



Name: Roll No.:

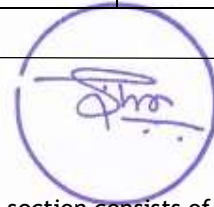
Branch: Signature of Invigilator:

Semester: VIth Date: 29/04/2022 (MORNING)

Subject with Code: PE319 MATERIAL DEFORMATION PROCESSES

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: B. TECH
BRANCH: PRODUCTION**

**SEMESTER: VI
SESSION: SP/22**

SUBJECT: PE319 MATERIAL DEFORMATION PROCESSES

TIME: 2.00 HOURS

FULL MARKS: 50

INSTRUCTIONS:

Read the instructions carefully before you begin answering: -

1. The question paper two sections (Section A and Section B). Section A consists of MCQ, and Section B consists of short questions.
 2. Put a tick mark for the correct option in the question paper itself.
 3. Submit Section A question paper.
 4. Attempt all questions from Section A and the questions have only single correct option.
 5. If there are ambiguities in the facts, make whatever assumptions are necessary to resolve an issue.
 6. If additional facts are needed, state what these facts are and why they are needed.
-

Section A (All questions are compulsory) (Full Marks = 30)

1. Liquid metal forging is a type _____ process
 - a. Additive manufacturing
 - b. Controlled rolling
 - c. Casting
 - d. Deep drawing

[0.5]

2. Recovery is _____
 - a. the increase in the average size of the grains
 - b. the annihilation of the point imperfection and dislocations without movement of the grain boundaries
 - c. the nucleation and growth of new, strain-free crystals from the cold worked metal
 - d. an excitation of the site occupations in a crystal lattice leading to point defects

[1.0]

3. Cold working is synonymous to
 - a. Recrystallization
 - b. Thermo-mechanical treatment
 - c. Strain hardening
 - d. Ausforming

[0.5]

4. The width to thickness ratio is less than 2 for
 - a. Slab
 - b. Billet
 - c. Plate
 - d. Bloom

[1.0]

5. During extrusion, the extra portion of workpiece which cannot be extruded and remains within the container is called
 - a. Center burst
 - b. Butt
 - c. Surge

[1.0]

d. Surface crack

6. In drawing operation, the difference between the original (D_0) and final (D_f) stock diameters, $D_0 - D_f$ is known as

- a. Fractional reduction in area
 - b. Semi-cone die angle
 - c. Draft
 - d. None of the above
- [1.0]

7. In sheet metal cutting operation, the sharp corner on the edge caused during final separation of the two pieces (shown in the image) is known as



- a. Fractured zone
 - b. Rollover
 - c. Burnish
 - d. Burr
- [1.0]

8. Bending the edge of the sheet over itself, in more than one bending step carried out to eliminate the sharp edge on the piece is known as

- a. Hemming
 - b. Curling
 - c. Seaming
 - d. Flanging
- [1.0]

9. Stress is a _____ tensor

- a. Rank 1
 - b. Rank 2
 - c. Rank 3
 - d. Rank 4
- [1.0]

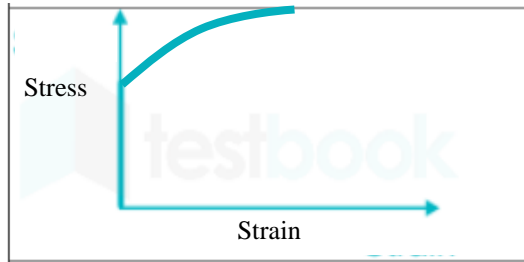
10. The equations of motion for a solid body deduces to the equilibrium equations under _____ conditions

- a. Unsteady state
 - b. Steady state
 - c. Dynamic
 - d. Rigid plastic
- [1.0]

11. The two-dimensional strain at a point is given by

- a. $\epsilon_{ij} = \frac{1}{2} \left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} \right)$
 - b. $\epsilon_{ij} = \frac{1}{2} \left(\frac{\partial u_i}{\partial x_i} + \frac{\partial u_j}{\partial x_j} \right)$
 - c. $\epsilon_{ij} = \frac{\partial u_i}{\partial x_i} + \frac{\partial u_j}{\partial x_j}$
 - d. $\epsilon_{ij} = \frac{\partial u_i}{\partial x_j}$
- [1.0]

12. The stress-strain relationship shown in the figure represents that of a _____



[1.0]

- a. Elastic-plastic material
- b. Elastic-perfectly plastic material
- c. Rigid plastic material
- d. Perfectly plastic material

13. In the plastic stress-strain theory, which one of the following considers both the elastic and plastic strain increments?

