BIRLA INSTITUTE OF TECHNOLOGY
MESRA – 835215, RANCHI, INDIA

UG

Name: …… Roll No.: ……..

Branch: …… Signature of Invigilator: ……

Semester: IVth Date: 04/05/2022 (MORNING)

Subject with Code: **ME292 SMART & NEW MATERIALS**

Marks Obtained	Section A (30)	Section B (20)	Total Marks (50)

INSTRUCTION TO CANDIDATE

1. The booklet (question paper cum answer sheet) consists of two sections. First section consists of MCQs of 30 marks. Candidates may mark the correct answer in the space provided / may also write answers in the answer sheet provided. The Second section of question paper consists of subjective questions of 20 marks. The candidates may write the answers for these questions in the answer sheets provided with the question booklet.
2. The booklet will be distributed to the candidates before 05 minutes of the examination. **Candidates should write their roll no. in each page of the booklet.**
3. Place the Student ID card, Registration Slip and No Dues Clearance (if applicable) on your desk. All the entries on the cover page must be filled at the specified space.
4. Carrying or using of mobile phone / any electronic gadgets (except regular scientific calculator)/chits are strictly prohibited inside the examination hall as it comes under the category of unfair means.
5. No candidate should be allowed to enter the examination hall later than 10 minutes after the commencement of examination. Candidates are not allowed to go out of the examination hall/room during the first 30 minutes and last 10 minutes of the examination.
6. Write on both side of the leaf and use pens with same ink.
7. The medium of examination is English. Answer book written in language other than English is liable to be rejected.
8. All attached sheets such as graph papers, drawing sheets etc. should be properly folded to the size of the answer book and tagged with the answer book by the candidate at least 05 minutes before the end of examination.
9. The door of examination hall will be closed 10 minutes before the end of examination. Do not leave the examination hall until the invigilators instruct you to do so.
10. Always maintain the highest level of integrity. Remember you are a BITian.
11. Candidates need to **submit the question paper cum answer sheets before leaving the examination hall**.

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BE **SEMESTER: IV**
BRANCH: OE **SESSION: SP/22**

SUBJECT: ME 292(OE-I): SMART AND NEW MATERIALS

TIME: 2 Hrs **FULL MARKS: 50**

INSTRUCTIONS:
1. **The question paper contains 2 (Two) types of questions MCQ (30 marks) and Short Questions (20 Marks).**
2. **Candidates has to attempt all questions.**
3. **For MCQ candidates are required to write the correct answer and not (a), (b), (c)…….**
4. **The missing data, if any, may be assumed suitably.**
5. **Before attempting the question paper, be sure that you have got the correct question paper.**
6. **Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

MULTIPLE CHOICE QUESTIONS (MCQ) **30 X 1 = 30 MARKS**

1. The ability of a material to undergo plastic deformation without fracture when subjected to uniaxial tensile force is called.
   a) Tensile strength
   b) Yield strength
   c) Ductility
   d) Malleability
   e) All
   f) None

2. Shape Memory Effect is defined as:
   a) the actuation behavior of a SMA caused due to formation of stress induced martensite from austenite phase at constant temperature.
   b) Recovery of a strains imparted on a SMA at a certain temperature upon application of stress.
   c) Recovery of a strains imparted on a SMA at a lower temperature as a result of thermal activation.
   d) Training a SMA to recover strain upon application of stress and thermal activation.
   e) All
   f) None

3. What modern material remains stable and strong at high temperatures?
   a) Electroluminescent Lighting
   b) Thermo-Ceramics
   c) Liquid Crystal Displays
   d) Solar Panels
   e) All
   f) None

4. Which of the following statement is true?
   a) The input is always transformed into strain & used to produce motion/dynamics
   b) The desired change in geometrical dimensions is mostly time dependent.
   c) In active materials, the applied strain is transformed into a signal & is related to the strain level computation
   d) None
   e) All

5. Piezo generators convert _____.
   (a) electrical energy into mechanical energy
   (b) mechanical energy into electrical energy
   (c) same element produces both effects
   (d) none of the above

6. The SMA undergoes the change in shape:
   (i) Assertion: commercially used Titanium-Nickel alloys undergo phase transformation upon temperature change
   (ii) Reason: Austenitic to martensite transformation can directly lead to a volume and change shape of the sample.
   (a) (ii) is a correct explanation of (i)
   (b) (ii) is a not correct explanation of (i)

(c) both (i) and (ii) are not true for SMA
(d) None of the above

7. ER fluids are colloidal suspensions whose properties depend on _____ applied on them
   a) Force
   b) Electric Field
   c) Temperature Change
   d) Pressure
   e) All
   f) None

8. Which of the following are not used in Testing ER fluids:-
   a) Temperature Test
   b) Breakdown Test
   c) Viscosity Test
   d) Sedimentation Test
   e) Permittivity Test
   f) All
   g) None

9. Assertion (A): ER fluid behaves as a plastic material.
   Reason(R): Under shear flow, the ER fluid is capable of sustaining shear stresses without flowing.
   a) Both A and R are true and R is the correct explanation of A.
   b) Both A and R are true but R is not the correct explanation of A.
   c) A is true but R is false.
   d) A is false but R is true.
   e) Both A and R are false.

