GUJARAT TECHNOLOGICAL UNIVERSITY
BRANCH NAME: Mechanical Engineering
SUBJECT NAME: Metal Forming Analysis
SUBJECT CODE: 2171913
B.E. 7th SEMESTER

Type of course: Engineering Science
Prerequisite: Zeal to learn the subject
Rationale:

Teaching and Examination Scheme:

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
<th>Credits</th>
<th>Examination Marks</th>
<th>Total Marks</th>
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<td>3</td>
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<td>2</td>
<td>5</td>
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Content:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Content</th>
<th>Total Hrs</th>
<th>% Weightage</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to hot forming, cold forming, warm forming its advantages and disadvantages, Typical stress strain diagram for ductile materials, Forming properties of metals and alloys (yield strength/flow stress, ductility, strain hardening, strain rate sensitivity, effect of temperature and hydrostatic pressure on yield strength), Classification of forming processes and advantages of metal forming</td>
<td>02</td>
<td>5</td>
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<td>2</td>
<td>Stress of stress at a point, stresses on an inclined plane, Principal stress, Two dimensional Mohr’s circle for stress analysis, Deformation and strain, Stress of strain at a point</td>
<td>03</td>
<td>10</td>
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<td>3</td>
<td>Yield conditions, Von Mises’ hypothesis of yielding, Tresca’s hypothesis of yielding, graphical representation of yield criteria, Elastic stress strain relations for isotropic elastic materials, Idealized stress strain relations in plastic deformations, Isotropic and kinematic work hardening</td>
<td>05</td>
<td>10</td>
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<td>4</td>
<td>Introduction to; (i). Theory of slip lines, (ii). upper bound theorem and (iii). lower bound theorem</td>
<td>03</td>
<td>10</td>
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<td>5</td>
<td>FORGING processes: Introduction, classification of forging, forging machines, metal flow in forging, Analysis of plane strain compression, analysis of compression of circular disc with slab method</td>
<td>06</td>
<td>15</td>
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<td>7</td>
<td>ROLLING Processes: Classification, types of mill, Analysis of longitudinal strip or sheet rolling process (calculation of roll separating force, torque &amp; power, angle of bite, maximum reduction in rolling), rolling defects, roll flattening, roll camber</td>
<td>06</td>
<td>15</td>
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Suggested Specification table with Marks (Theory):

<table>
<thead>
<tr>
<th>R Level</th>
<th>U Level</th>
<th>A Level</th>
<th>N Level</th>
<th>E Level</th>
<th>C Level</th>
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<tr>
<td>20</td>
<td>10</td>
<td>10</td>
<td>10</td>
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</tbody>
</table>

Legend: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

Course Outcome:
After learning the course the students should be able to:
- Identify various forming processes
- Identify and determine various methods rolling processes
- Identify and determine various methods to forging processes
- Identify and determine various methods to extraction processes
- Identify and determine various methods to Drawing processes
- Identify and determine various methods to Sheet metal forming processes

List of Experiments:
1. To construct a slip-line net for upsetting a work piece.
2. Experimental determination of stress strain behavior for ductile material and to evaluate the various elastic and plastic constants.
3. To analyze flow stress of the given material and to plot a graph of forging ratio vs. flow stress. Plot the bulge profile of the forged pieces, to find the radius of curvature of bulging of the forged pieces and to plot a graph of forging ratio vs. Hf / Rc.
4. To analyze the bending force vs. bending angle for ‘V’ bending of strip and to plot the strain distribution.
6. To measure the force required in extrusion of model material by using a die having different diameter and to draw the graphs between extrusion force vs. extrusion ratio.
7. To study the rolling process and plot the graph for percentage reduction in area vs. power in rolling.
8. Industrial visits for exposure to various metal forming processes and report preparation based on observations and learning.

**Design based Problems (DP)/Open Ended Problem:**
2. To plot the forming limit diagram and to study the effect of various strain paths on formability.
3. To review research paper on experimental strain measurement in sheet metal forming processes.

**Major Equipment:**
Various test setups can be developed over the period of time as UG project work or post graduate dissertations for performing experiments on related topics.

**List of Open Source Software/learning website:**
1. Code_Aster
2. AutoForm
3. CalculiX
4. www.nptel.ac.in

**ACTIVE LEARNING ASSIGNMENTS:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.