- a. von-Mises criterion
- b. Tresca criterion
- c. Levy-Mises equations
- d. Prandtl-Reuss equations

[1.0]

14. Levy-Mises equations gives the relationship between stress and strain for _____ material

- a. Ideal plastic
- b. Rigid plastic
- c. Perfectly plastic
- d. Elastic plastic

[1.0]

15. The plane whose normal vector forms equal angles with the coordinate system is called _____

- a. Tetrahedral
- b. Octahedral
- c. Equivalent
- d. Hexagonal

[1.0]

16. The true stress-strain can be approximated by a power law expression $\sigma = K\varepsilon^n$ which is known as the

- a. Hollomon equation
- b. Ludwik equation
- c. Fick's law
- d. Newton's equation

[1.0]

17. The yield surface shape and size remain unaltered in _____

- a. Isotropic hardening
- b. Recrystallization
- c. Kinematic hardening
- d. Bauschinger effect

[1.0]

18. Coulomb's model of friction is valid for light normal load for which condition of relation between apparent (A) and real (A_{real}) contact areas

- a. $A_{real} \ll A$

[1.0]

- b. $A_{real} > A$
- c. $A_{real} = A$
- d. $A_{real} \geq A$

19. For pure sticking, the shear friction factor is

- a. $m = 0$
- b. $m = 2$ [1.0]
- c. $m < 1$
- d. $m = 1$

20. A constant contact between the friction surfaces at high surface points (micro-asperities) occurs during _____ regime

- a. Mixed lubrication
- b. Boundary lubrication [1.0]
- c. Hydrodynamic lubrication
- d. Thick film lubrication

21. The dimensions of the workpiece in one of the co-ordinate directions should be much greater than the dimensions in the other two co-ordinate directions for a cartesian system under _____ condition

- a. Plane stress [1.0]
- b. Isotropic
- c. Plane strain
- d. None of the above

22. Deformation stress as calculated by uniform deformation energy method is given by

- a. $\sigma = \bar{\sigma}_0 l n \frac{1}{1-r}$
- b. $\sigma = \bar{\sigma}_0 l n \frac{A_2}{A_1}$
- c. $\sigma = \bar{\sigma}_0 l n \frac{\epsilon_1}{\epsilon_2}$ [2.0]
- d. $\sigma = \bar{\sigma}_0 \frac{\epsilon_1}{\epsilon_2}$

where r is the fractional reduction in area, $\bar{\sigma}_0$ is the average flow stress, A_1 and A_2 are the initial cross-sectional areas of the workpiece, respectively and ϵ_1 and ϵ_2 are the initial and final true strains, respectively during the deformation process

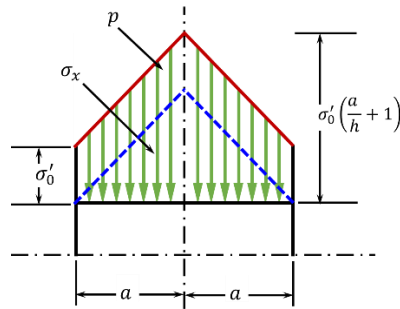
23. In slip line field analysis, the deformation is considered to occur under plane strain condition.

- a. True
- b. False [1.0]
- c. None of the above
- d. Not Applicable

24. The slip lines must meet a frictionless interface at _____

- a. 90°
- b. 60° [1.0]
- c. 45°
- d. 22.5°

25. The friction hill for forging under plane strain conditions represented by the adjacent graph represents the case of _____ [1.0]



- Sliding friction
- Sticking friction
- Mixed friction
- Coulomb's friction

26. During forging of a circular disc considering the mixed sliding sticking friction, the following relationship between forging pressure for Coulomb sliding friction (p_{CF}) and pressure for sticking friction (p_{SF}) is true at the radius at which the transition from sticking to slipping occurs

- $p_{CF} < p_{SF}$
- $p_{CF} = p_{SF}$
- $p_{CF} > p_{SF}$
- $p_{CF} \geq p_{SF}$

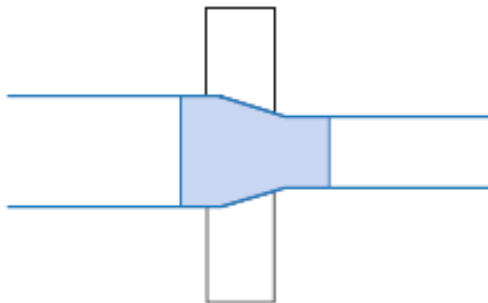
[1.0]

27. In tandem drawing the wire passes through _____ and the drawing block remaining _____ the die(s)

- Single die, after
- Several dies in parallel, before
- Several dies in series, in between
- Single die, after

[1.0]

28. The type of tube drawing process shown in the diagram is known as drawing _____



[1.0]

- Without internal support
- With internal support using moving mandrel
- With internal support using fixed plug
- With internal support using floating plug

29. For tube drawing process with a cylindrical mandrel, the constant B_{mandrel}^* is given as

- $B_{\text{mandrel}}^* = \frac{\mu_1 - \mu_2}{\tan\alpha - \tan\beta}$
- $B_{\text{mandrel}}^* = \frac{\mu_1 + \mu_2}{\tan\alpha - \tan\beta}$
- $B_{\text{mandrel}}^* = \frac{\mu_1 - \mu_2}{\tan\alpha + \tan\beta}$
- $B_{\text{mandrel}}^* = \frac{\mu_1 - \mu_2}{\tan\beta}$

[1.0]

where μ_1 and μ_2 are the coefficients of friction, respectively, at the die-tube interface and at the tube-plug interface, α is the semi-cone die angle and β is the semi-cone mandrel angle

30. The maximum extrusion pressure for direct extrusion is _____ that of indirect extrusion

- a. Less than
- b. Equal to
- c. Greater than
- d. Lesser than or equal to

[1.0]

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2. In Section B, attempt only 4 questions.
3. If there are ambiguities in the facts, make whatever assumptions are necessary to resolve an issue.
4. If additional facts are needed, state what these facts are and why they are needed.
5. Write legibly and be as concise as possible.

Section B (Answer any four questions) (Full Marks = 20)

1. (a) Define Kronecker delta. [1]
(b) Write a short note on tensor giving emphasis on the rank of the tensor. [2]
(c) What are surface forces? State with examples. [2]
2. (a) Derive the equations of motion for a solid body under static equilibrium. [4]
(b) Under what conditions, does the equations of motion reduce to the equilibrium equations? [1]
3. Justify the statement "Tresca yield surface is an irregular hexagon and the von Mises yield surface is an ellipse for biaxial state of stress". [5]
4. Differentiate between the following
(a) Plane stress and plane strain conditions. [2]
(b) Hot rolling and cold rolling processes [3]
5. (a) What are the advantages and disadvantages of ring compression test? [3]
(b) What are the different types of metal forming lubricants? Describe with examples [2]
6. (a) If the flow curve of a material follows the empirical relationship represented by Hollomon equation, then show that at the point of maximum loading, the uniform true strain is equal to the strain hardening coefficient. [3]
(b) What is angle of bite in rolling? Deduce a relationship between the maximum draft, roll radius and angle of bite for unaided rolling. [2]
7. (a) Describe the dependence of the extrusion pressure on the type of extrusion with suitable graphs. [2]
(b) Show that the maximum reduction possible in a single pass during tube drawing with a mandrel is 63% when the friction coefficient at the die-tube interface and that at the tube-mandrel interface is equal. [3]
8. Write short notes on any two of the following with suitable sketches
(a) Bending Operation
(b) Isoforming
(c) Hydrostatic extrusion [2.5x2]
(d) Wire drawing
(e) Explosive forming



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