10. Which of the followings are not true for PZT materials?
   a) Lead based non-biocompatible
   b) PVDF or PVF2 are biocompatible
   c) PVDF have high thermal stability
   d) PVDF have excellent chemical resistance
   e) None of the above

11. The electrostriction effect appears to be:
   a) Quadratic at low field and linear up to maximum field strength
   b) Linear at low field and quadratic up to maximum field strength
   c) Maximum at low field and minimum at high field strength
   d) Maximum at high field and minimum at low field strength

12. The change in temperature in pyroelectricity affects the crystal structure of material as:
   a) Position of atoms changes
   b) Position of atoms remains unaltered
   c) Position and polarization of atoms changes
   d) None

13. Under specific conditions, SMAs can absorb and dissipate mechanical energy by undergoing a reversible hysteretic shape change when
   a) Increased mechanical loading
   b) subjected to applied mechanical cyclic loading.
   c) no external load is applied and temperature is increased.
   d) None

14. Upon cooling in the absence of applied load, the crystal structure changes from:
   a) The crystal structure do not change.
   b) Martensite (product phase) to austenite (parent phase)
   c) Austenite to martensite
   d) None

15. High annealing temperatures or chemically active environments can result in oxidation and corrosion, leading to crack nucleation and growth.
   a) Reducing the fatigue life of SMAs
   b) Increasing the fatigue life of SMAs
   c) Both (a) and (b)

d) None

16. Which of the following statements is/are true about smart materials?
    i) Smart material has fixed properties.
    ii) Smart material changes its properties during the manufacturing process.
    i) Smart material changes its properties in response to an environmental/external factor.

    a) i) and ii) are correct.
    b) Only i) is correct.
    c) ii) and iii) are correct.
    d) Only iii) is correct.
    e) All are correct
    f) None is correct

17. Which of the following smart material gives highest free strain upon actuation?
    a) PZT
    b) Terfenol-D
    c) EAP
    d) Nitinol
    e) All
    f) None

18. The temperature on the surface of a space shuttle can go up to 1500 deg Celsius. What in your opinion is a good material for the nose cone of the space shuttle?
    a) Nylon fiber
    b) Smart material reinforced composite
    c) Carbon-Carbon composite
    d) Kevlar fiber
    e) All
    f) None

19. The stimulus can be a change in temperature or in magnetic field which results the materials response intrinsically towards the following output:
    a) change in length
    b) change in viscosity
    c) change in electrical conductivity
    d) None
    e) All

20. If there is low electric field in PZT, there exist a _____ relationship between strain and electric field.
    a) Linear
    b) Non-linear
    c) Parabolic
    d) None
    e) Logarithmic

21. A Helical Magnetic Field producing torque in magnetostrictive material is known as:
    (a) Joule Effect
    (b) Magneto-volume effect
    (c) Wiedemann effect
    (d) Villari Effect

22. Rheology Addresses the behaviour of real materials with properties intermediate between those of
    a) Ideal solids and ideal liquids
    b) Real solids and real liquids
    c) Ideal solids and real liquids
    d) Real solids and ideal liquids
    e) None

23. What we need for calculating the power consumption of the suitable ER fluid:-
    a) Viscosity
    b) Current density
    c) Temperature
    d) Permittivity

e) All
f) None

24. Arrange the following in correct order regarding preparation of ER fluids
    I. The desired powder is chosen and same particle powder size particle are required for the ER fluid dispensing particle.
    II. The powder is poured in glass container and desired amount of the ER fluid is poured in the glass container which contains the powder of uniform size and are stirred continuously until the powder mixed with the fluid completely.
    III. The mixed solution is passed to a vane pump five ties to get a good result homogenous solution.
    IV. The mixture of the powder and the fluid are stirred for 2 hrs by glass rod or magnetic starrer at a constant RPM to get a uniform homogenous mixture.
    V. The chosen powder must be passed through size sieve for all the particles same and must be weighted on the weighing machine.
    VI. This process should be followed for other ER solution preparation.
        a) I-III-IV-V-VI-II
        b) I-V-II-IV-III-VI
        c) I-IV-III-V-VI-II
        d) I-V-III-IV-II-VI

25. The piezoelectric effects occur when material produces electric charges due to
    a) Applied voltage
    b) Applied mechanical shear stress
    c) Applied electric field
    d) Applied magnetic field
    e) All
    f) None

26. The displacement of ions in an electrostriction material results a strain which is:
    a) Inverse of polarization
    b) Proportional to polarization
    c) Proportional to the square of polarization
    d) None

27. The energy states (viz. kinetic, electrical and thermal) in a crystal are visualized as a triangle. Which of the following is true about piezoelectric effect?
    a) The side between electrical and thermal corners represents piezoelectric effect produces thermal energy.
    b) The side between kinetic and electrical corners represents the piezoelectric effect and produces kinetic energy.
    c) The side between kinetic and electrical corners represents the piezoelectric effect and produces no heat.
    d) The side between kinetic and thermal corners represents the piezoelectric effect and no heat

28. Shape memory alloys are unique class of shape memory materials that can regain its shape when
    a) The temperature is decreased.
    b) The temperature is increased.
    c) The temperature remains constant.
    d) Shape remains unaltered.

29. Higher actuation frequencies are achievable by a class of SMA called
    a) Electric shape memory alloy
    b) Magnetic shape memory alloy
    c) Both electric and magnetic shape memory alloys
    d) None

30. The SMAs are associated with stress induced transformation, which leads to the strain generation during loading, such behaviour of SMAs is termed as:
    a) Pyroelasticity
    b) Pseudoelasticity
    c) both (a) and (b)
    d) none

Short Questions **10 X 2 = 20 MARKS**

Answer the following in a very short (1 to 2 Lines)

31. Brief on the role of Pressure transducer in smart structure.
32. Write briefly on Signal processing with reference to Smart Structure
33. How the actuators are used in smart structures?
34. Name the piezoelectric materials used in smart structures.
35. Explain shape memory effect.
36. Explain Electro rheological fluid Theory
37. Explain applications of Shape Memory Alloys (SMA).
38. Briefly explain vibration control using various characteristics of SMA.
39. State the reason for considering shape memory alloys as smart materials.
40. List the characteristics of shape memory alloys.