentence about compressibility factor:

- A) It can be 1, <1 or >1 for real gases
- B) It will be nearly 1 for Nitrogen at 0°C and atmospheric pressure
- C) It is equal to 0 for ideal gases
- D) It is also the actual specific volume to ideal specific volume

18) 1000 kJ heat is added from a source at 1000 K to a sink at 500 K, what will be the entropy change of the universe?

- A) 0.5 kJ/K
- B) 1.0 kJ/K
- C) 2.0 kJ/K
- D) No change as it's a reversible process

19) Following is the unit of convective mass transfer coefficient:

- A) W/m²K
- B) kg/m²K
- C) kmol/m² K
- D) m/s

20) 600 litres per minute of oil flows through a pipe and the pressure drop measured over the length of the pipe is 100 Pa. The theoretical pumping power required in this case is:

- A) 60 W
- B) 60 kW
- C) 6 kW
- D) 1 Kw

21) The following sentence about the natural convection is not correct

- A) Natural convection and forced convection can occur simultaneously
- B) Natural convection and radiation heat transfer can occur simultaneously
- C) There is no bulk movement of the fluid in natural convection
- D) The surface should be put in quiescent media

22) Which one of the following is never used as refrigerant?

- A) Water
- B) Carbon dioxide
- C) Propane
- D) All are used

23) The following type of heat load is not purely sensible load

- A) Solar radiation load
- B) Infiltration load
- C) Heat transmission through roof
- D) All are purely sensible load

24) What is the merit of vapour absorption refrigeration system compared to the vapour compression refrigeration system?

- A) It has high COP
- B) Its cost is lower per ton of refrigeration
- C) Its power consumption is very low
- D) It is simpler system

25) Which heat exchanger works at the lowest flue gas temperature in modern steam power plants?

- A) Air preheater
- B) Superheater
- C) Reheater
- D) Economizer

- 26) The condensing temperature in steam power plant is kept low because
- Heat exchanger effectiveness improves
 - Cooling water is available at low temperatures
 - It increases efficiency of the cycle
 - Heat losses to atmosphere reduce
- 27) In case of power plants, which of the following is not an example of co-generation?
- Gas and steam power cycles are operated using single fuel
 - Refrigeration as well as power generation are produced with a single fuel
 - Process steam is generated using exhaust of gas turbine power plant
 - Rather than rejecting heat in condenser, steam is utilized in process heating
- 28) A flow field is a region in which the flow _____ is defined at each and every point in space, at any instant of time
- Acceleration
 - Velocity
 - Mass
 - Work
- 29) Spiral casing is used in
- Francis Turbine
 - Pelton Wheel
 - Impulse Turbine
 - All type of Turbine
- 30) In an axial flow compressor, stage pressure rise is having limitation due to
- Rotor blade is having fatigue limit
 - Rotor blades are heavy
 - Flow separation due to adverse pressure gradient
 - Rotor blades are thin
- 31) Restriction of Maximum temperature in the turbine inlet of a Gas Turbine power plant is due to
- Material of construction
 - Fuel used
 - Friction loss
 - Oxygen level
- 32) An assemblage made up of 3 links and having one higher pair has _____ degree of freedom,
- 0
 - 2
 - 1
 - 1
- 33) Oldham Coupling is an inversion of
- Slider crank mechanism
 - Whitworth Mechanism
 - Double slider mechanism
 - pantograph.
- 34) A link (O_2A) rotates about O_2 . The angular velocity of the link is $10\hat{k}$. The link is 100 mm long and makes 45° with positive X-axis. What is the velocity of point A?
- $(0.707i + 0.707j)m/s$
 - $(0.707i - 0.707j)m/s$
 - $(-0.707i + 0.707j)m/s$
 - $(-0.707i - 0.707j)m/s$
- 35) The balance masses are introduced in the plane parallel to the plane of rotation of the disturbing mass. To obtain complete dynamic balance, a minimum number of balance masses to be introduced is
- One
 - Two
 - three.
 - Four
- 36) If the ratio of the length of connecting rod to the crank radius increases
- primary unbalanced forces increases
 - primary unbalanced forces decreases
 - secondary unbalanced forces increases
 - secondary unbalanced forces decreases.
- 37) In a spring mass system of mass m and stiffness k , the end of the spring are securely fixed and mass is attached to intermediate point of spring. The natural frequency of longitudinal vibration of the system
- is maximum when the mass is attached to the mid point of the spring
 - is minimum when the mass is attached to the mid point of the spring
 - zero
 - None of the above.
- 38) The whirling speed of a rotating shaft carrying a mass m at the centre is
- more than the natural frequency of transverse vibration of the system
 - less than the natural frequency of transverse vibration of the system
 - is equal to natural frequency of the transverse vibration of the system
 - is more or less depending upon the stiffness of the shaft.
- 39) Tapered roller bearings can take
- radial load only
 - axial load only
 - both radial and axial loads and the ratio of these being less than unity
 - both radial and axial loads and the ratio of these being greater than unity

