Ph.D. COMMON ENTRANCE TEST - JANUARY 2025

SUBJECT – MECHANICAL ENGINEERIING

PART B

Roll No:

Duration: 60 minutes **Maximum Marks: 50**

Instructions:

1. **This entrance test question paper is not to be taken out of the examination hall**
2. **Question paper consists of Section A and Section B**
3. **Section A consists of 30 MCQs carrying 1 Mark each. Write the Alphabet of the correct answer in the space given.**
4. **Section B consists of Descriptive questions carrying 5 marks each. Restrict your answer to 500 words. Additional plain sheets have been attached to the question paper to answer Section B**

SECTION – A

Answer the following questions by writing the Alphabet of the correct answer in the Box given: **30 X 1 = 30**

1. **Which of the following is NOT a basic manufacturing process?**

   a) Casting

   b) Forging

   c) 3D Printing

   d) Machining

2. **What is the primary purpose of heat treatment of steel?**

   a) To increase its weight

   b) To alter its microstructure and properties

   c) To make it more brittle

   d) To reduce its melting point

3. **Which technique is used to analyse the crystal structure of materials?**

   a) Optical Microscopy

   b) Scanning Electron Microscopy (SEM)

   c) X-ray Diffraction (XRD)

   d) Mechanical Testing

4. **Powder Metallurgy is a process that involves:**

   a) Melting and pouring metal into a mold

   b) Shaping metal by hammering or pressing

   c) Compact and sintering metal powders

   d) Removing material from a workpiece using cutting tools

5. **Which of the following is an example of an advanced manufacturing process?**

   a) Welding

   b) Forging

   c) Casting

   d) Additive Manufacturing (3D Printing)

6. **Which of the following is NOT a type of loading on a beam?**

   a) Point Load

   b) Uniformly Distributed Load (UDL)

   c) Moment

   d) None of the above

7. **In the bending stress equation ($\sigma = My/I$), what does 'I' represent?**

   a) Shear Force

   b) Bending Moment

   c) Moment of Inertia

   d) Young's Modulus

8. **Which of the following is NOT an elastic constant?**

   a) Young's Modulus (E)

   b) Shear Modulus (G)

   c) Poisson's Ratio (ν)

   d) Ultimate Tensile Strength (UTS)

9. **What is the primary function of a spring?**

a) To resist compression only

b) To store and release mechanical energy

c) To transmit torque only

d) To prevent any type of deformation

10. **In the torsion equation ($\tau = T\rho/J$), what does 'J' represent?**

a) Polar Moment of Inertia

b) Shear Stress

c) Torque

d) Radius of the shaft

11. **Which of the following is NOT a core principle of Design Thinking?** *

a) Human-centred

b) Iterative

c) Linear and Sequential

d) Hands-on

12. **The "Empathize" stage in Design Thinking primarily focuses on:**

a) Generating creative solutions

b) Building prototypes

c) Understanding user needs and perspectives

d) Testing solutions with users

13. **Which of the following is a technique used in the "Define" stage?**

a) Brainstorming

b) User Personas

c) A/B Testing

d) Storyboarding

14. **The purpose of "Prototyping" in Design Thinking is to:**

a) Finalize the design before any testing

b) Create a detailed blueprint for manufacturing

c) Test core concepts and gather user feedback

d) Present the final solution to stakeholders

15. **Which of the following is NOT a common technique used in the "Ideate" stage?**

    a) SCAMPER

    b) Brainstorming

    c) Empathy Mapping

    d) Mind Mapping

16. **Which of the following is NOT a fluid property?**

    a) Density

    b) Viscosity

    c) Surface Tension

    d) Hardness

17. **What is the primary mode of heat transfer in a stationary solid?**

    a) Convection

    b) Conduction

    c) Radiation

    d) None of the above

18. **Which type of heat exchanger generally provides the highest heat transfer rate?**

    a) Counterflow

    b) Parallel flow

    c) Cross-flow

    d) Shell and tube

19. **Which of the following is NOT a major mode of heat transfer?**

    a) Conduction

    b) Convection

    c) Friction

d) Radiation

20. **In fluid flow, the Reynolds number is a dimensionless quantity that helps predict:** a) The flow regime (laminar or turbulent)
    b) The pressure drops in a pipe
    c) The viscosity of the fluid
    d) The rate of heat transfer

21. **Which of the following is NOT a statement of the First Law of Thermodynamics?** a) Energy can neither be created nor destroyed, only transformed.
    b) Heat and work are equivalent forms of energy.
    c) The total energy of an isolated system remains constant.
    d) Heat always flows from a colder body to a hotter body.

22. **The Second Law of Thermodynamics primarily deals with:**
    a) Conservation of mass
    b) Conservation of energy
    c) The direction of heat transfer and the availability of energy for work
    d) The relationship between pressure and volume

23. **Which thermodynamic cycle is most commonly used in power plants?**
    a) Carnot cycle
    b) Rankine cycle
    c) Otto cycle
    d) Brayton cycle

24. **What is the primary function of a solar thermal collector?**
    a) To directly convert sunlight into electricity
    b) To absorb and collect solar energy as heat
    c) To split water into hydrogen and oxygen
    d) To store solar energy for later use

25. **Which of the following is NOT a key component of a photovoltaic (PV) cell?**
    a) Turbine
    b) Semiconductor material
    c) Junction
    d) Anti-reflective coating

26. **Which of the following is NOT a major greenhouse gas?**
    a) Carbon dioxide (CO2)
    b) Methane (CH4)
    c) Nitrous oxide (N2O)
    d) Oxygen (O2)

27. **What is the primary function of a fuel cell?**
    a) To store solar energy
    b) To generate electricity through a chemical reaction
    c) To refine crude oil
    d) To cool electronic devices

28. **Which of the following is NOT a key stage in the Life Cycle Assessment (LCA) of a battery?**
    a) Raw material extraction
    b) Manufacturing
    c) Transportation of the final product only
    d) End-of-life management (recycling or disposal)

29. **A sustainable building in a developing country would likely prioritize:**
    a) Maximum use of air conditioning
    b) Reliance on fossil fuels for energy
    c) Integration with local climate and resources
    d) High energy consumption for modern amenities

30. **Which of the following best describes a carbon footprint?**
    a) The total amount of energy consumed by an individual or organization

b) The total greenhouse gas emissions caused by an individual, event, organization, or product

c) The amount of land area required to support a person's lifestyle

d) The impact of human activities on biodiversity

Section - B

Answer any four questions (Each question carries 5 marks 4*5 = 20)

1. 1. Explain the advantages and limitations of powder metallurgy compared to traditional manufacturing processes.
2. Draw and explain a typical stress-strain diagram for a ductile material.
3. Why is prototyping considered a crucial step in the design thinking process?
4. Compare and contrast parallel flow and counterflow heat exchangers. Discuss the advantages and disadvantages of each type.
5. State and explain the First and Second Laws of Thermodynamics. Discuss the implications of the Second Law on the direction of heat transfer and the efficiency of thermal systems.
6. Discuss the scientific evidence for global climate change, including the role of greenhouse gases and the potential impacts of climate change on the environment and human society.

All the BEST