SAN LEANDRO UNIFIED SCHOOL DISTRICT
COURSE PROPOSAL

SECTION A. COVER PAGE

1. Course Title: Machine Technology	**7. Action** ☐ New Course ☒ Course Revision ☐ Title Change Only
2. Date Submitted: 10/13/14	**8. Grade Level** ☒ 9 ☒ 10 ☒ 11 ☒ 12
3. Transcript Title/Abbreviation(s)	**9. Prerequisites** (Please list.) ☐ Required ☒ Recommended Algebra, Geometry, Adv Algebra & Trig
4. Transcript Course Code/Course Number :	**10. Seeking Program Distinction?** ☐ YES (Check one below.) ☒ NO ☐ Honors ☐ AP ☐ Other
5. Subject Area Career Technical Education	**11. Is this a CTE course?** ☒ YES ☐ NO **If YES, complete Section C**
6. Department CTE	**12. Previously approved by UC?** ☐ YES ☒ NO Year approved Year removed
13. UC ELIGIBILITY **Already eligible?** ☐ YES ☐ NO a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☐ **Proposing eligibility?** ☒ YES ☐ NO a ☐ b ☐ c ☐ d ☐ e ☐ f ☐ g ☒ Please mark one for approved eligibility or proposed eligibility.	**14. Unit Value/Course Credit/Length of Course** ☐ 0.5 (semester or half-year ☒ 1.0 (one year equivalent) ☐ 2.0 (two-year equivalent) ☐ Other
15. School Contact: Name:aalvarez@slusd.us Phone:(510) 618-4600 ext 2502 Email:aalvarez@slusd.us Position:Teacher	
16. Signatures: Department Chair Principal:	**DISTRICT OFFICE USE ONLY** **Date approved by Board Curriculum Committee** 10-27-14 **Date approved by Board**

SECTION B. COURSE CONTENT

17. Course Description

This course teaches the principles of machining and metal cutting using modern machine tools, hand tools, and precision measuring tools. Students will learn to use all of the four basic machine tools: Lathe, vertical mill, drill press, and surface grinder. In addition, students will learn how to operate modern CNC equipment as used industrially in rapid prototyping and production. Students will apply elements of trigonometry, geometry, and algebra to identify and layout tapers and angles, and to compute part dimensions and tool speeds. Students will engage in individual and group assignments and projects using demonstrations, presentations, and written expositions. Students will keep a learning journal to keep track of their learned skills and progress.

Course Goals and/or Major Student Outcomes

1) Demonstrate safe and proven methods of shop procedures.
2) Operate a manual lathe correctly
3) Operate a manual milling machine correctly
4) Operate a drill press correctly
5) Operate a surface grinder correctly
6) Operate a pedestal grinder correctly
7) Use layout instruments to prepare parts for machining
8) Manually create a G-code program
9) Operate a CNC mill

18. Course Objectives (standards)

1. Demonstrate safe and proven methods of shop procedures.

Learning objectives

a. Identify the causes of accidents in the machine shop environment.
b. List the safety equipment required in shop operations.
c. List the safety rules for each piece of machine shop equipment.
d. Identify the conditions in the shop which could be considered hazardous.

Performance Standards

Competence will be demonstrated:

* in completion of assigned projects.
* in using correct tools for each task and using them correctly.

Criteria - Performance will be satisfactory when:

* learner practices recognized safety procedures in the shop at all times and always uses the prescribed safety equipment.
* learner demonstrates an ability and willingness to follow designated procedures.

2. Operate a manual lathe correctly.

Learning objectives

a. Set and adjust the lathe according to the desired outcome.
b. Calculate speeds and feeds correctly.
c. Complete 8 different assigned operations on a lathe.
d. Clean, lubricate, and maintain the lathe in accordance with operations sheet.

Performance Standards

Competence will be demonstrated:

* in completing assigned projects using the lathe and the necessary tools and measuring instruments.

Criteria - Performance will be satisfactory when:

* learner operates the lathe correctly.

* learner makes all of the lathe adjustments for speeds and feeds according to the requirement for each task.
* learner performs 8 standard lathe operations accurately and efficiently.

