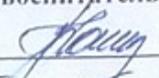


Министерство сельского хозяйства Российской Федерации

ФГБОУ ВО Тверская ГСХА

«УТВЕРЖДАЮ»

Проректор по учебной
и воспитательной работе

 Г.В. Бочаров
« 26 »  2016г.

РАБОЧАЯ ПРОГРАММА ДИСЦИПЛИНЫ

ПЕРЕВОДЧЕСКАЯ ПРАКТИКА (наименование дисциплины)

Направление подготовки: программа дополнительного профессионального образования «Переводчик в сфере профессиональной коммуникации»

Квалификация (степень) выпускника: переводчик в сфере профессиональной коммуникации

Форма обучения – очная

г. Тверь – 2016 г.

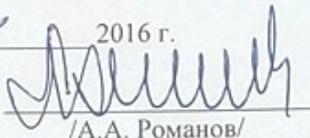
Автор: к.ф.н., доцент кафедры теории языка и межкультурной коммуникации А.В. Стасюк

Программа рассмотрена на заседании кафедры теории языка и межкультурной коммуникации

« 12 » 04 2016 г.

Протокол № 9

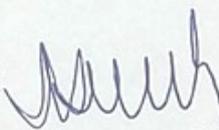
Зав. кафедрой


/А.А. Романов/

Программа одобрена на заседании предметно-методической комиссии кафедры теории языка и межкультурной коммуникации

« 12 » 04 2016 г, протокол № 9

Председатель предметно-методической комиссии кафедры ТЯиМК


/А.А. Романов/

1. Вид практики, способ, форма ее проведения

Вид практики	учебная
Тип практики	по закреплению и развитию умений и навыков
Способ проведения	стационарная
Формы проведения	дискретно
Место проведения	Кафедра ТЯиМК

2. Цель и задачи практики

Целями ознакомительной практики являются:

- закрепление и конкретизация результатов теоретической подготовки;
- развитие иноязычной (межкультурной) профессионально ориентированной коммуникативной (профессионально-коммуникативной) компетенции, позволяющей учащимся в дальнейшем интегрироваться в мультиязыковую и мультикультурную профессиональную среду
- развитие переводческой компетенции, позволяющей осуществлять в рамках владения иностранным языком полный (реферированный) письменный перевод (с иностранного на русский язык).

Задачи практики:

- научиться осуществлять предпереводческий анализ текста, определять цель перевода, характер его рецепторов и тип переводимого текста;
- научиться выбирать общую стратегию перевода с учетом его цели и типа оригинала, осуществлять письменный (в ограниченном объеме – устный) перевод текстов, относящихся к сфере основной профессиональной деятельности;
- научиться использовать основные способы и приемы достижения смысловой, стилистической адекватности;
- научиться правильно оформлять текст перевода в соответствии с нормами и узусом, типологией текстов на языке перевода;
- научиться профессионально пользоваться словарями, справочниками, базами данных и другими источниками дополнительной информации;

3. Перечень планируемых результатов обучения при прохождении практики, соотнесенных с планируемыми результатами освоения образовательной программы

Код компетенций	Планируемые результаты освоения ОПОП (компетенции)	Планируемые результаты обучения при прохождении практики
ПК-11	владеть основными способами достижения эквивалентности в переводе и способностью применять основные приемы перевода;	уметь - осуществлять письменный перевод с соблюдением норм лексической эквивалентности, соблюдением грамматических, синтаксических и стилистических форм; - находить в русском языке эквиваленты терминам исходного языка или создавать новые термины, пользуясь соответствующей справочной литературой; - определять соотношения языка оригинала и языка перевода, сходства и расхождения на уровнях их языковых систем, языковых норм,

		речевых (узуальных) норм;
ПК-12	владеть навыками осуществления письменного перевода с соблюдением норм лексической эквивалентности, соблюдением грамматических, синтаксических и стилистических норм языка;	<p>уметь</p> <ul style="list-style-type: none"> - анализировать лексико-грамматическую природу и структурно-семантическое построение английских терминов и их интерпретацию на русском языке; - привлекать и анализировать факторы коммуникативной ситуации перевода для понимания коммуникативного замысла автора и логики изложения высказывания; - создавать переведенный текст на основе понятого исходного текста с учетом различий в лингвистическом, прагматическом, социокультурном, предметном потенциале отправителя и получателя текста, а также дискурсивных и жанровых особенностей текстов по специальности в исходном языке и языке перевода;
ПК-13	владеть способностью аккумулировать научно-техническую информацию, отечественный и зарубежный опыт в области автоматизации технологических процессов и производств, сферы профессиональной коммуникации	<p>уметь</p> <ul style="list-style-type: none"> - работать с электронными словарями и другими электронными ресурсами для решения лингвистических задач; - оформлять перевод в соответствии с требованиями Государственного стандарта; - анализировать и корректировать переведенный текст с учетом выбранной стратегии перевода.

4. Место практики в структуре ОП ДПО

Практика относится к разделу «Практики» ОП ДПО. Практика проводится в 4 семестре согласно плану.

Дисциплины общего и специального циклов «Практический курс иностранного языка», «Основы теории иностранного языка», «Теория перевода» являются предшествующими для освоения компетенций практики.

Переводческая практика является предшествующей для специальных дисциплин «Практический курс профессионально-ориентированного перевода», «Практикум».

5. Объем и содержание практики

5.1 Объем практики

В соответствии с учебным планом трудоемкость практики составляет 162 часа. Продолжительность практики 3 недели.

5.2. Содержание практики

Модули, разделы, темы, виды работ	Код формируемой компетенции
Подготовительный этап	ПК-11, ПК-13

1. Разработка плана практики. 2. Подбор материала для осуществления перевода. 3. Инструктаж по технике безопасности.	
Основной этап 1. Выполнение студентом письменного перевода оригинального текста объемом не менее 10 машинописных страниц, принадлежащего к любому функциональному стилю, кроме стиля художественной литературы, и подготовка готового перевода к публикации.	ПК-11, ПК-12, ПК-13
Завершающий этап 1. Подготовка отчета по практике.	ПК-12, ПК-13

Подготовительный этап

1. Разработка плана практики.
2. Подбор материала для осуществления перевода.
Выбор оригинального неадаптированного текста профессиональной направленности объемом не менее 10 страниц машинописного текста.
3. Инструктаж по охране труда и пожарной безопасности.
Общие сведения об охране труда, организационно-правовые вопросы охраны труда, требования к безопасности в учебном процессе, пожарная безопасность, оказание первой доврачебной помощи при несчастных случаях.

Основной этап.

Письменный перевод оригинального текста объемом не менее 10 машинописных страниц, принадлежащего к любому функциональному стилю, кроме стиля художественной литературы, и подготовка готового перевода к публикации.

Завершающий этап

Подготовка отчета по практике.

6. Формы отчетности по практике

Формы промежуточной аттестации по итогам практики: зачет.

Форма отчетности по практике: Отчет по переводческой практике.

Рекомендуемый объем отчета составляет до 25-27 страниц формата А4 машинописного текста. Отчет по практике является основным документом студента, отражающим, выполненную им работу во время практики, полученные им переводческие навыки и умения. Материалы отчета студент в дальнейшем будет использовать в своей работе.

В отчет включается:

- титульный лист
- содержание;
- оригинальный неадаптированный текст профессиональной направленности в объеме не менее 10 машинописных страниц;
- перевод текста на русский язык;
- заключение;
- список использованной литературы.

7. Фонд оценочных средств для проведения промежуточной аттестации обучающихся по практике.

7.1. Перечень компетенций с указанием этапов их формирования в процессе освоения образовательной программы

№ п\п	Наименование компетенции	Код компетенции
1.	владеть основными способами достижения эквивалентности в	ПК-11

	переводе и способностью применять основные приемы перевода;	
2.	владеть навыками осуществления письменного перевода с соблюдением норм лексической эквивалентности, соблюдением грамматических, синтаксических и стилистических норм языка;	ПК-12
3.	владеть способностью аккумулировать научно-техническую информацию, отечественный и зарубежный опыт в области автоматизации технологических процессов и производств, сферы профессиональной коммуникации.	ПК-13

Этапы формирования компетенций в ходе практики, соотнесенные с общими этапами формирования компетенций

Этап	Содержание этапа	Вид практики
2 этап	приобретение и развитие практических умений и навыков (уметь) - осуществлять письменный перевод с соблюдением норм лексической эквивалентности, соблюдением грамматических, синтаксических и стилистических форм	учебная
3 этап	закрепление теоретических знаний, умений и практических навыков (владеть) - методикой подготовки к выполнению перевода, включая поиск информации в справочной, специальной литературе и компьютерных сетях; - навыками извлечения необходимой информации из оригинального текста на иностранном языке.	учебная

Уровни освоения компетенций

Сформированность компетенции в рамках прохождения практики оценивается по трехуровневой шкале:

- *пороговый* уровень является обязательным для всех обучающихся по завершении практики (при освоении более 51% приведенных умений и навыков), в противном случае компетенция считается неосвоенной;
- *достаточный* уровень характеризуется превышением минимальных характеристик сформированности компетенции по завершении практики (при освоении более 75% приведенных умений и навыков);
- *повышенный* уровень характеризуется максимально возможной выраженностью компетенции (при освоении более 90% приведенных умений и навыков).

Шифр компетенции	Уровень освоения	Уметь	Владеть
ПК-11	пороговый	находить в русском языке эквиваленты терминам исходного языка или создавать новые термины, пользуясь соответствующей справочной литературой;	необходимым запасом иностранных слов, терминов, используемых в профессиональной коммуникации;
	достаточный	осуществлять письменный перевод с соблюдением норм лексической эквива-	иноязычной терминологией и навыками письменного перевода специальных текстов с

		лентности, соблюдением грамматических, синтаксических и стилистических форм;	иностранного языка на русский;
	повышенный	определять соотношения языка оригинала и языка перевода, сходства и расхождения на уровнях их языковых систем, языковых норм, речевых (узуальных) норм;	навыками извлечения необходимой информации из оригинального текста на иностранном языке;
ПК-12	пороговый	- анализировать лексико-грамматическую природу и структурно-семантическое построение английских терминов и их интерпретацию на русском языке;	иноязычной терминологией и навыками письменного перевода специальных текстов с иностранного языка на русский;
	достаточный	привлекать и анализировать факторы коммуникативной ситуации перевода для понимания коммуникативного замысла автора и логики изложения высказывания;	в сопоставительном плане общенаучной лексикой и узкоспециальной лексикой, представляющей соответствующую сферу профессиональной деятельности, на исходном языке и языке перевода;
	повышенный	создавать переведенный текст на основе понятого исходного текста с учетом различий в лингвистическом, прагматическом, социокультурном, предметном потенциале отправителя и получателя текста, а также дискурсивных и жанровых особенностей текстов по специальности в исходном языке и языке перевода;	системой лингвистических знаний, включающей в себя знание основных фонетических, лексических, грамматических, словообразовательных явлений и закономерностей функционирования изучаемого иностранного языка, его функциональных разновидностей;
ПК-13	пороговый	работать с электронными словарями и другими электронными ресурсами для решения лингвистических задач;	методикой оформления текста перевода в компьютерном текстовом редакторе;
	достаточный	оформлять перевод в соответствии с требованиями Государственного стандарта;	методикой подготовки к выполнению перевода, включая поиск информации в справочной, специальной литературе и компьютерных сетях.
	повышенный	анализировать и корректировать переведенный текст с учетом выбранной стратегии перевода.	навыками извлечения необходимой информации из оригинального текста на иностранном языке.