- 40) What is the maximum bending moment acting on simply supported beam of span 10 m and centrally loaded with $F=400N$?
- A) 4000Nm
B) 2000Nm
C) 1000Nm
D) 400Nm
- 41) Isotropic materials are those which have the same
- A) Elastic properties in all the directions at a point
B) Elastic properties all over the material
C) Stresses induced all over the material
D) Thermal properties all over the body
- 42) Which of the following is a higher pair?
- A) Belt and pulley
B) Helical pair
C) Turning pair
D) Sliding pair
- 43) For the state of stress given as $\tau_{ij} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ units the value of principal stress are:
- A) 1,1
B) 1,-1
C) 1,0
D) 2,0
- 44) For the hydrostatic state of stress, the radius of Mohr's circle is
- A) Sum of magnitude of principal stresses
B) Difference of magnitude of principal stresses
C) Sum of magnitude of applied stresses
D) Zero
- 45) The acceleration vector of centre of gravity of a link is written as $\bar{A}_G = (45i + 45j)m/s^2$ and its mass is 2 kg. The inertia force vector can be written as
- A) $\bar{F}_I = 63. \quad 45^0N$
B) $\bar{F}_I = 127. \quad 45^0N$
C) $\bar{F}_I = 63. \quad 225^0N$
D) $\bar{F}_I = 127. \quad 225^0N$
- 46) The acceleration vector of centre of gravity of a link is written as $\bar{A}_G = (46.8i + 155j)m/s^2$ and its mass is 1.5 kg. The mass moment of inertia is $0.012kgm^2$ and angular acceleration is $(119\hat{k})rad/s^2$. The inertia force vector will be displaced by _____mm to handle inertia torque.
- A) 0.058
B) 0.588
C) 5.88
D) 58.8
- 47) The inverse of matrix $A = \begin{bmatrix} 3 & 2 \\ 7 & 4 \end{bmatrix}$ is
- A) $\begin{bmatrix} 1/3 & 1/2 \\ 1/7 & 1/4 \end{bmatrix}$
B) $\begin{bmatrix} 4 & 7 \\ 2 & 3 \end{bmatrix}$
C) $\begin{bmatrix} \frac{2}{13} & \frac{1}{13} \\ \frac{7}{26} & \frac{3}{26} \end{bmatrix}$
D) $\begin{bmatrix} 3/26 & 1/13 \\ 3/26 & 2/13 \end{bmatrix}$
- 48) The height of the right circular cone is decreasing at 3mm/s and its radius is increasing at 2mm/s. What is the rate at which volume is changing (in mm^3/s) when height is 32 mm and the radius is 15 mm.
- A) 1300 mm^3/s
B) -1300 mm^3/s
C) 18 mm^3/s
D) 4 mm^3/s
- 49) Determine the resultant of the three co-planar forces acting at a point. Force A, 10 N at 45^0 from horizontal axis, Force B, 10 N at -45^0 from horizontal axis and Force C, 10 N at 180^0 from horizontal axis.
- A) 4.142 N at 0^0 from horizontal axis
B) 4.142 N at 180^0 from horizontal axis
C) 10 N at 0^0 from horizontal axis
D) 30 N at 0^0 from horizontal axis
- 50) Find a and b for the equation, $(2 - j3) = \sqrt{(a + jb)}$
- A) a=-5, b=-12
B) a=5, b=-12
C) a=-5, b=12
D) a=5, b=12
- *****

Rough Work: