新世纪

高职高专
数控技术应用类课程规划教材

数控技术专业英语

新世纪高职高专教材编审委员会组编
总主编 戴裕崴 主编 李桂云

大连理工大学出版社

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主　编　李桂云　　副主编　于海祥　高艳平

SHUKONG JISHU ZHUANYE YINGYU

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总　序

我们已经进入了一个新的充满机遇与挑战的时代，我们已经跨入了21世纪的门槛。

20世纪与21世纪之交的中国，高等教育体制正经历着一场缓慢而深刻的革命，我们正在对传统的普通高等教育的培养目标与社会发展的现实需要不相适应的现状作历史性的反思与变革的尝试。

20世纪最后的几年里，高等职业教育的迅速崛起，是影响高等教育体制变革的一件大事。在短短的几年时间里，普通中专教育、普通高专教育全面转轨，以高等职业教育为主导的各种形式的培养应用型人才的教育发展到与普通高等教育等量齐观的地步，其来势之迅猛，发人深思。

无论是正在缓慢变革着的普通高等教育，还是迅速推进着的培养应用型人才的高职教育，都向我们提出了一个同样的严肃问题：中国的高等教育为谁服务，是为教育发展自身，还是为包括教育在内的大千社会？答案肯定而且惟一，那就是教育也置身其中的现实社会。

由此又引发出高等教育的目的问题。既然教育必须服务于社会，它就必须按照不同领域的社会需要来完成自己的教育过程。换言之，教育资源必须按照社会划分的各个专业（行业）领域（岗位群）的需要实施配置，这就是我们长期以来明乎其理而疏于力行的学以致用问题，这就是我们长期以来未能给予足够关注的教育目的问题。

如所周知，整个社会由其发展所需要的不同部门构成，包括公共管理部门如国家机构、基础建设部门如教育研究机构和各种实业部门如工业部门、商业部门，等等。每一个部门又可作更为具体的划分，直至同它所需要的各种专门人才相对应。教育如果不能按照实际需要完成各种专门人才培养的目标，就不能很好地完成社会分工所赋予它的使命，而教育作为社会分工的一种独立存在就应受到质疑（在市场经济条件下尤其如此）。可以断言，按照社会的各种不同需要培养各种直接有用人才，是教育体制变革的终极目的。

随着教育体制变革的进一步深入，高等院校的设置是否会同社会对人才类型的不同需要一一对应，我们姑且不论。但高等教育走应用型人才培养的道路和走研究型（也是一种特殊应用）人才培养的道路，学生们根据自己的偏好各取所需，始终是一个理性运行的社会状态下高等教育正常发展的途径。

高等职业教育的崛起，既是高等教育体制变革的结果，也是高等教育体制变革的一个阶段性表征。它的进一步发展，必将极大地推进中国教育体制变革的进程。作为一种应用型人才培养的教育，它从专科层次起步，进而应用本科教育、应用硕士教育、应用博士教育……当应用型人才培养的渠道贯通之时，也许就是我们迎接中国教育体制变革的成功之日。从这一意义上说，高等职业教育的崛起，正是在为必然会取得最后成功的教育体制变革奠基。

高等职业教育还刚刚开始自己发展道路的探索过程，它要全面达到应用型人才培养的正常理性发展状态，直至可以和现存的（同时也正处在变革分化过程中的）研究型人才培养的教育并驾齐驱，还需要假以时日；还需要政府教育主管部门的大力推进，需要人才需求市场的进一步完善发育，尤其需要高职教学单位及其直接相关部门肯于做长期的坚忍不拔的努力。新世纪高职高专教材编审委员会就是由全国100余所高职高专院校和出版单位组成的旨在以推动高职高专教材建设来推进高等职业教育这一变革过程的联盟共同体。

在宏观层面上，这个联盟始终会以推动高职高专教材的特色建设为己任，始终会从高职高专教学单位实际教学需要出发，以其对高职教育发展的前瞻性的总体把握，以其纵览全国高职高专教材市场需求的广阔视野，以其创新的理念与创新的运作模式，通过不断深化的教材建设过程，总结高职高专教学成果，探索高职高专教材建设规律。

在微观层面上，我们将充分依托众多高职高专院校联盟的互补优势和丰裕的人才资源优势，从每一个专业领域、每一种教材入手，突破传统的片面追求理论体系严整性的意识限制，努力凸现高职教育职业能力培养的本质特征，在不断构建特色教材建设体系的过程中，逐步形成自己的品牌优势。

新世纪高职高专教材编审委员会在推进高职高专教材建设事业的过程中，始终得到了各级教育主管部门以及各相关院校相关部门的热忱支持和积极参与，对此我们谨致深深谢意，也希望一切关注、参与高职教育发展的同道朋友，在共同推动高职教育发展、进而推动高等教育体制变革的进程中，和我们携手并肩，共同担负起这一具有开拓性挑战意义的历史重任。

新世纪高职高专教材编审委员会

2001年8月18日

前言

《数控技术专业英语》是新世纪高职高专教材编审委员会组编的数控技术应用类课程规划教材之一。

本教材旨在使学生熟悉数控加工工艺、数控编程、数控机床操作与维护中常见的英文，为学生今后阅读相关的说明书及资料，掌握数控编程和操作及进一步学习打下良好的英语基础；本教材综合应用部分的内容能够拓宽学生的视野，有利于学生就业。

本教材在编写过程中力求突出以下特点：

1. 课文选取紧密结合专业课教学内容，篇幅适度，难易适中。

2. 精读部分由课文、词汇、注释、练习题等部分组成，每篇精读课文都有参考译文，练习题配有参考答案。

3. 泛读内容与精读课文一一对应，方便有兴趣学生进一步学习。

4. 根据课文内容，选择恰当的图片，使教材图文并茂，有助于学生更直观地理解教学内容。

5. 附录中列出了常用的G代码、M代码、缩略语和数控加工常用词汇，方便学生查找与使用。

本教材共分为四个单元，分别是数控加工工艺、数控编程、数控机床操作与维护以及综合应用。

本教材由李桂云任主编，于海祥、高艳平任副主编。具体编写分工如下：高艳平编写1.1、1.3、3.4、4.1、4.4；于海祥编写2.2、2.3、3.5；其余部分由李桂云编写。本教材由李桂云统稿。本教材在编写过程中得到了娄锐、冯艳红等老师的帮助。渤海船舶职业技术学院的杨宜莹老师审阅了全稿，并提出了许多宝贵的意见和建议，在此一并表示感谢。

本教材可以作为高职高专数控技术应用、模具制造、机械制造及自动化、机电一体化技术等专业的教学用书，也可以作为从事加工制造业的技术人员或操作者的参考书。

本教材如存在纰漏之处，敬请各相关高职高专院校和读者在使用本教材的过程中给予指正，并将改进意见及时反馈给我们，以便在下次修订时完善。

所有意见、建议请寄往：gzjckfb@163.com
联系电话：0411－84707604 84707492

编　者
2008年4月

目 录

Unit One

Technics of CNC Machining

1.1 Cutting Tools

Part A

Text

1.1.1 Cutting Tool Materials and Property

Cutting tools must possess certain mechanical properties in order to function adequately during the cutting operations. These properties include high hardness and the ability to retain it even at the elevated-temperatures generated during cutting. They also include toughness, abrasion resistance, and the ability to withstand high bearing pressures. A cutting material is selected to suit the cutting conditions, such as the workpiece material, cutting speed, production tare, coolants used and so on. The following are the commonly used cutting tool materials.

1. Plain carbon steel

Plain carbon steel contains 0.8 to 1.4 percent carbon and has no additives, and it is subjected to heat treatment to increase its hardness. Nevertheless, plain carbon steel is suitable only for making hand tools or when soft metals are machined at low cutting speeds, since it cannot retain its hardness at temperatures above 600 °F (300 ℃) due to tempering action.

2. Alloy steel

The carbon content of alloy steel is similar to that of plain carbon steel. Nevertheless, it contains alloying elements (in limited amounts), as the name suggests. Tools made of alloy steel must also be heat-treated and used only when machining is carried out at low cutting speeds. Again, the temperature generated as a result of cutting, should not exceed 600 °F (300 ℃) to avoid tempering action.

3. High-speed steel

High-speed steel (HSS) is a kind of alloy steel that contains a reasonable percentage of alloying elements, such as tungsten (18 percent), chromium (4 percent), molybdenum, vanadium, and cobalt. High-speed steel is heat-treated by heating (at two stages), cooling by

employing a stream of air, and then tempering it. Tools made of HSS can retain their hardness at elevated temperature up to 1100 ℉ (600 ℃).

4. Cemented carbides

The cemented carbide is usually composed of tungsten carbide, titanium carbide, or tantalum carbide and cobalt in various combinations. A typical composition of cemented carbide is 85 to 95 percent carbides of tungsten and the remainder cobalt.

Cemented carbides are the most widely used tool materials in the machining industry. They are particularly useful for cutting tough alloy steels which quickly break down high-speed tool steel. A large percentage of machining is on alloy steels for automotive and other industrial machine parts.

5. Diamond

Diamond pieces are fixed to steel and are used in precision cutting operations. They are recommended for machining aluminium, magnesium, titanium, bronze, rubber and polymer. When machining metallic materials, a mirror finish can be obtained.

1.1.2 Geometry of Cutting Tool

Figure 1-1-1 shows a typical cutting tool and the terminology used to describe it. The actual geometry varies with the type of work to be done.

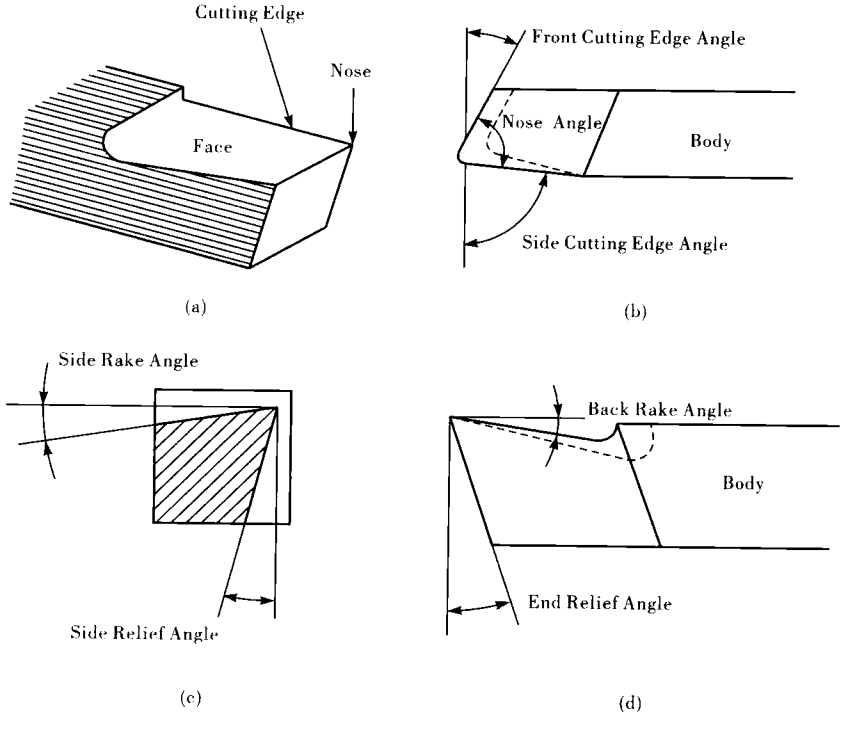

Fig. 1-1-1 Cutting tool terminology

The cutting part of cutting tool includes a face for passing chips and a flank directed to the workpiece. The intersecting face and flank form a cutting edge. The tool performance depends on its material and angles, the main of which include: nose angle, rake angle, relief angle (also called clearance angle) and cutting edge angle (front cutting edge angle and side cutting edge angle).

Rake angle decides the tartness degree of tool, the larger of the rake angle, the more tartness. Rake angles can be positive, negative, or zero. Its value usually varies between 0° and 15°, whereas the back rake angle is usually taken as 0°.

Relief angle serves to eliminate rubbing between the workpiece and the end flank. The degree of relief angle has important effect on surface quality of the workpiece. At the same time, relief angle affects the intensity of tool edge. It can also affect the tartness degree of tool. Usually, the values of each of these angles range between 4° and 6° (rough machining) or 8° and 12° (finishing machining).

1.1.3 Tooling System and Automatic Tool Changer

The production of a part involves the use of a variety of cutting tools, and the machine has to satisfy their use. The way in which a range of cutting tools can be located and securely held in position is referred to as a tooling system and is usually an important feature of the machine tool manufactures' advertising literature.

The tooling system for machining center is illustrated in Figure 1-1-2. Note the use of tool

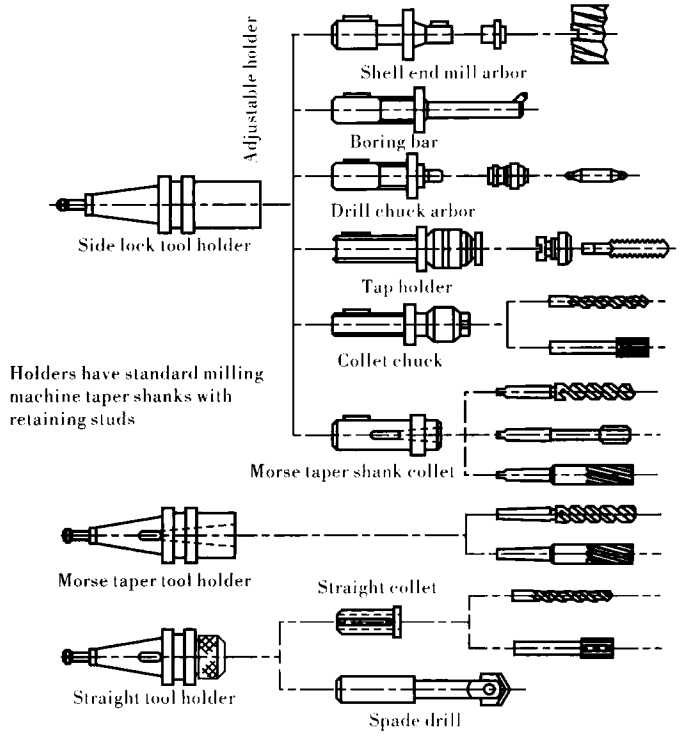

Fig. 1-1-2 The tooling system for machining center

holders with standard tapers, a feature that can be very helpful in keeping tooling costs to a minimum. A tooling system for a turning center will indicate the range of tooling which is accommodated on the machine. One such system is illustrated in Figure 1-1-3.

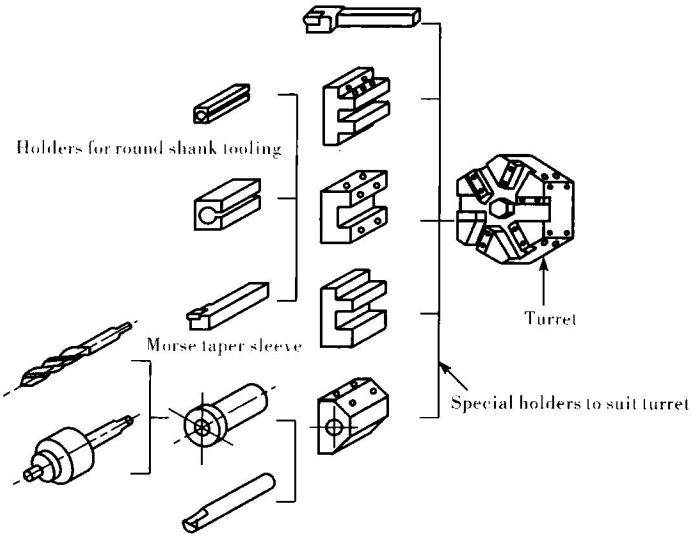

Fig. 1-1-3 A tooling system for a turning center

For automatic tool changer, cutting tools need to be stored at the machining center so that the desired tool can be selected according to the part program. These tools are usually stored on drum or chain type of magazines. 16 ~ 24 tools magazines are quite common but 150 tools capacity are also available. The drum type of tool storage magazine is shown in Fig. 1-1-4. The chain magazine (Fig. 1-1-5) is also mounted on the top or the side of the machine tool on certain type. The magazine does not move in this case, instead, the movement of spindle and slides brings the tool to the desired positions.

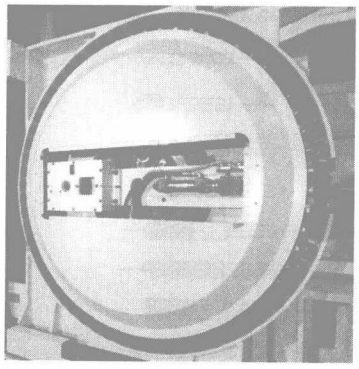

Fig. 1-1-4 The drum type of tool storage magazine

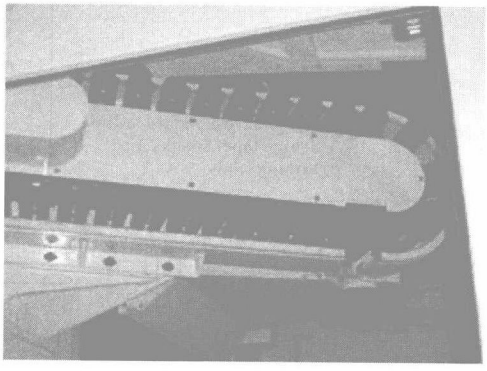

Fig. 1-1-5 The chain type of tool storage magazine

1.1.4 Cutting Fluids

1. Functions of cutting fluids

Cutting fluids have been used extensively in machining operations to achieve the following results:

(1) reducing friction and wear, thus improving tool life and the surface finish of the workpiece;

(2) cooling the cutting zone, thus improving tool life and reducing the temperature and thermal distortion of the workpiece;

(3) reducing forces and energy consumption;

(4) flushing away the chips from the cutting zone, and thus prevent the chips from interfering with the cutting process, particularly in operations such as drilling and tapping;

(5) protecting the machined surface.

Depending on the type of machining operation, the cutting fluid needed may be a coolant, a lubricant, or both. The effectiveness of cutting fluids depends on a number of factors such as the type of machining operation, tool and workpiece materials, cutting speed, and the method of application. Water is an excellent coolant and can reduce effectively the high temperatures developed in the cutting zone.

2. Types of cutting fluids

Three general types of cutting fluids are commonly used in machining operations:

(1) Synthetic oils

Synthetic oils are typically used for low-speed operations where temperature rise is not significant.

(2) Emulsions

Emulsions are a mixture of oil, water and additives, generally are used for high-speed operations because temperature rise is significant. The presence of water makes emulsions very effective coolants.

(3) Synthetics

Synthetics are chemicals with additives, diluted in water, and contain no oil.

3. Selection of cutting fluids

In selecting a cutting fluid, one should consider whether the machined component will be subject to stress and adverse effects. This consideration is important particularly for cutting fluids with sulfur and chlorine additives. Cutting fluids may also affect adversely the machine tool components, thus their compatibility with various metallic and nonmetallic materials in the machine tool must be considered. The selection of a cutting fluid should also include biological and environmental considerations.

New Words and Phrases

possess /pə'zes/ v. 拥有，持有
property /'prɒpəti/ n. 性质，特性
toughness /'tʌfnɪs/ n. 韧性，坚韧，刚性，健壮性
abrasion /ə'breɪʒən/ n. 磨损
withstand /wið'stænd/ v. 抵挡，经受住
tare /teə/ n. 毛重
additive /'ædətɪv/ n. 添加剂
retain /rɪ'teɪn/ v. 保持，保留
nevertheless /ˌnevəðə'les/ conj. 然而，不过 adv. 仍然，不过
alloy /'ælɔɪ/ n. 合金
element /'elɪmənt/ n. 要素，元素，成分
percentage /pə'sentɪdʒ/ n. 百分数，百分率，百分比
tungsten /'tʌŋstən/ n. [化]钨
chromium /'krəʊmɪəm/ n. [化]铬
molybdenum /mə'lɪbdɪnəm/ n. [化]钼
vanadium /və'neɪdɪəm/ n. [矿]钒，铅矿
cobalt /'kəʊbɔ:lt/ n. [化]钴
cemented carbides 硬质合金
titanium /taɪ'teɪnɪəm/ n. [化]钛
tantalum /'tæntələm/ n. 钽(金属元素)
fix /fɪks/ v. 使固定
aluminium /ˌælə'mɪnɪəm/ n. [化]铝
magnesium /mæg'ni:zɪəm/ n. [化]镁
bronze /brɒnz/ n. 青铜
rubber /'rʌbə/ n. 橡皮，橡胶
polymer /'pɒlɪmə/ n. 聚合体
metallic /mɪ'tælɪk/ adj. 金属(性)的
chip /tʃɪp/ n. 碎片，切屑
intersect /ˌɪntə'sekt/ v. 横断 vi. (直线)相交，交叉
flank /flæŋk/ n. 侧面
angle /'æŋgl/ n. [数]角
nose angle 刀尖角
rake /reɪk/ n. (刀具的)前角
relief angle (刀具的)后角
clearance angle(刀具的)后角
cutting edge angle 偏角
side relief angle 旁锋后让角，副后角

tartness /tɑːtnɪs/ n. 锋利
literature /ˈlɪtərɪtʃə/ n. 文学(作品), 文献
taper /ˈteɪpə/ n. 锥形, 锥度
vary /ˈveəri/ v. 改变, 变更, 使多样化
indicate /ˈɪndɪkeɪt/ v. 指出, 显示, 象征
drum /drʌm/ n. 鼓, 鼓声, 鼓形圆桶
tool magazine 刀具库
fluid /ˈfluːɪd/ n. 流动性, 流度
drilling /ˈdrɪlɪŋ/ n. 钻孔
tapping /ˈtæpɪŋ/ n. 攻丝
coolant /ˈkuːlənt/ n. 冷冻剂, 冷却液, 散热剂
emulsion /ɪˈmʌlʃən/ n. 乳状液
synthetics /sɪnˈθetɪks/ [用作复]人工合成(绝缘)材料
stress /stres/ n. 重压, 压力
chlorine /ˈklɔːriːn/ n. [化]氯
biological /baɪəˈlɒdʒikəl/ adj. 生物学的
adverse /ˈædvɛːs/ adj. 不利的, 敌对的, 相反的
sulfur /ˈsʌlfə/ n. [化] 硫磺, 硫黄
compatibility /kəmˌpætɪˈbɪlɪti/ n. [计]兼容性

Exercises

Ⅰ. Translate the following phrases into Chinese.

1. high hardness _____
2. elevated-temperature _____
3. production tare _____
4. hand tool _____
5. abrasion resistance _____
6. the ability to withstand high bearing pressures _____
7. cutting speed _____
8. plain carbon steel _____
9. heat treatment _____
10. alloy steel _____
11. high-speed steel _____
12. tungsten carbide _____
13. nose angle _____
14. relief angle _____
15. standard taper _____

Ⅱ. Answer the following questions briefly according to the text.

1. Why is plain carbon steel suitable only for making hand tools or when soft metals are machined at low cutting speeds?
2. What is the typical composition of cemented carbide?
3. What material is diamond recommended for machining?
4. What function is the rake angle?
5. What function is the relief angle?
6. Which rake angle is usually taken as 0°?
7. Why do the tool holders use standard tapers?
8. What is the function of the cutting fluid in the cutting zone?
9. What does the selection of a cutting fluid should include?

Ⅲ. Mark the following statements with T (true) or F (false).

( ) 1. Plain carbon steel is not suitable for making hand tools or when soft metals are machined at low cutting speeds.

( ) 2. Tools made of alloy steel must also be heat-treated and used only when machining is carried out at low cutting speeds.

( ) 3. The tool performance depends on its material and angles.

( ) 4. Rake angles can be positive, negative, but not zero.

( ) 5. The intersecting face and flank form a cutting edge.

( ) 6. Relief angles determine the direction of flow of the chip onto the face of the tool.

( ) 7. A tooling system for a turning center does not have to indicate the range of tooling.

( ) 8. Water is an excellent coolant and can reduce effectively the high temperatures developed in the cutting zone.

( ) 9. Cutting fluid is another name of coolant.

( ) 10. Tool is nothing to the effectiveness of cutting fluids.

( ) 11. Cutting fluids may also affect adversely the machine tool components.

Ⅳ. Fill in the blanks according to the text.

1. Cutting tools must possess certain mechanical properties in order to _____ during the cutting operations.
2. The carbon content of alloy steel is _____ to that of plain carbon steel.
3. Plain carbon steel contains 0.8 to 1.4 percent _____ and has no _____.
4. High-speed steel (HSS) is a kind of _____ that contains a reasonable percentage of alloying elements.
5. Cemented carbides are the most _____ used tool materials in the machining industry.
6. Diamond pieces are fixed to _____ and are used in _____ cutting opera-

tions.

7. The intersecting face and flank form a _____.
8. It is the _____ angle that has the dominant influence on cutting.
9. The value of rake angle usually varies between _____ and _____.
10. The way in which a range of cutting tools can be located and securely held in position is referred to as _____.
11. Depending on the type of machining operation, the cutting fluid needed may be a _____, a _____ or both.

Part B

Reading Material

1.1.1

Cermets (from the words ceramic and metal) were first used in the early 1950s and consist of ceramic particles in a metallic matrix[1]. They were introduced in the 1960s and are black or hot-pressed ceramics.

Typical cermets consist of 70% aluminium oxide and 30% titanium carbide[2]; other cermets contain molybdenum carbide, niobium carbide, and tantalum carbide. Although they have chemical stability and resistance to built-up-edge formation, the brittleness and high cost of cermets have been a limitation to their wider use[3]. Further refinements of these tools have resulted in improved strength, toughness, and reliability. Their performance is somewhere between that of ceramics and carbides and has been particularly suitable for light roughing cuts and high-speed finishing cuts, chip-breaker features are important for cermets inserts. Although they can be coated, the benefits of coated cermets are somewhat controversial, as the improvement in wear resistance appears to be marginal[4].

1.1.2

There are three basic types of metal cutting tools: single-point tools, multi-point tools and abrasives[5]. A single-point metal cutting tool has a single cutting edge and is used for turning, boring, shaping and planning. The most common machine tools have two or more cutting edges such as drills, reamers and milling cutters. The cutting edge is that part of the tool where cutting is actually done. Grinding wheels are an example of abrasive cutting tools. Each grinding wheel has a lot of abrasive grains, which act as very cutting tools[6].

1.1.3

Generally speaking, automatic tool changers for machining centers fall into three basic categories: single-arm tool transfer system, double-arm tool transfer system, and turret-style tool