7.2. Описание показателей и критериев оценивания компетенций на различных этапах их формирования, описание шкал оценивания

При проведении переводческой практики осуществляется получение профессиональных умений и опыта профессиональной деятельности. При оценке обучающихся по результатам переводческой практики используются показатели, отражающие типовые виды учебных действий обучающихся:

№ действия	Виды учебных и трудовых действий обучающегося
1	Ответ на основной вопрос
2	Перевод текста
3	Ответ на дополнительный вопрос

Критерии оценки действия №1 - ответа на основной вопрос

№ п/п	Параметр	Оценка
1	Обучающийся владеет научной терминологией, свободно излагает материал, ответ логичный и полный	3
2	Обучающийся владеет научной терминологией, достаточно свободно излагает материал, ответ логически выстроен, но недостаточно полный	2
3	Обучающийся владеет общенаучной терминологией, в ответе есть неточности, ответ недостаточно полный	1

Критерии оценки действия №2 - качество перевода текста

№ п/п	Параметр	Оценка
1	Обучающийся разносторонне проанализировал ситуацию. Обучающийся перевел весь текст, не допустил ошибки. Предложил обоснованные переводческие решения. Обучающийся привел примеры эффективности аналогичных решений.	3
2	Обучающийся разносторонне проанализировал ситуацию. Обучающийся перевел весь текст, допустил не более двух ошибок. Предложил обоснованные переводческие решения.	2
3	Обучающийся поверхностно проанализировал ситуацию. Обучающийся перевел текст, допустил более трех ошибок. Не предложил обоснованные переводческие решения.	1

Критерии оценки действия №3 - ответов на дополнительные вопросы

№ п/п	Параметр	Оценка
1	Полный перевод текста	3
2	Перевод текста недостаточно полный или содержащий неточности	2
3	Перевод текста недостаточно корректный, но проявлено стремление к поиску верного перевода с помощью преподавателя.	1

3 этап: При проведении переводческой практики, осуществляется получение и закрепление переводческих умений и навыков.

Для оценки результатов прохождения переводческой практики определены следующие показатели и критерии оценки:

- качество оформления отчетной документации и своевременность представления руководителю практики от Академии;
- качество выполнения всех видов деятельности, предусмотренных программой практики;
- качество доклада и ответов на вопросы.

№ п/п	Критерии оценки	Количество баллов
1	Своевременность представления отчета	до 5
2	Полнота и качество оформления отчета	до 10
3	Содержание отчета и его соответствие программе практики	до 25
4	Доклад на защите, ответы на вопросы	до 25
Общее максимальное количество баллов		75

Шкала пересчета

0-37 баллов	«неудовлетворительно»
38-55 баллов	«удовлетворительно»
56-66 баллов	«хорошо»
67-75 баллов	«отлично»

7.3. Типовые контрольные задания или иные материалы, необходимые для оценки умений, навыков и (или) опыта деятельности, характеризующих этапы формирования компетенций в процессе освоения образовательной программы

7.3.1. Контрольные задания или иные материалы, применяемые на втором этапе (этапе приобретения и развития практических умений) формирования компетенций

Перечень контрольных вопросов для оценки теоретической подготовленности студентов к прохождению переводческой практики.

1. Единицы перевода.
2. Языковые соответствия полные, частичные соответствия, безэквивалентные языковые единицы, способы их перевода.
3. Критерии адекватности перевода.
4. Критерий соответствия нормам функционального стиля и жанра.
5. Критерий единства экспрессивной и эмоциональной окраски текста-оригинала и перевода.
6. Переводческие трансформации.
7. Наиболее частотные лексические и грамматические трансформации при переводе.
8. Стилистический аспект перевода – учет речевого регистра, жанра и стиля текста.
9. Стилистические приемы, «фигуры речи», способы их перевода.
10. Понятие основной, коммуникативно иррелевантной и избыточной информации.
11. Адекватное воспроизведение основной информации за счет компрессии иррелевантной и избыточной информации.

12. Редактирование перевода, устранение семантических и стилистических погрешностей.
13. Оформление перевода в соответствии с государственным стандартом.
14. Работа с наиболее распространенными электронными словарями.

<i>Номера контрольных вопросов (ситуаций) из общего перечня</i>		
<i>Пороговый уровень</i>	<i>Достаточный уровень</i>	<i>Повышенный уровень</i>
<i>№№ 1, 4, 7, 12, 14</i>	<i>№№ 1-3, 6-9, 12-14</i>	<i>№№ 1-14</i>

7.3.2. Контрольные задания или иные материалы, применяемые на третьем этапе (этапе закрепления теоретических знаний, умений и практических навыков) формирования компетенций

Примерный перечень текстов для оценки практических навыков и умений при прохождении переводческой практики

The Role of Culture in Economic Development

How Flat is the World?

"The world is flat," Thomas Friedman has famously declared. His claim is that in this modern age of globalization, when capital can cross national borders so easily, when investment funds can be pulled from one country to another instantaneously to respond to new business opportunities, economic development is attainable in the most surprising of places. Today, as never before in the past, economic growth should be within the reach of any country anywhere in the globe.

All that is required for the golden fruit to flower, it would seem, is to have the door open to investment and the phone at hand. Naturally, there are conditions to be met to attract investment dollars (or yuan or yen or Euros or pesos). But given a stable government, the assurance that the rule of law will be upheld, and an investor-friendly climate, any country should be a position to become the new Singapore—a nation powered by steady economic growth.

The hitch is that not all needy nations are able to meet these conditions. In some parts of the world, in fact, almost none are—as if some toxic substance in the soil makes it impossible for economies to take root there. But even if most of the primary conditions are met—in other words, the government is responsible and the country has the official welcome mat out for foreign businessmen—there may other factors that make investors shake their heads and walk off with the decision to drop their money somewhere else. Perhaps the world isn't flat, after all. Possibly there are ingredients for economic development, more far-reaching and subtler than the conditions usually prescribed, that touch on the national ethos and its traditions. In other words, economic development might well be affected by those intangibles that are collectively known as culture.

Flirtation of Economics with Culture

Economics, once known as "the dismal science," has come a long way since its early days. The discipline, relying on its scientific formulas and precise metrics, has patented a storehouse of remedies for ailing economies. Yet it doesn't seem to know what to do with a concept as untidy as culture.

It wasn't always this way, though. Back in its earliest days, economics had plenty of room for the vagaries of human behavior. Adam Smith, sometimes regarded as the founder of modern economics, argued in his classic work *Wealth of the Nations* (written in 1776) that each individual, motivated by the pursuit of his own interests, contributes to the public interest in a system that is self-regulating. Smith was keen-sighted enough to recognize that the "pursuit of personal interests" involved much more than just making money. Hence, his tract, "Theory of Moral Sentiments", deals with what today we would call cultural values. John Stuart Mill, writ-

ing 70 years later, made the same point when he noted that cultural constraints on individuals could have a stronger impact on them than the pursuit of personal financial gain.

Max Weber, the German social scientist writing in the early 20th century, offered more specific insights into how cultural or even religious values could impact on economic output. He argued that the Protestant work ethic, supported by Reformation teachings that the pursuit of wealth was a duty, inculcated the virtues needed for maximum economic productivity. For this reason, Protestants were more productive than Catholics throughout Europe—just think of Germany and Great Britain, for instance, compared to Ireland, Spain, Portugal and Italy in his day.

In the meantime, the worldview of economists was radically changing. Economic progress was now a given, as the discipline shed its grim premise, first enunciated by Thomas Malthus in the 18th century, that population growth doomed people to a declining standard of living. Malthus believed that total wealth was a constant—there was only so much land and a strict limit to the resources it could produce, after all—and that most of the world's population would inevitably be reduced to fighting over the scraps from the table. The remarkable growth in the economies of the United States and many European countries during the 19th century, however, provided evidence that a different set of assumptions was needed. Economic theory was subsequently guided by a new insight: there was not simply a fixed amount of wealth, but an ever expanding economic pool to draw from. This meant, for one thing, that those nations that had little industrialization and whose people lived a largely subsistence life could join the more highly developed nations at the table. In theory, there would be plenty for everyone to eat.

After having offered hope to the underdeveloped that they could join the party, economics seems to have narrowed its field of vision since the 1930s and dedicated its energies largely to generating ever more sophisticated formulas relating to such things as markets, rents, income policies, price stability, and inflation control. It has also been busy refining its set of mathematical tools to test the theories that the discipline has been generating. Its principal interest has been in measuring the impact of different strategies on financial and economic crises so as to develop a dependable set of guidelines for predicting and managing these crises.

But as it has been doing all this, it appears that its interest in culture has been waning. Its presupposition seems to be that *Homo economicus*, no matter where he happens to be dwelling, is subject to the same ineluctable laws of supply and demand, maximization of profit, and pricing. The apparatus it's devised to analyze and manage economic situations are self-contained and have little room for the vagaries of human behavior. Today, ironically enough, with the prophets of globalization proclaiming new hope for nations struggling to pull themselves out of poverty, economics has little to offer them on how this might be done. In short, the discipline's abandonment of its early fascination with culture has rendered it speechless to those who most need its help today.

Culture Does Seem to Matter

Why do some countries do very well, while others fail to develop, even when all the requisite economic factors seem to be in place? How can we explain the repeated failure of African nations, even when aid is given in great supply, to develop their economy? Why are countries like Indonesia and the Philippines, even with a strong resource base and a well educated population, so resistant to development? For that matter, what is there to explain the slow economic growth rates of the Pacific nations?

Most development economists might explain these inequalities by appealing to the list of conditions that must be met for an economy to develop. Good governance is seen as a prerequisite of development: the political system should be stable; laws must be clearly promulgated and enforced so that contractual agreements will be honored; and government officials should not be corrupt or inefficient. Moreover, land should be available at a fair rate for business opportunities; foreign investment should be encouraged; and the bureaucratic procedures for applying for a business permit should not be too onerous.

There may be something to be said for this list, but it still doesn't deal with the more fundamental issue of how culture impacts on development. Why do some ethnic groups do so

well in business that they leave others in the dust, even when these ethnic groups are minorities in other cultures? Amy Chua raises this question in her much acclaimed book *World on Fire*.

In her work we learn that ethnic Chinese in the Philippines, accounting for less than two percent of the population, control 60% of the nation's private economy, including the country's four major airlines and almost all the country's banks, hotels and shopping malls. But it's not just in the Philippines that Chinese ethnic minorities have made their mark. They have come to dominate business in other parts of Southeast Asia as well-especially Indonesia, Thailand, Burma and Malaysia. Even closer to home, Chinese have distinguished themselves in the Solomons, Tonga, and in Majuro, triggering occasional reactions from the local populations.