3. Operate a manual milling machine correctly.

Learning objectives

a. Set up and adjust the settings on the milling machine for the desired outcome.
b. Show the correct use of machine locks for various milling operations.
c. Demonstrate conventional and climb milling on vertical and horizontal milling operations.
d. Calculate spindle speeds and table feeds for a variety of machining conditions.
e. Mount different types of work holding devices to the machine table and align correctly.
f. Clean, lubricate, and maintain the milling machine in accordance with the operation sheet.

Performance Standards

Competence will be demonstrated:

* in setting up and operating the milling machines in the machine shop.
* in machining assigned projects to specifications.

Criteria - Performance will be satisfactory when:

* learner makes setups on the milling machine correctly.
* learner operates the milling machine correctly.
* learner performs all of the basic milling machine operations correctly.

4. Operate a drill press and other drilling equipment correctly.

Learning objectives

a. Set and adjust spindle speeds and feed rates for the requirements of the different drill press operations.
b. Perform 5 different drill press operations in fabricating assigned projects.
c. Identify all of the tools which are commonly used on the drill press.
d. Identify the parts of a drill.
e. Specify the different cutting fluids which should be used in drilling different materials.

Performance Standards

Competence will be demonstrated:

* in using the drilling machines in the machine shop.
* in completing assigned projects to specifications.

Criteria - Performance will be satisfactory when:

* learner correctly chooses cutting tools.
* learner makes proper machine set-ups.
* learner operates the machines safely and properly.
* learner performs all of the basic drilling machine operations satisfactorily.

5. Operate a precision surface grinder correctly.

Learning objectives

a. Interpret the numerical code on a grinding wheel and choose the correct wheel for the requirements of the job.
b. Describe the advantages and limitations of the different types of grinding coolants which are used on precision grinding machines.
c. Discuss the primary purpose and advantage of the different types of precision grinding machines.
d. Identify all of the controls on precision grinding machines and describe their use.
e. Demonstrate the correct use of the magnetic chuck for different grinding conditions.
f. Demonstrate the correct procedures for dressing a wheel on a surface grinder.
g. Clean, lubricate, and maintain the precision grinders correctly.

Performance Standards

Competence will be demonstrated:

* in correctly installing and dressing grinding wheels on the surface grinder.
* in using the surface grinder to complete assigned projects.

Criteria - Performance will be satisfactory when:

* learner sets up and operates the surface grinders correctly.
* learner installs and dresses grinding wheels correctly.
* learner produces 16 nm finishes and holds dimensional tolerances to within .0004".

6. Operate a pedestal grinder correctly.

Learning objectives

a. Interpret the numerical code on a grinding wheel and choose the correct wheel for the requirements of the job.
b. Identify the major components of the pedestal grinder.
c. Demonstrate the proper settings and adjustments on the grinder.
d. Prepare cutting tools via grinder operations.
e. Clean, lubricate, and maintain the grinder correctly.

Performance Standards

Competence will be demonstrated:

* in completing assigned projects on the grinder.
* by preparing high-speed steel cutting tools for use on the lathe, which conform to plan dimensions and that produce finished parts of the correct profile.

Criteria - Performance will be satisfactory when:

* learner sets and operates the grinder correctly.
* learner uses ground tools to produce lathe parts which pass inspection.

7. Demonstrate the ability to use layout instruments and do layout work by completing assigned projects.

Learning objectives

a. Describe the different types of surface plates and list their advantages.
b. Demonstrate the correct use of the height gage and surface gage.
c. Adjust the sliding Vernier scale on a height gage to set the scribe.
d. Scribe layout lines on a machined part to print specifications.

Performance Standards

Competence will be demonstrated:

* in using layout dye, surface plate, height gage, dividers, protractors, and angle blocks to produce a correct layout.

Criteria - Performance will be satisfactory when:

* learner does a completed layout of the assigned project.

