Team Project (120 Points)

Computer Integrated Manufacturing: New Product Development

Project Overview
In this project, the class will be divided into teams of three or four students. Each team will design a different and approved product, which should consist of six or more parts (eight or more parts for a four-member team). Teams should identify a project that requires design and implementation of a flexible manufacturing system (FMS) made up of at least the following sub-systems: machines/machining centers, MHS, measurement/inspection system, loading/unloading station, part washing station, and labor component. The project is expected to include some aspect of product design, documentation, web design (or a document/data-sharing system such as Google Docs), management, scheduling, process planning, CNC programming, tool design, facility layout, simulation, marketing and financing, prototyping, written and oral presentations.

Product Profile and Design (10 Points)
A product selected from the following product areas and approved by the instructor must be designed and produced by each team: Transportation, Recreational, and/or Material Handling in the form of Flatbed, Go-kart, or Bicycle. Team members must agree on the product before bringing their idea to the instructor for approval. Each student must own at least two of the six parts of the product. Before coming to the instructor, each student should determine and sketch their assigned parts on a sheet of paper. The attached project proposal sheet and all pertinent sketches must be filled and submitted to the instructor before a project can be approved. Each part must undergo at least five different processes. After instructor's approval, every one of these parts must be designed on a CAD system. Product documentation should include the student’s name, all individual parts, product structure diagrams, NC programs, the assembled product, a bill of materials, dimensioned drawings with title blocks, and geometric drawings.

Process Planning and Questions (10 Points)
Each student should do a process plan for the fabrication phase of all of his/her two parts using regular process (routing) sheets or other suitable tools. A computer-aided process planning (CAPP) technique is ideal. From your analysis, determine the following:

1) How much time it will take to produce only your parts based on the forecasted volume and using your chosen CIM systems and personnel.
2) How much time it will take to manually produce only your parts based on the forecasted volume if you replaced your automated FMS with manual operators.
3) How many operators it will take to manually produce only your parts in one month if you
replaced your automated FMS with manual operators. Assume only 8-hour daily shift.

4) How much it will cost your company in operator wages to produce only your parts in the one-month period. Assume manual production at $20/hour and no overhead etc.

**CNC Programs, Interpretations and Set-Up Sheet Explanation (10 Points)**

Each team member must produce at least two different programs used to machine either a portion of their assigned parts or a logo, emblem, or initials of choice on one or two of the group member’s parts. The programs must be free of errors, safe, and include appropriate codes and format. One of the programs must have interpretations of the first 20 program blocks to receive full credit. Manual or computer-generated programs are also acceptable but must be interpreted as specified here to receive credit. For long programs, print only the first two pages of each program. Also, a 2-3 paragraph explanation of set up sheet (preferred), tool path, or simulation is required here.

**Assigned Tasks (10 Points)**

In addition to the individual tasks of design, process planning, NC generation and interpretation, and part production, each team member must also accomplish some assigned tasks described in this section. These tasks include assembly drawing design, bill of materials creation, product structure diagram creation, tooling design, forecasting, scheduling, marketing brochure design, product cost estimation, inventory design, facility layout design, web site or Google Docs design, operation/assembly process chart design, and other managerial tasks listed under the headings in this section.

**Web Design, Google Doc, Database etc.:** One member of each team must design a networking web site, Google Docs, database or other appropriate storage and networking system to help manage the materials (data/information) and activities of its members. To keep the system’s materials current, an administrator must be designated to load and update the contents so members will be able to retrieve up-to-date information. At a minimum, the system must include the following information:

- members’ names and email addresses
- members’ assigned tasks and titles
- a full working schedule of the team’s project
- all assembly and parts drawings of the product with dimensions
- bill of materials
- product structure diagram
- process planning information (process charts and OPC/assembly charts)
- all manufacturing planning and control schedules (MPS, MRPs and DPSs)
- marketing information brochures and other documentation
- updated cost estimation sheet of the project
- facility layout (in all required formats) showing hardware arrangement (FMS) for the project
- all tooling drawings for the project including pictures of setups
- all NC program files needed to machine or fabricate all parts
- all set up sheets
- all necessary instructions relating to the project.

**Scheduling:** This project requires one of the team members to develop several schedules. The first one is a project schedule developed during the first group meeting when the group should generate a working schedule that contains all expected group activities and the specific times the group should be working on them. This schedule, whether it is a critical path method (CPM),
project evaluation and review technique (PERT), or any of the regular types, should be developed in a responsible manner as it will be guiding all the activities of the group and contributes to the points allotted to the project. The schedule should be designed to align with the class schedule provided. Failure to follow these schedules may result in lost points. To keep up with this schedule, instructor will be collecting bi-weekly status reports from each group member. These reports should be one-page, double-spaced, typed documents that show what each member did the previous two weeks toward the project, and are due during the first class meeting of the week or as required by instructor. Late reports are not accepted.

The second schedule is a one-month master production schedule for the team, which is generated from a three-month trend enhancement or moving average of 2600, 3100, and 3300 units respectively. The third schedule is a weekly, five-day material requirement plan (MRP) from which a fourth schedule (daily production schedule) is developed for each part to be produced by the team. Note that the weekly MRP and daily production schedules are developed by drawing from the information contained in the master production schedule.

Therefore, each team member must assume one of the following roles and associated assigned tasks, in addition to the requirements already described:

1. **Chief Design Engineer**: This person produces the following:
   - the group’s assembly drawings with clear titles and labels
   - bill of materials (BOM)
   - dimensioned facility design fully labeled
   - 3-D model of product for marketing documentation
   - product structure diagram
   - tooling drawings (jigs and fixtures), set up drawing/pictures (if needed) and any other graphics needed by the group
   - converts assembly design into format needed by other departments

2. **Chief Marketing Analyst**: This person produces the following:
   - determines market demand or forecasting
   - prepares master production schedule, MRPs and daily production schedules
   - produces all marketing brochures with 3-D model from Design Engineer
   - prepares a 3-D image of the facility which shows customers the look of the company
   - designs web site, Google Docs, or CIM information storage system
   - collects materials from team members and updates CIM system contents
   - determines comprehensive product cost estimation of project

3. **Chief Manufacturing Engineer**: This person produces the following:
   - prepares the operation/assembly process chart needed for assembling all the parts
   - supervises the machining or fabrication phase of other machine-related processes
   - determines and documents meaningful, comprehensive listings of inventories of tools, machines, workstations, hardware, instruments, and supplies needed to stock the facility.
   - if needed, fabricates all tooling needed by team
   - supervises and ensures that equipment and work area are cleaned after team’s use
   - supervises and ensures that tools and instruments are properly stored after team’s use in the labs
   - documents a facility layout design that uses different line colors/types to show all part
flows in the facility.

4. **Chief Operations Engineer**: This person produces the following:
   - Describes how the following operations are conducted in the company’s five branches located in three states and two countries:
     - Design
     - Production engineering
     - Sales and marketing
     - Supply chain management
   - Shows the layouts of the company’s five branches illustrating how cloud computing helps in integrating the information sharing for the company
   - Documents the following inventories of the company:
     - Personnel
     - Equipment
     - Offices
     - Suppliers
   - Documents the company’s waste stream analysis chart

**Log of Group’s Meetings (10 Points)**
Groups are expected to meet at least once every week. During the meetings, team member should take notes of their discussions, and keep notes of dates of meetings and attendance to these meetings. These notes and their dates should be typed out and placed in the portfolio as evidence (log) of the meetings. The notes should be detailed and informative. Instructor will also be observing these meetings and may attend any of them at any time.

**Compliance with Schedule (10 Points)**
As noted above, to keep up with the schedule, instructor will be collecting bi-weekly status reports from each group member. Groups are expected to meet at least once every week to plan and discuss the progress of their projects. Instructor will also be observing these meetings and may attend or call any of them at any time. At these meetings, the instructor will be checking the progress and compliance of members to their schedules and will be issuing points accordingly.

**Finished Product (20 Points)**
Each team must produce one complete and finished (assembled) product. Group members are expected to each produce their assigned parts. These parts must be assembled by the team members to form the completed product. The product will be graded for quality: completeness, specification, finish, fit, burrs, dents, safety, application, functionality, and so forth.

**Report (10 Points)**
A 2½-2-page, double-spaced written report is required from each student. The report should include the following (each with its own subheading or title): (1) A ¾-page description of all your individual activities and personal contributions to the whole project, including project idea and design, process planning, manufacturing planning, programming, web design and so forth, (2) ¾-page descriptions of two communication links the activities in your group assigned role had with the activities of the other group member-areas in this project relative to CIM (one link for each area), and (3) ¾-page of how you think your project can be improved to yield better productivity in the real world. Only your assigned contributions should be described. Each report should have the student’s name, assigned title, assigned parts’ names, and product name on the top right hand corner. All individual reports should be collected and bound into one report as
described in the portfolio section below.

**Oral Presentation (10 Points)**
Your group will be required to make a 15-20-minute oral presentation of your project. This presentation should include visual aids or appropriate graphics to illustrate your activities in the FMS design and operation. Each student will describe their undertakings and perform their relative demonstration to show how their areas relate to their product. Although optional, simulation and/or animation may also be used to demonstrate your system. **The products will also be featured and demonstrated.**

**Portfolio Content Organization and Submission (10 Points)**
The comprehensiveness of this project demands that each group submit their report in a well-bound portfolio: three-ring or professionally bound. All materials generated should be placed in a portfolio and their pages noted before submission. The project portfolio is due on the scheduled date (see class schedule). Most contents should be printed on standard letter-size paper. The only exception would be larger sheets if needed for readability in graphic drawings. However, larger sheets should still be folded such that they are nearly letter-size (no larger than 9"x 12" after folding). All photographs should normally be incorporated directly into the document as digital images printed on ordinary paper. The contents of each portfolio should be ordered as follows.

1. Cover Page that includes a title for the group, the course name, and the names and titles of everyone in the group.
2. A table of contents for the entire report
3. Approved proposal page
4. Log of group meetings with dates, attendance record, and typed details of each meeting
5. Individual Cover Sheet and Work for Chief Design Engineer
   a. Report for the Chief Design Engineer
   b. Individual parts design drawings from Chief Design Engineer
   c. Process charts of parts for the Chief Design Engineer
   d. Process planning answers for the Chief Design Engineer
   e. CNC programs, interpretations, set up sheet and set up sheet report from Chief Design Engineer
   f. Required attachments (documentation) from assigned tasks of the Chief Design Engineer

6. Individual Cover Sheet and Work for Chief Marketing Analyst
   a. Report for the Chief Marketing Analyst
   b. Individual parts design drawings from Chief Marketing Analyst
   c. Process charts of parts for the Chief Marketing Analyst
   d. Process planning answers for the Chief Marketing Analyst
   e. CNC programs, interpretations, set up sheet and set up sheet report from Chief Marketing Analyst
   f. Required attachments (documentation) from assigned tasks of the Chief Marketing Analyst

7. Individual Cover Sheet and Work for Chief Manufacturing Engineer
   a. Report for the Chief Manufacturing Engineer
   b. Individual parts design drawings from Chief Manufacturing Engineer
   c. Process charts of parts for the Chief Manufacturing Engineer
d. Process planning answers for the Chief Manufacturing Engineer

e. CNC programs, interpretations, set up sheet and set up sheet report from Chief Manufacturing Engineer

f. Required attachments (documentation) from assigned tasks of the Chief Manufacturing Engineer

8. Individual Cover Sheet and Work for Chief Operations Engineer
   a. Report for the Chief Operations Engineer
   b. Individual parts design drawings from Chief Operations Engineer
   c. Process charts of parts for the Chief Operations Engineer
   d. Process planning answers for the Chief Operations Engineer
   e. CNC programs, interpretations, set up sheet and set up sheet report from Chief Operations Engineer
   f. Required attachments (documentation) from assigned tasks of the Chief Operations Engineer

**Suggested Steps:**

1. Identify and select product from list provided; work on schedule
2. Do sketches and get instructor’s approval; work on schedule; work on database
3. Design a project schedule; also members design product parts; do process planning
4. Generate CNC programs; machine or fabricate parts; update database
5. Perform CAM tasks, generate set up sheets
6. Design ideal database or web site; perform assigned tasks as needed
7. Load and update database as needed; perform assigned tasks as needed; machine parts
8. Design and construct necessary tooling; perform assigned tasks as needed
9. Machine or fabricate parts; perform assigned tasks as needed; update database
10. Calculate answers to process planning questions; perform assigned tasks as needed
11. Write report and attach other materials; update database; machine or fabricate parts
12. Write report and attach other materials; update database; machine or fabricate parts
13. Do oral presentation and submit report
### Grading Criteria for Tech 149 Team Project (120 Points)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Points Possible</th>
<th>Group Members’ Names</th>
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<tbody>
<tr>
<td><strong>1. Portfolio Organization:</strong> Completeness, format, clear title page,</td>
<td>(10)</td>
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<tr>
<td>team members’ names, table of contents, detailed meeting log, sequenced</td>
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<td>and well-organized members’ reports, well bound etc.</td>
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<td><strong>2. Log of Group’s Meetings:</strong> Completeness, format, date, attendance,</td>
<td>(10)</td>
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<td>names, details of each meeting etc.</td>
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<td><strong>3. Compliance with Schedule:</strong> Availability, status report, participation</td>
<td>(10)</td>
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<td>in group, update, others.</td>
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<td>**4. Written Report (2 ½-3 pages): Completeness, format, grammar, spelling</td>
<td>(10)</td>
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<td>, content, clarity etc.</td>
<td></td>
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<td><strong>5. Product Design:</strong> Completeness, format, dimensioning, title, analysis,</td>
<td>(10)</td>
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<td>clarity, specs, etc.</td>
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<td><strong>6. Process Planning/Charts &amp; Questions:</strong> Completeness, format, clarity,</td>
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<td>analysis, correctness.</td>
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<td><strong>7. CNC Program, Interpretation, Set Up Sheets,</strong> Set Up Sheet Report:</td>
<td>(10)</td>
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<td>Completeness, correctness, safety, format, etc.</td>
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<td><strong>8. Facility Design, Layout &amp; Image:</strong> Completeness, correctness,</td>
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<td>clarity, safety, format, meaningful, labels, dimensions, etc.</td>
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<td><strong>8. Oral Presentation &amp; Demonstrations:</strong> Time, completeness, content,</td>
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<td>visual aids, clarity, outline, audibility, appearance, demo etc.</td>
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<td><strong>9. Assigned Tasks Documentation:</strong> Completeness, correctness, analysis,</td>
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<td>etc.</td>
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<td><strong>10. Finished Product:</strong> Completeness, specifications, fitness, Dents,</td>
<td>(20)</td>
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<td>sharp edges, finish, squareness, functionality, safety, etc.</td>
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<td><strong>Total Points Received out of 120</strong></td>
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Comments: ________________________________________________________________
_______________________________________________________________________
Project Proposal Form

Title or Name of Product: ___________________________________________________

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<thead>
<tr>
<th>Team Members</th>
<th>Responsibilities (Assigned Parts)</th>
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<td>3.</td>
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Requirements

Description of the project’s purpose, including number of parts, brief manufacturing processes and machines to be used.

*Draft CAD drawings for the overall assembly and for EACH part in the assembly. Only rough outer dimensions are required. (Attach Sketches)*

List of machine stations and specific tools required, including cutter/bit sizes, instruments and needed hardware.

List of raw materials and estimated size/quantity for each.

Instructor’s Approval: ____________________________________________________________