Chinese are far from the only group to achieve such success. As Chua points out in her book, no matter where we look around the world, we will find examples of what she calls "dominant minorities"-ethnic groups that have demonstrated a remarkable ability to succeed in business wherever they may live. The Lebanese have become the entrepreneurs in Sierra Leone and other parts of West Africa, while Indians have assumed the same reputation in East Africa. In Russia, six of the seven billionaires following the privatization of public resources less than a decade ago were Jewish.

Clearly, some ethnic groups seem to be far more successful in business than others. Unfortunately, their financial success can incite violent retaliation against these groups, for they are usually small minorities in their adopted countries. During the last two decades, just as globalization was being trumpeted as the big leveling force through the world, uprisings have occurred in one country after another to strip the dominant business minorities of their economic power. Many of these sought to redress the imbalance by expropriation of holdings, expulsion of ethnic minorities, or worst of all by genocidal wars. Apart from the enormous human suffering generated by the conflicts themselves, further misery followed.

Even so, the summons to a globalization that will offer all ethnic groups equal opportunity continues to ring out.

Why the Differences?

If some cultural groups seem to do better than others, what would explain the differences? The real intent of this question, of course, is to discover what might be done to compensate for these differences and cancel the competitive disadvantages that some cultures seem to bear in this age of globalization.

The inequality of cultures is one of the themes explored by Gregory Clark in his recent *Farewell to Alms*, which he subtitles *A Brief Economic History of the World*. It was no accident, he argues, that the Industrial Revolution occurred in Great Britain and not some other nation. Although his book is more concerned with the antecedents of the Industrial Revolution than the transforming impact of this landmark event on subsequent history, he points out that it gave rise to what he calls the "Great Divergence." The Industrial Revolution may have brought about enormous changes in production technology, but it left many nations impoverished just as it made others wealthy. After the mid-19th century, the heyday of the Industrial Revolution, the differences in national income and standard of living around the globe became even greater than they ever had been before, Clark points out, and the differences continue to widen with each passing decade.

Why was Britain in a unique position to give birth to the Industrial Revolution? And why did the effects of the Industrial Revolution vary so greatly from one part of the globe to another, from one nation to another? Clark maintains that Britain's development was not a sudden leap forward that was propelled by the invention of a few power-driven machines. It was gradual, he maintains, taking place over the course of several hundred years prior to the 19th century. In his way of thinking, the Industrial Revolution would have never occurred had it not been for the changes in values that were happening for centuries before. From the High Middle Ages on, following the Magna Carta in the 13th century that limited royal authority, Britain had the stable political, legal and economic institutions so often touted as the preconditions for economic growth.

But such institutions of themselves do not generate economic progress, Clark maintains. Stable political institutions, a reliable legal system, predictable land values and functioning

markets were the necessary but not sufficient conditions for the economic take off Britain experienced when new sources of power were harnessed. They did, however, lead to the gradual development of precisely that set of deep cultural changes, especially a sense of competitiveness and a strong work ethic, that was required if sudden technological breakthroughs were to have any real impact on the society. The data that the author presents to us offers a picture of a society that was losing its taste for violence even as its homicide rate was dropping, a society with high population growth among the well-to-do, one in which people had to work hard and long to gain a competitive advantage over their peers, a society that was increasingly literate and patient. These traits served people so well in Britain.

All of this predated the Industrial Revolution, Clark points out, so that when the steam engines and other new means of production were developed in the early 19th century, the British could utilize them to expand their economy many times over. By contrast, when India was introduced to the technology later in the 19th century, the results were far different. The power-driven cotton mills that had spurred such a startling economic burst in Britain were introduced to India but never offered the country the same competitive advantage. The productivity of British mill workers, thanks to the very traits that Clark has described for us, was so far greater than that of their Indian counterparts.

So, in the end, it was people and the values they had absorbed over the years, not the power-driven mills or any other form of advanced technology, that had made the difference.

Closer to Home

Many parts of the world have been written off as resistant to development. We may think of most of Africa, parts of Latin America, the Middle East, and a few of the countries in Southeast Asia. Of course, many of these countries still lack the reliable institutions, beginning with stable government and the rule of law, that are a requisite for development according to today's canon. Then there is the Pacific, which has shown disappointing economic growth rates over the past decade or two. If the authors we have cited are on the right track in suggesting that historical antecedents of a people produce a cluster of values and beliefs that foster economic development, then it might be enlightening to measure Micronesian island societies against this cluster.

Belief in the importance of individual effort. Island societies have never been distinguished for individualism or the belief system that encourages it. They have been better known for the communalism and the subordination of the individual to group interests that this demands.

Trust. This may range in societies according to how elaborate the suprafamilial institutions were. In groups like Pohnpei, Yap and Palau, political and social institutions were relatively well developed in traditional times. On the other hand, people from smaller, unstratified societies may not have developed trust in broader institutions, much as the Sicilians in Italy did not.

Generalized morality. By this is meant the application of ethical standards to all, not just those in one's immediate kin group. This may have varied by locality, but was probably not pronounced in traditional times. However, the pressure to develop such a standard intensified everywhere following the advent of Christianity.

Autonomy. This has never been especially high on the list of virtues in island society. In fact, island life is slanted in the opposite direction-toward conformity, in keeping with strategies needed for survival in a small isolated community.

Ethic of hard work. Persistent work done for long hours day after day and week after week was not regarded as a value traditionally. Island life could demand feverish outbursts of hard work, but such an outburst was almost always followed by a long period of relaxation. This reflects the fact that work needed for survival was limited to a few hours a day. After all, Pacific Islanders did not have to spend all day in the fields plowing and planting as Asians and others were required to do.

Thrift. This was associated with niggardliness, which was perceived as a fault rather than a virtue in island life. Instead, the investment in social capital-in the form of contributions to a community feast or tribute to a chief-demanded lavish generosity.

Overall, Micronesia, like the rest of the Pacific, probably does not rank very high in those cultural value and attitudes that have been identified as helpful in promoting economic development today. This is not an indictment of Micronesia or the other Pacific Island cultures. Nor is it to suggest that these islands suffer from corruption or political instability or some of the other problems that plague less fortunate countries in other parts of the world. Indeed, the traditional Micronesian value cluster was clearly well suited to survival in small islands in the past. Yet, the same value set that allowed islanders to maintain harmony and support one another throughout good times and hard times in the past is not equally well suited to building a modern economy. In other words, Micronesia simply does not enjoy the same cultural advantages that led Britain to prosperity after the Industrial Revolution .

What Would It Take?

What would it take to develop the set of values that a line of authors, extending from Adam Smith to contemporary economists, see as fundamental conditions for achieving real economic development? Must we wait centuries for this to happen, as Britain and the US did, or can this process be accelerated?

Improved education for the population is an almost automatic response, as Amy Chua points out, but she admits that research on the impact of education does not support the conclusion that this will work. She goes on to point out that much more work needs to be done on the interplay of culture with economic success, and writes that even if the relationship between the two were pinpointed, leveling the playing field between ethnic groups "will be a painfully slow process, taking generations if it is possible at all."

Gregory Clark offers evidence to support his conviction that the path to economic development is to increase worker output, whether in a textile mill or a computer lab. He traces the steady rise of Japanese worker output against that of Indian mill employees during the early years of the 20th century, showing that by the 1930s Japan had outproduced India and had come to dominate the market. The greater efficiency of Japanese workers during this time was a result of their strong discipline, which in turn stemmed from their cultural values.

A growing number of authors seem to agree that economic growth will take more than an infusion of investment capital, more than an import of the latest technology, even more than dependable political and economic institutions. A constellation of cultural values suited for modern business seems to be a critical ingredient as well, although no one has identified these values with precision, to say nothing of devising a strategy for inculcating these values in developing populations. For now, we can only conclude that in the contest for economic development the playing field is far from level. The world is not nearly as flat as Friedman exuberantly proclaimed.

Meanwhile, the small nations of Micronesia are not left hanging in the wind. They enjoy substantial dollar amounts of aid from the US, access to the US for those who can not find employment at home, and a measure of successful business in the islands. What they do not enjoy, however, is the cultural climate that is deemed essential in order to turn the islands into a whirlwind of economic activity and to stimulate the level of growth that outsiders had hoped to witness.

At present in Micronesia, money is viewed as a means to more meaningful ends than simply expanding one's financial wealth. In island culture strictly economic considerations are limited by other considerations, ones that individuals often judge to offer them greater personal advantages than multiplying their money. These considerations fall under three headings: security, status and solidarity.

Security often takes the form of land, regarded throughout the Pacific as the last fallback and possibly the most important currency of wealth. For a person to trade off his own land for the opportunity to make a modest killing in a business venture could present a serious problem for many islanders.

Status may be the motivation when an individual forgoes a business opportunity to make a large contribution toward a church or community event. The payoff for the individual is an increase in prestige, or a higher position in society

Solidarity, or sense of belonging, is the purpose of remitting a portion of one's earnings to a relative in order to strengthen the family cohesion that is so vital to islanders.

None of this is reprehensible, but neither does it reflect the value set that will create millionaires and promote the rapid growth that the islands seek today. Although entirely reasonable to island people, choices like these can be mystifying to consultants in that they seem to flout what should be irresistible economic incentives so as to achieve other trivial gains. But what is "trivial" from one cultural viewpoint is not necessarily so from another. Here is where cultural values impact on economic choices, where an island-oriented cost-benefit analysis defies what outsiders would consider "common sense." Here, too, is where the conversation on economic development must begin.

But what happens when Micronesians are plucked from their own cultural soil and are transplanted in the US? What is the effect of this relocation on the set of cultural values that tend to inhibit economic development? The tens of thousands of Micronesians who have emigrated to the US to find jobs and a new home there could provide a population sample for research into the speed with which cultural values changes. A study of these emigrants could offer insights into the impact of their new cultural surroundings on these islanders, even as it helps us answer the question of whether the cultural changes needed to improve economic development can be accelerated.

Economics in One Lesson Public Works Mean Taxes

1

There is no more persistent and influential faith in the world today than the faith in government spending. Everywhere government spending is presented as a panacea for all our economic ills. Is private industry partially stagnant? We can fix it all by government spending. Is there unemployment? That is obviously due to "insufficient private purchasing power." The remedy is just as obvious. All that is necessary is for the government to spend enough to make up the "deficiency."

An enormous literature is based on this fallacy, and, as so often happens with doctrines of this sort, it has become part of an intricate network of fallacies that mutually support each other. We cannot explore that whole network at this point; we shall return to other branches of it later. But we can examine here the mother fallacy that has given birth to this progeny, the main stem of the network.

Everything we get, outside of the free gifts of nature, must in some way be paid for. The world is full of so-called economists who in turn are full of schemes for getting something for nothing. They tell us that the government can spend and spend without taxing at all; that it can continue to pile up debt without ever paying it off, because "we owe it to ourselves." We shall return to such extraordinary doctrines at a later point. Here I am afraid that we shall have to be dogmatic, and point out that such pleasant dreams in the past have always been shattered by national insolvency or a runaway inflation. Here we shall have to say simply that all government expenditures must eventually be paid out of the proceeds of taxation; that to put off the evil day merely increases the problem, and that inflation itself is merely a form, and a particularly vicious form, of taxation.

Having put aside for later consideration the network of fallacies which rest on chronic government borrowing and inflation, we shall take it for granted throughout the present chapter that either immediately or ultimately every dollar of government spending must be raised through a dollar of taxation. Once we look at the matter in this way, the supposed miracles of government spending will appear in another light.