8. Operate a CNC (Computer Numeric Control) milling machine correctly.

Learning objectives

a. Set up and adjust the tooling and offsets on the machine for the desired outcome.
b. Show the correct use of machine locks for various milling operations.
c. Demonstrate ability to use Cartesian coordinates to generate toolpaths; use toolpaths in conjunction with machine codes and general CNC commands to create a G-code program.
d. Calculate spindle speeds and table feeds for a variety of machining conditions.
e. Mount different types of work holding devices to the machine table and align correctly.
f. Clean, lubricate, and maintain the CNC milling machine in accordance with the operation sheet.

Performance Standards

Competence will be demonstrated:

* in setting up and operating the milling machines in the machine shop.
* in machining assigned projects to specifications.

Criteria - Performance will be satisfactory when:

* learner makes part and tooling setups on the CNC milling machine correctly.
* learner operates the CNC milling machine correctly.

19 . Course Outline

Unit 1:Safety

Help students learn about shop hazards and safety procedures. Students will learn correct procedures to work in the shop safely and efficiently.

1. Demonstrate safe and proven methods of shop procedures.

Learning Activities

1. Participate in a demonstration of shop procedures.
2. List the five most hazardous conditions for each machine tool.

Assessment Activities

1. Turn in the machine tool hazard list to the instructor.
2. Pass the machine shop safety test with a score of 90% or better.
3. Complete individual or group presentation using various media on working in the shop safely and efficiently

Unit 2: Layout and Measurement

Students learn how to layout parts using a surface plate, height gage, divider, layout dye, and prick punch. Also learn measurement and inspection using a micrometer, calipers, telescoping depth gage, gage blocks, bore gage, thread gage, and sine plate.

2. **Demonstrate the ability to use layout instruments and do layout work by completing assigned projects.**

Learning Activities

1. Learn precision part measurement and layout.
2. List the purpose and technique for using different measurement instruments.

Assessment Activities

1. Measure standardized parts against an existing plan to confirm readings.
2. Inspect subsequent parts against their plans to confirm adherence to specs.
3. Complete and present a graphic organizer and visual schematic representation using various forms of media as if to teach the key concepts of this lesson to another or to the class

Unit 3:Drill Press

Students will learn the fundamentals of drilling and drilling machinery.

3. Operate the drill press and other drilling equipment correctly.

Learning Activities

1. Identify the parts of the standard drill press.
2. Identify the parts of a drill bit.
3. Use drills and other drill press cutting tools to complete assigned projects.

Assessment Activities

1. Take a test on the material presented in class on drilling machine operations.
2. Write a presentation paper on the drill press project. Complete and present this project to class in various forms of media.

Drill Press Project

* **Calculate proper RPM based on tooling and materials.**
* **Demonstrate drilling, reaming, countersinking, counterboring, and tapping by selecting proper tools and operational sequence.**
* **Calculate proper drill sizes for tapping and reaming operations**

Unit 4:Tool Grinding

Students will learn the principles of tool grinding. Students will learn the procedures for wheel dressing, wheel maintenance, toolrest adjustment, and accurate grinding feeds.

4. Operate the pedestal grinders correctly.

Learning Activities

1. Complete assigned projects to specifications using precision grinding methods.

Assessment Activities

1. Take a test on grinding principles and procedures.
2. Write a presentation paper on the tool grinding project. Complete and present this project to class using various forms of media.

Grinding Tools for Lathe Turning and Threading

* **Develop understanding of cutting tool terminology, including clearance, rake and shear angles, and their purpose on cutting tools.**
* **Analyze tool failure based on improper grinding and overheating.**
* **Use protractor and center gage to correctly measure tool angles.**

Unit 5:Lathe

Students will learn the principles of the lathe and lathe operations and will perform eight basic lathe operations.

5. Operate all of the lathes correctly.

Learning Activities

1. Complete assigned projects which include turning, boring, facing, groove cutting, and external threading.

Assessment Activities

1. Write a presentation paper on the lathe project. Complete and present this project to class using various forms of media
2. Take a test on lathes and lathe operations.

Lathe Turning and Threading Project

* **Calculate proper speeds and feeds for appropriate lathe operations including turning, facing, center drilling, and threading.**
* **Demonstrate proper use of precision measuring tools, including dial calipers, micrometers, thread pitch micrometers, pitch gage, and thread wires.**
* **Calculate and select proper dimensions for cutting threads, including major, minor, and pitch diameters, thread relief, and chamfers.**

Unit 6:Mill

The purpose of this learning plan is to help students learn about the milling machine and the operations that can be done on the milling machine.

6. Operate a manual milling machine correctly.

Learning Activities

1. Identify all of the basic milling cutters and explain their use.
2. Complete the assigned milling projects.

Assessment Activities

1. Complete the test on milling machines and milling operations.
2. Write a presentation paper on the mill project. Complete and present this project to class using various forms of media.

Milling Angle Plate Project

*** Calculate proper speeds and feeds for appropriate milling operations, including use of facing mill, and mill, and drilling.**

*** Demonstrate proper calculations, use of layout tools, and use of an edge finder to locate the radius properly.**

Unit 7:Surface Grinding

Students will learn the principles of precision grinding. Students will learn the procedures for wheel dressing diamond truing, coolant usage, and accurate grinding feeds.

7. Operate the precision surface grinders correctly.

Learning Activities

1. Complete assigned projects to specifications using precision grinding methods.

Assessment Activities

1. Take a test on grinding principles and procedures.
2. Write a presentation paper on the surface grinding project. Complete and present this project to class using various forms of media

Unit 8:CNC

The purpose of this learning plan is to help students learn about a CNC machine and the operations that can be done using CNC technology.

8. Operate a CNC milling machine correctly.

Learning Activities

1. Generate toolpaths; create a G-code program.
2. Complete the assigned CNC projects.

Assessment Activities

1. Complete the test on CNC machines and G-code programming.
2. Turn in completed G-code program for evaluation
3. Write a presentation paper on the CNC machining project. Complete and present this project to class using various forms of media.

CNC Project

*** Map toolpaths based on a part plan; compute radii, offsets, and table travel using Cartesian coordinate planes. Manually generate G-code for project, to plan spec.**

*** Demonstrate proper tool setup, including tool offsets and machine axes zeroing, and proper warm-up cycles.**

*** Produce workpiece to spec.**

20. Instructional Materials:
Board approved required text

Precision Machining Technology (Hoffman, et.al; 2012. NIMS Press)

21. Supplementary materials

Operations Manual for Machine Tool Technology (Clifford Oliver; ND)
Machinery's Handbook, 26th ed. (Oberg, et.al; 2000. Industrial Press)

22. Key Assignments

Students will engage in individual and group assignments and projects using demonstrations, presentations, and written expositions. Students will keep a learning journal to keep track of their learned skills and progress.

1. Complete and present a graphic organizer and visual schematic representation using various forms of media as if to teach the key concepts of each lesson to another or to the class.

2. Write a presentation paper on key concept/s of each unit. Complete and present this project to class in various forms of media.

3. PROJECTS

Drill Press Project

*** Calculate proper RPM based on tooling and materials.**

*** Demonstrate drilling, reaming, countersinking, counterboring, and tapping by selecting proper tools and operational sequence.**

*** Calculate proper drill sizes for tapping and reaming operations**

4. Grinding Tools for Lathe Turning and Threading

*** Develop understanding of cutting tool terminology, including clearance, rake and shear angles, and their purpose on cutting tools.**

*** Analyze tool failure based on improper grinding and overheating.**

*** Use protractor and center gage to correctly measure tool angles.**

5. Lathe Turning and Threading Project

*** Calculate proper speeds and feeds for appropriate lathe operations including turning, facing, center drilling, and threading.**

*** Demonstrate proper use of precision measuring tools, including dial calipers, micrometers, thread pitch micrometers, pitch gage, and thread wires.**

*** Calculate and select proper dimensions for cutting threads, including major, minor, and pitch diameters, thread relief, and chamfers.**

6. Milling Angle Plate Project

*** Calculate proper speeds and feeds for appropriate milling operations, including use of facing mill, and mill, and drilling.**

*** Demonstrate proper calculations, use of layout tools, and use of an edge finder to locate the radius properly.**

7. CNC Project

*** Map toolpaths based on a part plan; compute radii, offsets, and table travel using Cartesian coordinate planes. Manually generate G-code for project, to plan spec.**

*** Demonstrate proper tool setup, including tool offsets and machine axes zeroing, and proper warm-up cycles.**

*** Produce workpiece to specs.**

23. Instructional Methods and/or Strategies

Classroom instructor will engage students in reading, writing, listening, and speaking. Connections to previously learned material or currently being learned material in Algebra, Geometry, and Trigonometry will be incorporated. Connections to actual workplace activities and career opportunities and projections will be emphasized in all discussions. The following tools will be utilized.

1. Instructor demonstration of procedures.
2. Lab work on assigned projects (i.e. project-based learning).
3. Individual and group expository writing on machine basics and procedures learned
4. Individual and group demonstration using various forms of media of skill in performing machine functions and operating various machine tools and equipment.

24. Assessment Methods and/or Tools

Assessments will include written and oral presentations using various forms of media. Demonstration of knowledge of operating the tools and machines learned during the lessons will also be assessed. Completion of assigned key projects to their specifications will also be evaluated. Furthermore, all project-based assignments will be based on the competency and performance indicators described below.

Unit 1

Competence will be demonstrated:

* in completion of assigned projects.

* in using correct tools for each task and using them correctly.

Criteria - Performance will be satisfactory when:

* learner practices recognized safety procedures in the shop at all times and alwaysuses the prescribed safety equipment.

* learner demonstrates an ability and willingness to follow designated procedures.

Unit 2

Competence will be demonstrated:

* in completing assigned projects using the lathe and the necessary tools and measuring instruments.

Criteria - Performance will be satisfactory when:

* learner operates the lathe correctly.

* learner makes all of the lathe adjustments for speeds and feeds according to the requirement for each task.

* learner performs 8 standard lathe operations accurately and efficiently.

Unit 3

Competence will be demonstrated:

* in setting up and operating the milling machines in the machine shop.

* in machining assigned projects to specifications.

Criteria - Performance will be satisfactory when:

* learner makes setups on the milling machine correctly.

* learner operates the milling machine correctly.

* learner performs all of the basic milling machine operations correctly.

Unit 4

Competence will be demonstrated:

* in using the drilling machines in the machine shop.

* in completing assigned projects to specifications.

Criteria - Performance will be satisfactory when:

* learner correctly chooses cutting tools.

* learner makes proper machine set-ups.

* learner operates the machines safely and properly.

* learner performs all of the basic drilling machine operations satisfactorily.

Unit 5

Competence will be demonstrated:

* in correctly installing and dressing grinding wheels on the surface grinder.

* in using the surface grinder to complete assigned projects.

Criteria - Performance will be satisfactory when:

* learner sets up and operates the surface grinders correctly.

* learner installs and dresses grinding wheels correctly.

* learner produces 16 nm finishes and holds dimensional tolerances to within .0004".

Unit 6

Competence will be demonstrated:

* in completing assigned projects on the grinder.

* by preparing high-speed steel cutting tools for use on the lathe, which conform to plan dimensions and that produce finished parts of the correct profile.

Criteria - Performance will be satisfactory when:

* learner sets and operates the grinder correctly.
* learner uses ground tools to produce lathe parts which pass inspection.

Unit 7

Competence will be demonstrated:

* in using layout dye, surface plate, height gage, dividers, protractors, and angle blocks to produce a correct layout.

Criteria - Performance will be satisfactory when:

* learner does a completed layout of the assigned project.

Unit 8

Competence will be demonstrated:

* in setting up and operating the milling machines in the machine shop.

* in machining assigned projects to specifications.

Criteria - Performance will be satisfactory when:

* learner makes part and tooling setups on the CNC milling machine correctly.

* learner operates the CNC milling machine correctly

25. Grading Policy

Attendance = 10%	Classwork including projects and project presentations = 75%
Exams = 15%	

24. Grading Policy

A = >90%	B = 89% - 80%	C = 79% - 70%
D = 69% - 60%	F = <60%	

SECTION C

26. Context for Course (optional)

REQUIRED FOR CTE COURSES

NOTE: In order to understand the context for a new course, sometimes it is helpful to understand the broader educational program and/or reform efforts of the school. How does this course fit into broader departmental and/or pathway structure? How does it fit into the overall school restructuring plans? Is the course intended to be a core course or supplemental? What are the student/school/community needs met by this course?

One of the reasons that Machine Technology has been redesigned is to refocus the curriculum from one where students were asked to make a series of adorable trinkets, into one derived from the college level, where students have to call upon important skills ancillary to machining -- such as complex problem solving, collaboration, trigonometry, geometry, algebra, reference consultation, and computer programming -- to produce an increasingly complex progression of parts within tolerance limits stated by plans, each requiring more machining skill than the last. For many students enrolled in Machine Technology, it is their second foray into the machine shop -- the first having been a one semester survey course intended for freshmen. Thus, it has a much more comprehensive curriculum, intended to make wider use of the modern, professional-grade equipment in the shop.

Machine Technology is supplemental to the overarching college preparatory curriculum of our school, but should be required for students enrolled in a planned Biotechnology Academy, because those students would then be able to utilize manual machining skills and professional-grade computer controlled machines (Computer Numeric Controlled mill and CNC router in Metal Tech; 3D printer in the Computer Aided Design lab) to produce prototypes and finished parts. The same logic applies to a Science/Technology/Engineering/Math academy presently in the discussion phase.

This course meets three main needs for students: It gives students planning on pursuing college degrees in engineering a leg up in admissions, it gives students who are kinesthetic learners the exposure to a field where job growth and economic advancement are proven, and it offers students the chance to apply abstract concepts (such as trigonometry, and the Cartesian coordinate system) in a practical setting. The school is served primarily by the fact that Machine Technology has traditionally been a haven for students who are not necessarily 4-year college bound straight out of high school, but who are well served by career technical education -- either as a direct pathway to a future vocation, or as entrée to further education in community college (some of whom, no doubt, will avail themselves of IGETC transfer opportunities to UC schools) or apprenticeship programs. Possibly the biggest beneficiary of Machine Technology programs (in general) is the community: As the American economy has picked up steam (confluent with the accelerating repatriation of manufacturing and the Silver Tsunami of millions of retiring Baby Boomers in the next three-to-five years), manufacturers, research facilities, industrial maintenance firms, public utilities, mass transit systems, and airlines (to name a few) are desperate to ensure that there is sufficient Machine Tech talent to continue fueling our growing economy. Machine Technology is serving an important role to help meet that need.

27. History of Course Development (optional)

REQUIRED FOR CTE COURSES

NOTE: Likewise, it is sometimes helpful know the origins of a course and who was involved in its development. Was this course modeled after another course at another school? If so, is that course UC approved? How does the course being submitted differ from the course after which it was modeled? Has this course received any special recognitions, designations or awards? Has it been articulated to local community colleges or universities?

This course is closely modeled on MACH210 at Laney College in Oakland, "Machine Technology I", and projects for the SLHS class were planned in consultation with Machine Technology instructor Louis Quindlen, Chairman of the CTE Department at Laney. The Machine Technology class also uses elements drawn from the National Institute for Metalworking Skills' Machining Level I credential series, and its textbook (Precision Machining Technology) is the primary text. The NIMS credential series is taught at Laney as Special Projects classses (MACH200). Furthermore, modules have been adapted from Laney's CSU-approved MACH30 ("Introduction to CNC Programming and CAD/CAM Technology") to teach fundamental Computer Numeric Control concepts commonly used in industry.

There are few differences between the Machine Technology and Laney Machine Tech I classes, the primary one being that the SLHS version is an amalgam of three different Laney courses (MACH30, MACH200, and MACH210). In addition, the original class at our high school spends much more time on safety instruction and presupposes that students have no previous experience with (or exposure to) to hand or power tools, whatsoever.

Although this course is not yet articulated to Laney (or Diablo Valley College), the process is underway to achieve both. We will also pursue certification from NIMS to allow our students who successfully complete the curricular and practical requirements of elements of their Machining Level I to receive certification for them.