A certain amount of public spending is necessary to perform essential government functions. A certain amount of public works—of streets and roads and bridges and tunnels, of armories and navy yards, of buildings to house legislatures, police, and fire departments—is necessary to supply essential public services. With such public works, necessary for their own sake, and defended on that ground alone, I am not here concerned. I am here concerned with public works considered as a means of "providing employment" or of adding wealth to the community that it would not otherwise have had.

A bridge is built. If it is built to meet an insistent public demand, if it solves a traffic problem or a transportation problem otherwise insoluble, if, in short, it is even more necessary than the things for which the taxpayers would have spent their money if it had not been taxed away from them, there can be no objection. But a bridge built primarily “to provide employment” is a different kind of bridge. When providing employment becomes the end, need becomes a subordinate consideration. “Projects” have to be invented. Instead of thinking only where bridges must be built, the government spenders begin to ask themselves where bridges can be built. Can they think of plausible reasons why an additional bridge should connect Easton and Weston? It soon becomes absolutely essential. Those who doubt the necessity are dismissed as obstructionists and reactionaries.

Two arguments are put forward for the bridge, one of which is mainly heard before it is built, the other of which is mainly heard after it has been completed. The first argument is that it will provide employment. It will provide, say, 500 jobs for a year. The implication is that these are jobs that would not otherwise have come into existence.

This is what is immediately seen. But if we have trained ourselves to look beyond immediate to secondary consequences, and beyond those who are directly benefited by a government project to others who are indirectly affected, a different picture presents itself. It is true that a particular group of bridgeworkers may receive more employment than otherwise. But the bridge has to be paid for out of taxes. For every dollar that is spent on the bridge a dollar will be taken away from taxpayers. If the bridge costs \$1,000,000 the taxpayers will lose \$1,000,000. They will have that much taken away from them which they would otherwise have spent on the things they needed most.

Therefore for every public job created by the bridge project a private job has been destroyed somewhere else. We can see the men employed on the bridge. We can watch them at work. The employment argument of the government spenders becomes vivid, and probably for most people convincing. But there are other things that we do not see, because, alas, they have never been permitted to come into existence. They are the jobs destroyed by the \$1,000,000 taken from the taxpayers. All that has happened, at best, is that there has been a diversion of jobs because of the project. More bridge builders; fewer automobile workers, radio technicians, clothing workers, farmers.

But then we come to the second argument. The bridge exists. It is, let us suppose, a beautiful and not an ugly bridge. It has come into being through the magic of government spending. Where would it have been if the obstructionists and the reactionaries had had their way? There would have been no bridge. The country would have been just that much poorer.

Here again the government spenders have the better of the argument with all those who cannot see beyond the immediate range of their physical eyes. They can see the bridge. But if they have taught themselves to look for indirect as well as direct consequences they can once more see in the eye of imagination the possibilities that have never been allowed to come into existence. They can see the unbuilt homes, the unmade cars and radios, the unmade dresses and coats, perhaps the unsold and ungrown foodstuffs. To see these uncreated things requires a kind of imagination that not many people have. We can think of these nonexistent objects once, perhaps, but we cannot keep them before our minds as we can the bridge that we pass every working day. What has happened is merely that one thing has been created instead of others.

2

The same reasoning applies, of course, to every other form of public work. It applies just as well, for example, to the erection with public funds of housing for people of low incomes. All that happens is that money is taken away through taxes from families of higher income (and perhaps a little from families of even lower income) to force them to subsidize these selected families with low incomes and enable them to live in better housing for the same rent or for lower rent than previously.

I do not intend to enter here into all the pros and cons of public housing. I am concerned only to point out the error in two of the arguments most frequently put forward in favor of public housing. One is the argument that it “creates employment;” the other that it creates wealth which would not otherwise have been produced. Both of these arguments are false, because

they overlook what is lost through taxation. Taxation for public housing destroys as many jobs in other lines as it creates in housing. It also results in unbuilt private homes, in unmade washing machines and refrigerators, and in lack of innumerable other commodities and services.

And none of this is answered by the sort of reply which points out, for example, that public housing does not have to be financed by a lump sum capital appropriation, but merely by annual rent subsidies. This simply means that the cost is spread over many years instead of being concentrated in one. It also means that what is taken from the taxpayers is spread over many years instead of being concentrated into one. Such technicalities are irrelevant to the main point.

The great psychological advantage of the public housing advocates is that men are seen at work on the houses when they are going up, and the houses are seen when they are finished. People live in them, and proudly show their friends through the rooms. The jobs destroyed by the taxes for the housing are not seen, nor are the goods and services that were never made. It takes a concentrated effort of thought, and a new effort each time the houses and the happy people in them are seen, to think of the wealth that was not created instead. Is it surprising that the champions of public housing should dismiss this, if it is brought to their attention, as a world of imagination, as the objections of pure theory, while they point to the public housing that exists? As a character in Bernard Shaw's *Saint Joan* replies when told of the theory of Pythagoras that the earth is round and revolves around the sun: "What an utter fool! Couldn't he use his eyes?"

We must apply the same reasoning, once more, to great projects like the Tennessee Valley Authority. Here, because of sheer size, the danger of optical illusion is greater than ever. Here is a mighty dam, a stupendous arc of steel and concrete, "greater than anything that private capital could have built," the fetish of photographers, the heaven of socialists, the most often used symbol of the miracles of public construction, ownership, and operation. Here are mighty generators and power houses. Here is a whole region lifted to a higher economic level, attracting factories and industries that could not otherwise have existed. And it is all presented, in the panegyrics of its partisans, as a net economic gain without offsets.

We need not go here into the merits of the TVA or public projects like it. But this time we need a special effort of the imagination, which few people seem able to make, to look at the debit side of the ledger. If taxes are taken from people and corporations, and spent in one particular section of the country, why should it cause surprise, why should it be regarded as a miracle, if that section becomes comparatively richer? Other sections of the country, we should remember, are then comparatively poorer. The thing so great that "private capital could not have built it" has in fact been built by private capital—the capital that was expropriated in taxes (or, if the money was borrowed, that eventually must be expropriated in taxes). Again we must make an effort of the imagination to see the private power plants, the private homes, the typewriters and radios that were never allowed to come into existence because of the money that was taken from people all over the country to build the photogenic Norris Dam.

3

I have deliberately chosen the most favorable examples of public spending schemes—that is, those that are most frequently and fervently urged by the government spenders and most highly regarded by the public. I have not spoken of the hundreds of boondoggling projects that are invariably embarked upon the moment the main object is to "give jobs" and "to put people to work." For then the usefulness of the project itself, as we have seen, inevitably becomes a subordinate consideration. Moreover, the more wasteful the work, the more costly in manpower, the better it becomes for the purpose of providing more employment. Under such circumstances it is highly improbable that the projects thought up by the bureaucrats will provide the same net addition to wealth and welfare, per dollar expended, as would have been provided by the taxpayers themselves, if they had been individually permitted to buy or have made what they themselves wanted, instead of being forced to surrender part of their earnings to the state.

Taxes Discourage Production

There is a still further factor which makes it improbable that the wealth created by government spending will fully compensate for the wealth destroyed by the taxes imposed to pay

for that spending. It is not a simple question, as so often supposed, of taking something out of the nation's right-hand pocket to put into its left-hand pocket. The government spenders tell us, for example, that if the national income is \$200,000,000,000 (they are always generous in fixing this figure) then government taxes of \$50,000,000,000 a year would mean that only 25 percent of the national income was being transferred from private purposes to public purposes. This is to talk as if the country were the same sort of unit of pooled resources as a huge corporation, and as if all that were involved were a mere bookkeeping transaction. The government spenders forget that they are taking the money from A in order to pay it to B. Or rather, they know this very well; but while they dilate upon all the benefits of the process to B, and all the wonderful things he will have which he would not have had if the money had not been transferred to him, they forget the effects of the transaction on A. B is seen; A is forgotten.

In our modern world there is never the same percentage of income tax levied on everybody. The great burden of income taxes is imposed on a minor percentage of the nation's income; and these income taxes have to be supplemented by taxes of other kinds. These taxes inevitably affect the actions and incentives of those from whom they are taken. When a corporation loses 100 cents of every dollar it loses, and is permitted to keep only 60 cents of every dollar it gains, and when it cannot offset its years of losses against its years of gains, or cannot do so adequately, its policies are affected. It does not expand its operations, or it expands only those attended with a minimum of risk. People who recognize this situation are deterred from starting new enterprises. Thus old employers do not give more employment, or not as much more as they might have; and others decide not to become employers at all. Improved machinery and better-equipped factories come into existence much more slowly than they otherwise would. The result in the long run is that consumers are prevented from getting better and cheaper products, and that real wages are held down.

There is a similar effect when personal incomes are taxed 50, 60, 75, and 90 percent. People begin to ask themselves why they should work six, eight, or ten months of the entire year for the government, and only six, four, or two months for themselves and their families. If they lose the whole dollar when they lose, but can keep only a dime of it when they win, they decide that it is foolish to take risks with their capital. In addition, the capital available for risk taking itself shrinks enormously. It is being taxed away before it can be accumulated. In brief, capital to provide new private jobs is first prevented from coming into existence, and the part that does come into existence is then discouraged from starting new enterprises. The government spenders create the very problem of unemployment that they profess to solve.

A certain amount of taxes is of course indispensable to carry on essential government functions. Reasonable taxes for this purpose need not hurt production much. The kind of government services then supplied in return, which among other things safeguard production itself, more than compensate for this. But the larger the percentage of the national income taken by taxes the greater the deterrent to private production and employment. When the total tax burden grows beyond a bearable size, the problem of devising taxes that will not discourage and disrupt production becomes insoluble.

How the Price System Works

1

The whole argument of this book may be summed up in the statement that in studying the effects of any given economic proposal we must trace not merely the immediate results but the results in the long run, not merely the primary consequences but the secondary consequences, and not merely the effects on some special group but the effects on everyone. It follows that it is foolish and misleading to concentrate our attention merely on some special point—to examine, for example, merely what happens in one industry without considering what happens in all. But it is precisely from the persistent and lazy habit of thinking only of some particular industry or process in isolation that the major fallacies of economics stem. These fallacies pervade not merely the arguments of the hired spokesmen of special interests, but the arguments even of some economists who pass as profound

It is on the fallacy of isolation, at bottom, that the “production-for-use-and-not-for-profit” school is based, with its attack on the allegedly vicious “price system.” The problem of

production, say the adherents of this school, is solved. (This resounding error, as we shall see, is also the starting point of most currency cranks and share-the-wealth charlatans.) The problem of production is solved. The scientists, the efficiency experts, the engineers, the technicians, have solved it. They could turn out almost anything you cared to mention in huge and practically unlimited amounts. But, alas, the world is not ruled by the engineers, thinking only of production, but by the businessmen, thinking only of profit. The businessmen give their orders to the engineers, instead of vice versa. These businessmen will turn out any object as long as there is a profit in doing so, but the moment there is no longer a profit in making that article, the wicked businessmen will stop making it, though many people's wants are unsatisfied, and the world is crying for more goods.

There are so many fallacies in this view that they cannot all be disentangled at once. But the central error, as we have hinted, comes from looking at only one industry, or even at several industries in turn, as if each of them existed in isolation. Each of them in fact exists in relation to all the others, and every important decision made in it is affected by and affects the decisions made in all the others.

We can understand this better if we understand the basic problem that business collectively has to solve. To simplify this as much as possible, let us consider the problem that confronts a Robinson Crusoe on his desert island. His wants at first seem endless. He is soaked with rain; he shivers from cold; he suffers from hunger and thirst. He needs everything: drinking water, food, a roof over his head, protection from animals, a fire, a soft place to lie down. It is impossible for him to satisfy all these needs at once; he has not the time, energy, or resources. He must attend immediately to the most pressing need. He suffers most, say, from thirst. He hollows out a place in the sand to collect rain water, or builds some crude receptacle. When he has provided for only a small water supply, however, he must turn to finding food before he tries to improve this. He can try to fish; but to do this he needs either a hook and line, or a net, and he must set to work on these. But everything he does delays or prevents him from doing something else only a little less urgent. He is faced constantly by the problem of alternative applications of his time and labor.

A Swiss Family Robinson, perhaps, finds this problem a little easier to solve. It has more mouths to feed, but it also has more hands to work for them. It can practice division and specialization of labor. The father hunts; the mother prepares the food; the children collect firewood. But even the family cannot afford to have one member of it doing endlessly the same thing, regardless of the relative urgency of the common need he supplies and the urgency of other needs still unfilled. When the children have gathered a certain pile of firewood, they cannot be used simply to increase the pile. It is soon time for one of them to be sent, say, for more water. The family too has the constant problem of choosing among alternative applications of labor, and, if it is lucky enough to have acquired guns, fishing tackle, a boat, axes, saws, and so on, of choosing among alternative applications of labor and capital. It would be considered unspeakably silly for the wood-gathering member of the family to complain that they could gather more firewood if his brother helped him all day, instead of getting the fish that were needed for the family dinner. It is recognized clearly in the case of an isolated individual or family that one occupation can expand only at the expense of all other occupations.

Elementary illustrations like this are sometimes ridiculed as "Crusoe economics." Unfortunately, they are ridiculed most by those who most need them, who fail to understand the particular principle illustrated even in this simple form, or who lose track of that principle completely when they come to examine the bewildering complications of a great modern economic society.

2

Let us now turn to such a society. How is the problem of alternative applications of labor and capital, to meet thousands of different needs and wants of different urgencies, solved in such a society? It is solved precisely through the price system. It is solved through the constantly changing interrelationships of costs of production, prices, and profits.

Prices are fixed through the relationship of supply and demand, and in turn affect supply and demand. When people want more of an article, they offer more for it. The price goes up. This increases the profits of those who make the article. Because it is now more profitable to make that article than others, the people already in the business expand their production of it, and more people are attracted to the business. This increased supply then reduces the price and reduces the profit margin, until the profit margin on that article once more falls to the general level of profits (relative risks considered) in other industries. Or the demand for that article may fall; or the supply of it may be increased to such a point that its price drops to a level where there is less profit in making it than in making other articles; or perhaps there is an actual loss in making it. In this case the “marginal” producers, that is, the producers who are least efficient, or whose costs of production are highest, will be driven out of business altogether. The product will now be made only by the more efficient producers who operate on lower costs. The supply of that commodity will also drop, or will at least cease to expand. This process is the origin of the belief that prices are determined by costs of production. The doctrine, stated in this form, is not true. Prices are determined by supply and demand, and demand is determined by how intensely people want a commodity and what they have to offer in exchange for it. It is true that supply is in part determined by costs of production. What a commodity has cost to produce in the past cannot determine its value. That will depend on the present relationship of supply and demand. But the expectations of businessmen concerning what a commodity will cost to produce in the future, and what its future price will be, will determine how much of it will be made. This will affect future supply. There is therefore a constant tendency for the price of a commodity and its marginal cost of production to equal each other, but not because that marginal cost of production directly determines the price.

The private enterprise system, then, might be compared to thousands of machines, each regulated by its own quasi-automatic governor, yet with these machines and their governors all interconnected and influencing each other, so that they act in effect like one great machine. Most of us must have noticed the automatic “governor” on a steam engine. It usually consists of two balls or weights which work by centrifugal force. As the speed of the engine increases, these balls fly away from the rod to which they are attached and so automatically narrow or close off a throttle valve which regulates the intake of steam and thus slows down the engine. If the engine goes too slowly, on the other hand, the balls drop, widen the throttle valve, and increase the engine’s speed. Thus every departure from the desired speed itself sets in motion the forces that tend to correct that departure.

It is precisely in this way that the relative supply of thousands of different commodities is regulated under the system of competitive private enterprise. When people want more of a commodity, their competitive bidding raises its price. This increases the profits of the producers who make that product. This stimulates them to increase their production. It leads others to stop making some of the products they previously made, and turn to making the product that offers them the better return. But this increases the supply of that commodity at the same time that it reduces the supply of some other commodities. The price of that product therefore falls in relation to the price of other products, and the stimulus to the relative increase in its production disappears.

In the same way, if the demand falls off for some product, its price and the profit in making it go lower, and its production declines.

It is this last development that scandalizes those who do not understand the “price system” they denounce. They accuse it of creating scarcity. Why, they ask indignantly, should manufacturers cut off the production of shoes at the point where it becomes unprofitable to produce any more? Why should they be guided merely by their own profits? Why should they be guided by the market? Why do they not produce shoes to the “full capacity of modern technical processes”? The price system and private enterprise, conclude the “production-for-use” philosophers, are merely a form of “scarcity economics.”

These questions and conclusions stem from the fallacy of looking at one industry in isolation, of looking at the tree and ignoring the forest. Up to a certain point it is necessary to produce shoes. But it is also necessary to produce coats, shirts, trousers, homes, plows, shovels,

factories, bridges, milk, and bread. It would be idiotic to go on piling up mountains of surplus shoes, simply because we could do it, while hundreds of more urgent needs went unfilled.

Now in an economy in equilibrium, a given industry can expand only at the expense of other industries. For at any moment the factors of production are limited. One industry can be expanded only by diverting to it labor, land, and capital that would otherwise be employed in other industries. And when a given industry shrinks, or stops expanding its output, it does not necessarily mean that there has been any net decline in aggregate production. The shrinkage at that point may have merely released labor and capital to permit the expansion of other industries. It is erroneous to conclude, therefore, that a shrinkage of production in one line necessarily means a shrinkage in total production.

Everything, in short, is produced at the expense of forgoing something else. Costs of production themselves, in fact, might be defined as the things that are given up (the leisure and pleasures, the raw materials with alternative potential uses) in order to create the thing that is made.

It follows that it is just as essential for the health of a dynamic economy that dying industries should be allowed to die as that growing industries should be allowed to grow. For the dying industries absorb labor and capital that should be released for the growing industries. It is only the much vilified price system that solves the enormously complicated problem of deciding precisely how much of tens of thousands of different commodities and services should be produced in relation to each other. These otherwise bewildering equations are solved quasi-automatically by the system of prices, profits, and costs. They are solved by this system incomparably better than any group of bureaucrats could solve them. For they are solved by a system under which each consumer makes his own demand and casts a fresh vote, or a dozen fresh votes, every day; whereas bureaucrats would try to solve it by having made for the consumers, not what the consumers themselves wanted, but what the bureaucrats decided was good for them.

Yet though the bureaucrats do not understand the quasi-automatic system of the market, they are always disturbed by it. They are always trying to improve it or correct it, usually in the interests of some wailing pressure group. What some of the results of their intervention is, we shall examine in succeeding chapters.

Braking Systems

1.1 Introduction

The safe and reliable use of a road vehicle necessitates the continual adjustment of its speed and distance in response to change in traffic conditions. This requirement is met in part by the braking system, the design of which plays a key role in ensuring a particular vehicle is suitable for a given application. This is achieved through the design of a system that makes as efficient use as possible of the finite amount of traction available between the tyre and the road over the entire range of operating conditions that are likely to be encountered by the vehicle during normal operation. The purpose of this chapter is to introduce the reader to the basic mechanics associated with the deceleration behaviour of a road vehicle and provide insight to the many issues that must be addressed when selecting the brake rotor and friction materials. A complete coverage is not feasible within the confines of a single chapter and so a set of references and additional reading is provided at its end that points the interested reader to further

sources of information. The chapter commences with a review of the function of a brake system together with an outline of the principal components and their possible configurations. The subject of legislation is reviewed and its importance as a tool to aid the designer of a brake system is highlighted. Straight forward kinematic and kinetic analyses are used to address the fundamentals of the braking problem as a precursor to the analysis of brake proportioning, adhesion utilization and other related issues. A case study is built into this section of the chapter that illustrates the application of the theory and so reinforces understanding. The selection of appropriate materials from which to manufacture the friction pair is reviewed and problems linked to thermo-mechanical behavior highlighted. The chapter concludes with a brief summary

of more advanced topics, often linked to modern chassis control, that integrate the braking system with other chassis systems.

1.2 The functions and conditions of use of a brake system

In order to understand the behaviour of a braking system it is useful to define three separate functions that must be fulfilled at all times:

(a) The braking system must decelerate a vehicle in a controlled and repeatable fashion and when appropriate cause the vehicle to stop.

(b) The braking system should permit the vehicle to maintain a constant speed when travelling downhill.

(c) The braking system must hold the vehicle stationary when on a flat or on a gradient.

When simply stated, as above, the importance of the role played by the brakes/braking system in controlling the vehicle motion is grossly understated. Consideration of the diverse conditions under which the brakes must operate leads to a better appreciation of their role. These include, but are not limited to, the following:

- *slippery wet and dry roads.
- *rough or smooth road;
- *split friction surfaces;
- *straight line braking or when braking on a curve;
- *wet or dry brakes;
- *new or worn linings;
- *laden or unladen vehicle;
- *vehicle pulling a trailer or caravan;
- *frequent or infrequent applications of short or lengthy duration;
- *high or low rates of deceleration;
- *skilled or unskilled drivers.

Clearly the brakes, together with the steering components and tyres, represent the most important accident avoidance systems present on a motor vehicle which must reliably operate under various conditions. The effectiveness of any braking system is, however, limited by the amount of traction available at the tyre–road interface.

1.3 System design methodology

The primary functions of a brake system, listed above, must be fulfilled at all times. In the event of a system failure, the same functions must also be performed albeit with a reduced efficiency. Consequently the braking system of a typical passenger car comprises a service brake for normal braking, a secondary/emergency brake used in the event of a service brake failure and a parking brake. Current practice permits service brake components to be used in the secondary/parking brake systems. Irrespective of the detail design considerations all brake systems divide into the following subsystems:

(1) Energy source

This includes all those components which generate, store or release energy required by the braking system. In standard passenger cars muscular pedal effort, applied by the driver, in combination with a vacuum boost system comprise the energy source. In the event of a boost failure, the driver can still apply the brakes by muscular effort alone. Alternative sources of energy include power braking systems, surge brakes, drop weight brakes, electric and spring brakes.

(2) Modulation system

This embraces those elements of the brake system which are used to control the level of braking effort applied to each brake. Included in this system are the driver, pressure limiting/modulating valves and, if fitted, anti-lock braking systems (ABSs).

(3) Transmission system

The components through which energy travels to the wheel brakes comprise the transmission system. Brake lines (rigid tubes) and brake hoses (flexible tubes) are used in hydraulic and air brake systems. Mechanical brakes make use of rods,

levers, cams and cables to transmit energy. The parking brake of a car quite often makes use of a mechanical transmission system.

(4) Foundation brakes

These assemblies generate the forces that oppose the motion of the vehicle and in doing so convert the kinetic energy associated with the longitudinal motion of the vehicle into heat.

There are four main stages involved in the design of

a brake system. The first, and perhaps most fundamental stage, is the choice of brake force distribution between the axles of the vehicle. This is primarily a function of the vehicle dimensions and its weight distribution. Next is the design of the transmission system and this activity embraces the sizing of the master cylinder together with

the front and rear wheel cylinders. Additional components, such as special valves that modulate the hydraulic pressure applied to each wheel are physically accounted for at this stage. The foundation brakes form the focus of the third stage of the process. As well as being able to react the applied loads and torques, the foundation brakes must be endowed with adequate thermal performance, wear and noise characteristics. The last phase in the process results in the incorporation of the pedal assembly and vacuum boost system into the brake system. To accomplish this design task, the engineer requires access to several fundamental vehicle parameters. These

include:

- *laden and unladen vehicle mass;
- *static weight distribution when laden and unladen;
- *wheelbase;
- *height of centre of gravity when laden and unladen;
- *maximum vehicle speed;
- *tyre and rim size;
- *vehicle function;
- *braking standards.

It is essential to recognize that each of the preceding stages are closely linked and that the final design will take many iterations to realize. Thus any formal methodology must be designed so as not to compromise the overall system quality that could result from design changes at the component level. By way of example, a reduction in package space could lead to smaller diameter wheel brakes having to be fitted to the vehicle. This will change the brake force distribution unless checked, by say resizing the wheel cylinders, and in the worst case this could lead to premature wheel lock and a violation of the governing legislation.

1.4 Brake system components and configurations

The principal components put together comprise a conventional braking system that is outlined below together with possible brake system layouts. The discussion of the components begins with the pedal assembly and moves through the brake system finishing with the foundation or wheel brakes.

1.4.1 Pedal assembly

A brake pedal consists of an arm, pad and pivot attachments. The majority of passenger cars make use of hanging pedals. A linkage is connected to the pedal and this transmits both force and movement to the master cylinder.

1.4.2 Brake booster

The brake booster serves to amplify the foot pressure generated when the brake pedal is depressed. This has the effect of reducing the manual effort required for actuation.

Boosters are invariably combined with the master cylinder assembly. A vacuum booster employs the negative pressure generated in the intake manifold of a spark ignition engine, whereas a hydraulic booster relies upon the existence of a hydraulic energy source and typically finds application in vehicles powered by diesel engines that generate only a minimal amount of intake vacuum.

1.4.3 Master cylinder

The master cylinder essentially initiates and controls the process of braking. The governing regulations demand that passenger vehicles be equipped with two separate braking circuits and this is satisfied by the so-called tandem master cylinder. A tandem master cylinder has two pistons housed within a single bore. Each section of the unit acts as a single cylinder and

the piston closest to the brake pedal is called the primary piston whilst the other is called the secondary piston. Thus, if a leak develops within the primary circuit, the primary piston moves forward until it bottoms against the secondary piston. The push rod force is transmitted directly to the secondary piston through piston-to-piston contact, thus allowing the secondary piston to pressurize the secondary circuit. Conversely, if the secondary circuit develops a leak then the secondary piston moves forward until it stops against the end of the master cylinder bore. This then allows trapped fluid between the two pistons to become pressurized and so the primary circuit remains operative.

1.4.4 Foundation brakes

Foundation, or wheel brakes, divide into two distinct classes, namely disc (axial) and drum (radial) brakes. Modern vehicles are invariably fitted with disc units on the front axle and there is a growing tendency to fit similar units to the rear axle. If drum brakes are fitted to the rear axle then these are typically of the Simplex type which employs a leading and trailing shoe configuration to generate the required brake torque. The torque output of this type of drum brake is not sensitive to change in vehicle direction. On vehicles fitted entirely with disc brakes, then a small drum unit is often employed to act as a parking brake on the rear axle of the vehicle. Issues surrounding the selection of the materials used to manufacture both discs and drums together with their friction material partners are discussed in more detail later in the text.

1.4.5 Brake system layouts

Legislative requirements demand a dual circuit transmission system to be installed on all road vehicles. Of the five possible configurations, two have become standard and these are known as the II and X variants. The II design is characterized by separate circuits for both the front and rear axles whilst in the X configuration, each circuit actuates one wheel at the front and the diagonally opposed rear wheel. The II design is often found on vehicles that are rear heavy and the X layout has application on vehicles that are front heavy.

1.5 Advanced topics

1.5.1 Brake by wire

The driver behind brake-by-wire systems has arisen from the ongoing development of modern braking systems such as anti-lock and traction control systems (TCSs) along with the need to effect their seamless integration within the overall chassis control strategy. There are two strategies currently receiving attention. The first utilizes a conventional hydraulically actuated braking system, that includes the brake fluid, brake lines and conventional actuators, together with a significant number of electro-hydraulic components (Jonner et al., 1996). The second relies upon a full electro-mechanical system (Bill, 1991; Maron et al., 1997; Schenk et al., 1995) in which the brake force is generated directly by electromechanical foundation brake actuators. The electromechanical system potentially requires little maintenance due to the removal of the hydraulic fluid as the means of energy transmission and this conveniently combines with a reduction in the amount of hardware demanded by the brake system which in turn leads to an overall weight reduction. Such systems may also contribute towards the enhancement of passenger safety as the location of the pedal assembly within the vehicle can be optimized so that the likelihood of lower leg injury is minimized during impact events. As with all advanced control systems, it is the control unit, its associated software and the array of sensors that combine to define the overall effectiveness of the system. The controller must operate in closed loop fashion, be able to take into account the in-use variation of the system parameters and fail safe.

1.5.2 Anti-lock braking system

Under normal braking conditions, the driver of a vehicle makes use of the linear portion of the brake slip vs brake force characteristic. The brake force coefficient, m , builds from zero in the free rolling state to a maximum, m_p , at around 20% slip and within this region the wheel is both stable and controllable. When braking under extreme conditions the driver may demand a brake torque that is greater than that which is capable of being reacted by the wheel. This results in a torque imbalance that causes the wheel slip to increase and the wheel rapidly decelerates to the full lock condition and in this state, the brake force coefficient is approx-

imately 0.7 mp. If the front wheels have locked, then steering control is lost and if rear wheel lock takes place then the vehicle becomes unstable. Simultaneously, the ability of the vehicle to generate side force markedly reduces, and this explains why limiting wheel slip, thereby avoiding wheel lock, is more critical for steering and directional stability of the car than for stopping distance alone.

The purpose of ABS is to control the rate at which individual wheels accelerate and decelerate through the regulation of the line pressure applied to each foundation brake. The control signals, generated by the controller and applied to the brake pressure modulating unit, are derived from the analysis of the outputs taken from wheel speed sensors. Thus, when active, the ABS makes optimum use of the available friction between the tyres and the road surface.

1.5.3 Traction control systems

Traction control systems aim (TCSs) to control and maintain vehicle stability during acceleration manoeuvres, by, for example, preventing wheel spin when accelerating on a low friction surface or on a steep up-grade. This is achieved by the optimization of individual wheel torques through the control of some combination of fuel mixture, ignition and driven wheel brake torque. TCSs are able to utilize components used in ABS and integration of the two systems is becoming commonplace.

1.6 Disc materials/design evaluation

Ultimately, any new brake material or design must be validated by experimental trials on actual vehicles to allow accurately for model-specific parameters such as the effect of body trim on rotor cooling. However, much can be learnt about potential new rotor materials or designs by numerical simulations of critical brake tests using finite element (FE) analysis. Such techniques require the rotor and/or stator geometry to be broken down into a number of small non-overlapping regions known as elements which are assumed to be connected to one another at certain points known as nodes. A 2D axisymmetric FE idealization can be used as a first approximation but, for more accurate simulation of the heat flow and stresses, a 3D model is desirable.

The heat input to the system is estimated from theoretical consideration and applied over the rubbing surface. The heat loss to the surrounding is specified by convective and sometimes radiative heat transfer conditions along relevant boundaries of the model. The temperatures predicted by a thermal analysis can be used as input conditions to a structural analysis in order to predict thermal deformations and stresses. If the pad is included in the model, the contact pressure distribution (and hence the distribution of heat input) can be estimated leading to the possibility of a fully coupled thermal-structural analysis (Brooks et al., 1994).

In addition to details of geometry and material properties, accurate data on heat loss to other components and to the atmosphere are vital to allow accurate predictions of rotor temperatures using FE methods. Such data can be generated by conducting the so-called 'cooling tests' on actual vehicles fitted with representative brake rotors carrying rubbing or embedded thermocouples. The rotor surface is first heated to a predetermined temperature by dragging the brakes and then allowed to cool whilst the vehicle is driven at constant velocity. By comparing the experimental rate of cooling with that predicted by the FE simulation for different boundary conditions, optimized heat transfer coefficients can be derived which are then assumed to apply for different rotor materials and factored for the varying air stream velocity under different test conditions.

Two very different vehicle brake tests are often simulated to critically examine the maximum temperatures and integrity of new rotor materials or designs: (i) a long slow Alpine descent during which the brakes are dragged and the vehicle is subsequently left to stand at the end of the descent; (ii) a repeated high speed autobahn stop with the rotor allowed to cool only moderately between stops. The former test determines the ability of the design to limit temperature build-up in the rotor by heat transfer to the atmosphere whilst the high-speed repeated stop examines the ability of the rotor material to withstand repeated thermal cycling and the ability of the friction pair to resist 'fade' under these severe conditions.

Friction performance cannot easily be predicted by the FE approach and there remains a requirement for dynamometer testing to determine the fade-and-wear characteristics of every

new friction pair. The dynamometer can either be a full-scale device or a small sample rig in which the geometry and loading conditions are scaled to give an accurate representation of the actual brake. These tests will not only give data on friction performance over a wide range of conditions but can also be used to determine the MOT of the pad and rotor materials by progressively increasing the temperature at the rubbing interface until some form of failure occurs.

Transmissions and driveline

Introduction

This section introduces the transmission systems that can be found in today's passenger car. Of course, many car-derived components and systems can also be found in small commercial vehicles. Also, larger derivatives, which have much in common, can be found in heavy goods and public service vehicles. We have endeavoured to introduce the main transmission types and some areas of technology that can be found within the units. In this chapter, however, we can only hope to introduce the subject of transmissions to you. In order to make up for this brevity, we include references to other material so you are able to follow up any particular subject in greater detail. It is probably worth stating that, in practice, the choice of transmission units for a particular vehicle is heavily influenced by what is in production and available. The cost of developing and, more importantly, installing the equipment to manufacture a new gearbox would be prohibitive for a small specialist vehicle manufacturer. Equally, producing a special transmission to support a specific model would also be difficult to justify even for a large vehicle manufacturer.

Current developments are extremely interesting as technology, particularly electronic control, is very much blurring the distinction between the conventional classes of transmission. For example, automatic transmissions (ATs) are often found now with a manual override function to allow the car to be driven using the gears selected by the driver. Conversely, manual gearboxes are having automation added to operate the clutch or shift the gears. These developments not only make the transmission interesting from an engineering perspective, but also create marketing features from an area of the vehicle often hidden from view and largely ignored by the buyer until it causes a problem.

Definitions

Transmission – This term can be used to describe one unit within the driveline of a vehicle, often the main gearbox, or as a general term for a number of units.

Driveline – This includes all of the assembly(s) between the output of the engine and the road wheel hubs.

Powertrain – Essentially the driveline and engine together, and may also be taken to include other related parts of the vehicle such as the exhaust or fuel system.

Automatic transmission – ATs come in various forms but have the common ability to change the ratio at which they are operating with no intervention from the driver.

Manual transmission – As the name suggests, drivers have to change the gear ratio setting rather than the transmission doing the job for them.

Continuously variable transmission (CVT) – CVTs are able to vary the ratio between input and output in a stepless manner rather than having a number of discrete ratios.

Infinitely variable transmission (IVT) – Essentially a CVT which has the additional ability to operate with zero output speed, hence negating the need for a separate starting device.

This chapter is going to look at the transmission systems used in cars. The rest of the driveline will not be considered in any detail; so there will be no detail on such things as axles or 4 X 4 transfer gearboxes.

What the vehicle requires from the transmission

According to some engine colleagues, the transmission is a large, expensive bracket to stop the engine from dragging on the road. However, we will, hopefully, demonstrate that transmissions are much more interesting than the other, less significant, part of the power train!

Essentially, the transmission or driveline takes the power from the engine to the wheels and, in doing so, actually makes the vehicle usable. The functions that enable this include:

- *Allowing the vehicle to start from rest, with the engine running continuously.
- *Letting the vehicle stop by disconnecting the drive when appropriate.
- *Enabling the vehicle to start at varied rates, under a controlled manner.
- *Varying the speed ratio between the engine and wheels.
- *Allowing this ratio to change when required.
- *Transmitting the drive torque to the required wheels.

The transmission needs to perform all of the above functions and others in a refined manner. The structural aspects of the transmission, predominantly the casing, often contribute significantly to the structure of the powertrain and the vehicle as a whole. This is important when it comes to engineering for the lowest noise and vibration. The stiffness of the powertrain assembly itself is important in determining the magnitude and the frequency of the vibrations at the source (the engine). This stiffness (and indeed the strength) can also be important to the integrity of the vehicle in a crash. Particularly with front-wheel-drive vehicles, the way in which the body collapses on impact has to be engineered very carefully, and the presence of a large rigid lump such as the powertrain has a critical influence on the way this occurs. The size, shape and orientation of the unit also affect the intrusion into the passenger space after an impact.

Starting from rest

As the internal combustion engine cannot provide torque at zero speed, a device is required in the transmission that will enable the vehicle to start from rest and, when propulsion is not required, to disengage the drive between the engine and road wheels. Several devices are used in automotive transmissions to achieve this:

- *The single-plate dry friction clutch – used commonly with car manual gearboxes.
- *The multi-plate, wet (oil immersed) clutch – frequently used in motorcycles, variable transmissions and some large, heavy-duty ATs.
- *The fluid flywheel – rarely used today.
- *The torque converter – used in the majority of ATs.
- *Electromagnetic clutches – again used in some variable transmissions.

These devices are fitted between the engine output and transmission input. The design and application of the dry clutch and the torque converter are discussed in the sections on manual and ATs, respectively. It should be pointed out that a smaller multi-plate clutch is often used in ATs to disconnect or connect particular gears and hence allow the gear change required; these applications do not have the capacity of starting the vehicle from rest.

Changing ratios – matching of the transmission to the vehicle

It is important to appreciate that the choice of gear ratios in a transmission is often dictated, in practice, by what is available or what is already in production. This situation occurs because of the large expense involved in engineering new gearsets, and installing or modifying the manufacturing plant to make the new parts. There are some cases that do necessitate a change, however. These may include a change in the engine, for example, from petrol to diesel, or a significant change to the weight of the vehicle in which the gearbox is to be installed. Obviously, the finances available within the vehicle manufacturer and the volumes involved will have a very large influence in this decision. Where changes can be accommodated, they may be limited to one or two gear ratios, leaving the intermediate ratios as is, hence not necessarily optimized. Finally, before looking at how the ‘ideal’ ratio may be chosen, the other limitation on ratio choice is the gear design itself. An example is a first gear pair where there could be a limit on how small the drive pinion might be in order to withstand the shock loading which can occur in the gearbox.

There are a number of decisions that need to be made when deciding what gear ratios should be fitted in a particular transmission unit. A similar process has to be done

for manual transmissions, automatics and CVTs. There is more flexibility in an automatic or a CVT because of the effect of the torque converter and/or the shift map. These, in ad-

dition to the gear ratios, influence the effective, overall ratio at any point in the operating regime. The factors, which have to be taken into account, are:

- *The performance requirements of the vehicle.
- *The weight, rolling resistance and other parameters of the vehicle.
- *The restrictions that exist on the design of the transmission.
- *Packaging restrictions in the vehicle and on the engine ancillaries, if the casing has to be altered.
- *Availability – as discussed above.

The performance of a vehicle is very rarely simply a matter of top speed and acceleration!

Selection of the lowest ratio – 1st gear

This governs the starting performance of the vehicle

and will depend on:

- *Gradient of hill required to be climbed – worst case.
- *Gross (fully laden) weight of the vehicle.
- *Weight of any trailer required.
- *Characteristics of the engine at low engine revs – i.e. minimum engine speed for effective air inlet ‘boost’ on pressure-charged engines.

Selection of top gear ratio – typically 5th in passenger cars

- *Engine characteristics.
- *Economy requirements at cruise.
- *In-gear performance – is the driver expected to change gear on overtaking?
- *Top speed to be achieved in top or next gear (usually 4th) – is top gear an ‘overdrive’?

The intermediate gears are usually spaced to provide an even, comfortable spread between these extremes. In theory, the ratios are often chosen to give constant speed or varying speed increments, between the gears. By using constant speed increments, the engine would reduce by a consistent speed change each time the driver changed up. For example if a driver changed up while accelerating every time they reached, say 3000 rev/min, the engine speed would be the same after each gear shift. With variable speed increments, this would not be the case, usually meaning that the change in engine speed with each gearshift would get progressively smaller as higher gears were engaged. The following figures illustrate this. The ‘upshift’ points are shown as constant for illustration, although this is obviously not necessarily so in practice.

The particular vehicle requirements or limitations of the transmission selected can modify this spacing, for example, due to:

- *Complexity requirements – existing ratio sets may limit choice on new vehicles, especially for lower-volume vehicles.
- *In gear acceleration requirements – provision of particular characteristics at certain vehicle speeds, for example, achievement of 0–60 mph/100 kph without too many gear changes.
- *Casing limitations on gear sizes.
- *Emission and fuel economy requirements, i.e. engine conditions during the legislated drive cycle.
- *Refinement issues at particular engine or driveline speeds.

All of these factors will influence the selection of the gear ratios in practice and possibly cause a compromise between the calculated, ‘ideal’ ratio set for a given car and what can be used on an existing vehicle.

Example of the considerations in matching a transmission to a vehicle For this example, we will look at some of the factors which would need to be considered when designing a gearbox for a road car, in this case a large 4 X 4.

Consider the rolling resistance of the 4 X 4 vehicle in Fig. 2.1-1. Taking a rolling radius of 0.375 m for the tyre, the torque required at the wheel for any road speed within the range can be calculated. Consider Fig. 2.1-3 – this is a fuel consumption chart for a large petrol engine.

(A line can be drawn through the top of the lines of constant fuel flow to indicate the max torque line.) Taking some of the vehicle transmission details as:

Final drive ratio 4.2

Fifth gear 0.75

Fourth 1.0

Third 1.4

Plotting the engine conditions for 120 km/h (motorway) and assuming a loss of 5% in the transmission system give the engine conditions shown on the graph for the different gears. The required tractive force at this speed is 1100 N; this equates to a torque of 413 Nm (total) required at the wheels. In theory, this would be a nominal 103 Nm at each wheel in the case of our 4 X 4 example.

We can also calculate how fast the wheels, transmission and engine would be rotating at this speed. The rolling radius (above) means that the vehicle travels 1 km every 424 revolutions of the wheel. (Sometimes, it is easier to consider the speed of the wheel for a given road speed, in this case 7.1 rev/min per 1 km/h.) This means our wheels will be rotating at 852 rev/min at 120 km/h. From these figures, the engine torque and speed at 120 km/h for the various gears quoted can be calculated. The operating points for the engine in the various gears show that as the vehicle changes up to 4th and 5th gear, the engine speed drops, the torque increases and the indicated fuel mass flow reduces. As we might expect, the vehicle uses less fuel in top than the lower gears. What happens if we add an 'overdrive' sixth speed with a ratio of 0.6, or even 0.5? The line on the graph also indicates how the trend would continue if an overdrive ratio were to be added to the gearbox. The result indicates that, if taken too far, the fuel used would not necessarily continue to reduce. The engine conditions as the speed is reduced and the torque required increases are such that could find the engine to be unresponsive, requiring large throttle openings and even higher emissions due to the high engine load. If we now consider how the tractive force ('effort') provided by the powertrain varies in each gear (by using the maximum torque values for the engine considered above). By taking account of the various gear ratios, the force provided at the road can be compared with the road load (rolling resistance). In Fig. 2.1-4, the original line from Fig. 2.1-1 has been added (again considering the 4 X 4 vehicle). An allowance has also been made for the force required to climb hills of various gradients; so additional rolling resistance lines have been added for the different gradients.

These graphs can be plotted easily for any vehicle/ transmission/engine combination provided the basic information referred to above is known or can be estimated. The information provided is varied and useful; such as:

*The maximum speed attainable for different conditions and gears can be seen. In this example, we may expect the vehicle to go faster in 4th than 5th gear as the tractive effort line for level ground crosses the available force line for 5th at a lower speed than in 4th gear (and before we run out of available engine speed in the lower gear).

*The maximum gradient that the vehicle could be expected to climb in any one gear can be estimated. Here it could be assumed that 1 in 5 hills could just be climbed in 3rd gear – and at a maximum speed of about 80 km/h.

*Where the available force line is just above the required force, the close proximity of the two lines indicates that there is little, if any, available torque from the engine. So if the vehicle were on a 1 in 10 gradient at say 40 km/h in 4th gear, we might expect to be able to accelerate to nearer 120 km/h by looking at the graph. The two lines are quite close to each other, however, indicating that there is little additional torque available to accelerate the vehicle mass or accelerate the engine itself. At the very least we might expect the vehicle to be quite unresponsive.

It should be noted that in the lower gears these graphs can indicate that very steep hills can be climbed. In practice, it may not be possible to actually start from rest on anything like these gradients because of the capacity of the clutch and the difficulty of achieving just the correct engine conditions. On two-wheel-drive vehicles, the available grip from the tyres can also be a limiting factor. Even on the 4 _ 4 example we are considering, in practice, the low ratio in the transfer gearbox would be required at gradients much steeper than, say 1 in 3.

The manual gearbox

Most people who drive will be able to describe some aspects of one of these. As the name suggests, the driver has to change between one gear ratio and another, as the vehicle requires, when using this type of gearbox. The different gears have different ratios that allow different relative speeds between the engine and road wheels. There are several distinct types of these transmissions; including 'transverse' or 'transaxle' front-wheel-drive gearboxes and 'in-line' gearboxes used in rear and four-wheel-drive vehicles. Four-wheel-drive vehicles will have an additional transmission unit on the rear of the gearbox to enable the drive of both front and rear axles.

Uses

Inline gearboxes are used in a wide range of vehicles from small passenger cars up to large trucks, while the vast majority of transverse gearboxes is used in passenger cars and small vans. It should be noted that manual gearboxes are nowhere near as common in the US and Japanese passenger car markets as they are in Europe. This is particularly the case with small to medium cars. In the past, the majority of larger passenger and commercial vehicles in Europe used manual gearboxes of one type or another. This particular area of the market is changing and becoming dominated by ATs.

Advantages

- *Usually have high mechanical efficiency.
- *Arguably the most fuel-efficient type of transmission, although this depends on the driver selecting the most appropriate gear.
- *Relatively cheap to produce – possibly only half of the equivalent automatic.
- *Light weight – typically 50–70% of the equivalent automatic weight.
- *Smaller and hence usually easier to package in the vehicle.

Disadvantages

- *Some driver skill required – ask anyone who only drives autos!
- *Emissions and fuel consumption can be heavily influenced by the driver's gear selection.
- *Clutch operation and changing gears can be tiring, especially when in heavy traffic.
- *Not suitable for all drivers; controls on larger vehicles can be heavy and most require some dexterity during operation.

Gear ratios – how they are achieved

Section 2.4 discussed why different ratios were needed and how they were selected. Given the overall design package of a transmission, the next task is to design the gear pairs within the casing to achieve the required ratios between the input and output shaft.

As an illustration of how the ratios in a gearbox are achieved, included below are the gear tooth numbers used in a version of the Land Rover LT77 manual gearbox.

This was used in the Land Rover, Range Rover Classic and a number of other vehicles in both two- and four-wheel-drive versions.

The constant gears:

- *22 teeth on the input shaft/33 on the layshaft 'constant' gear (driven gear)
- *Ratio – 0.666, i.e. layshaft rotates at 0.666 of the speed of the input shaft (slower)

3rd gear:

- *29 teeth on layshaft/27 teeth on the mainshaft gear
- *Ratio – 1.074, i.e. mainshaft rotates at 1.074 of the speed of the layshaft (quicker)
- *Combining the ratios gives $0.666 \times 1.074 = 0.715$, i.e. mainshaft/output shaft rotates at 0.715 of the input speed (slower)
- *The inverse of this is normally quoted to cause a bit of confusion! So you would see 3rd gear quoted as being $1/0.715$, which is 1.397

2nd gear:

*19 teeth on layshaft/27 teeth on the mainshaft gear

*Ratio – 0.704, (slower)

*Combining the ratios gives $0.666 \times 0.704 = 0.469$, i.e. mainshaft/output shaft rotates at 0.469 of the input speed (slower)

*As with 3rd, by convention this is quoted as $2.132 = (1/0.469)$

1st gear:

*14 teeth on layshaft/31 teeth on the mainshaft gear

*Ratio – 0.452, i.e. mainshaft rotates at 0.452 of the speed of the layshaft (slower)

*Combining the ratios gives $0.666 \times 0.452 = 0.301$, i.e. mainshaft/output shaft rotates at 0.301 of the input speed (slower)

*As with 2nd and 3rd by convention this is quoted as $3.322 = (1/0.301)$

5th gear:

Fifth gear on the LT77 is an ‘overdrive’ gear. This means that the output shaft of the gearbox rotates faster than the input. The numbers work out as:

*37 teeth on layshaft/19 teeth on the mainshaft gear

*Ratio – 1.947, i.e. mainshaft rotates at 1.947 times quicker than the layshaft

*Combining the ratios gives $0.666 \times 1.947 = 1.297$, i.e. mainshaft/output shaft rotates at 1.297 times the input speed

*The inverse of this is again normally quoted, so you would see 5th gear quoted as being $1/1.297$, which is 0.771

Transmissions

Automated manual transmission

With the introduction of a number of vehicles recently, automation of synchromesh, ‘manual’ transmissions is becoming more popular. The reason for the development of these transmissions is twofold; firstly, they can show an economy benefit over both manual and ATs. This is because they are more efficient than automatics and can be programmed to change gear more effectively than most drivers would. Secondly, automated manual transmissions are gaining in popularity in the performance car market, probably because of the links to Formula 1 racing and as a result of clever marketing! Examples include: BMW M3, MMC Smart, VW Lupo and Alfa 156.

These developments started some time ago with the introduction of automated clutches on several vehicles including the Renault Twingo, Saab 900 Sensonic and Ferrari. These cars retained the normal gear lever but automated the clutch so that no pedal was required. At start-up, they operate as an automatic with the control system actuating the clutch to achieve a start from rest when the accelerator pedal is depressed. During gear changes, the clutch is operated in response to movement of the gear lever.

Consideration of the mechanics of the automated manual systems suggests that it may be difficult for these systems to replace the conventional automatic. The fundamental point is that the automated manual systems need to disconnect the drive from the engine to the transmission in order to achieve a gear change. With conventional automatics only a small reduction in the engine power is required to achieve a smooth transition from one gear to another because of the action of the torque converter. There are, however, twin-clutch designs of transmission, which overcome this limitation by providing two parallel torque paths through the transmission where a gearchange simply switches from one path to another and engages one clutch rather than the other. This can be done without reducing the engine output (a ‘hot shift’). This has been used in the past by large automotive gearboxes, but could be extended to the car market. In the commercial market, there are a number of manufacturers now producing automated manual transmissions for trucks. Whereas these developments have needed the driver to indicate the gear selection in the past, the latest developments have the intelligence to completely automate the gearchange. In heavy commercial vehicles, this may need to include missing some gears, especially when unladen, so the control software required is not trivial.

The AT

The concept of an AT offers considerable advantages to vehicle drivers since they can be relieved of the burden of selecting the right gear ratio. This burden, both mental and physical, has become more significant with increasing traffic congestion.

Any reduction in driver fatigue and increased opportunity for the driver to concentrate on other aspects of vehicle control must contribute to increased safety and a reduction in road traffic accidents. There are also benefits in terms of economy and emissions if an automated system can make a better selection of ratio than a non-expert driver does. There are several alternative solutions to achieve this automation including automated layshaft transmissions (described above), CVT (described in the next section) and the 'conventional' AT described here.

The term 'automatic transmission' is used to refer to a combination of torque converter with a ratio change section that is based on epicyclic gearsets. The use of these components can be traced back to the early days of automotive developments, and in a recognizable combination to the middle of the last century. Yet, it is an area that is still seeing extremely rapid development today. The success of this combination lies in the simplicity of the torque converter as a device that inherently has ideal characteristics to start a vehicle from rest, and the opportunity that epicyclic gear sets provide to give relatively easy and controllable changes between ratios.

The controllability of these devices has allowed automatics to be developed with the good shift quality necessary to satisfy the driver's expectations for a gear change. Somehow, drivers of conventional manual-shift vehicles are always more critical in judging the gear change of another driver rather than their own where a misjudged shift can be more easily forgiven. In just the same way, they are more discerning in judging the quality of an automated gear change and, thus, high standards are required. In the past, these have been virtually impossible to achieve from automated manual gearboxes. This situation is, however, changing with the greater use and sophistication of electronic controls.

The downside of an AT in comparison with a manual gearbox alternative is greater cost, greater weight, larger size and lower efficiency. It has thus been used most in larger cars where these penalties are less significant and the driveability advantages most appreciated. This may well account for the large proportion of ATs used in the USA (approaching 90%) in comparison with Europe (around 20%). However, all these disadvantages have acted to maintain the pressure for development of the AT leading to modern designs that achieve a greater number of gear ratios within the same or even a reduced space envelope.

Continuously variable transmissions

The overwhelming majority of transmissions in road going vehicles is either manual or conventional automatic in design. These transmissions use meshing gears that give discrete ratio steps between engine and the vehicle speed. However, alternative designs exist that can transmit power and simultaneously give a stepless change of ratio; in other words a CVT. Strictly speaking, a CVT is a transmission that will allow an input to output ratio to change, continuously without any steps, in a range between two finite limits. An extension of this idea is a transmission that also allows a zero output speed to be included within this operating range. This can be considered as an IVT*. Since all vehicles need to come to rest then, any transmission that inherently has an IVT characteristic is at an advantage. The use of the term CVT is used here in the more generic sense to include both types.

Hydraulic transmissions

There are three main categories of transmission mechanism that can be used to provide the power and speed range for vehicle use: hydraulic systems, variable radius pulleys and traction drives. The first of these, described in this section, can be further sub-divided into categories of hydrostatic transmissions. Both of these are capable of giving a zero output speed and hence give IVT operation. The hydrokinetic drives have been described above in Section 2.9.2, and, as discussed above, torque converters are widely used in road going vehicles of all types. Hydrostatic drives also rely on fluid flow to transmit power but it is the pressure level in the fluid that is significant rather than the flow velocity. A hydrostatic transmission comprises a pump unit supplying a motor unit, and both these are of the, so-called, positive displacement type. One at least must be variable capacity, usually this is the pump, and this is used to control the overall ratio. Hydrostatic drives are very widely used in agricultural and other off-road ve-

hicles but have never been commercially used in automotive applications. It is generally the efficiency at low powers and potentially high noise levels that are the weak points of hydrostatic transmissions. However, they are still under development and, even recently, proposals have been made for buses and delivery vehicles with energy storage and hence a hybrid capability

Curb appeal

We all know the saying “you only get one chance to make a first impression.” The same is true when selling a house.

The front yard is usually the first view a potential buyer has when shopping for a new home. In a slower housing market this impression can be what intrigues or attracts a buyer to look at a home. Creating curb appeal can make or break the sale of a home. Many buyers have difficulty visualizing the potential of a home’s landscape. Providing a well maintained yard can create comfort for the potential buyer as they view the interior and exterior elements of a home.

So what can be done to improve the curb appeal? First it might be helpful to view your house from the street. Look at your yard as a potential buyer would as they approach for the first time. Notice any unruly or tall shrubs that may be blocking interesting architectural features or views. These can easily be pruned back creating a more manicured look and open the landscape.

Keep lawn areas mowed and fertilized. A well kept lawn and its surroundings will let a buyer know that the house is well cared for. Pull or spray weeds that may be growing in planter beds and look for grasses growing up through walkway cracks.

A buyer’s opinion of a home will begin to develop as they walk towards the front door. Keep this area clear of debris and consider adding seasonal color along the walkway. A decorative pot of bright colored flowers is always a welcome at the doorway.

Don’t forget about the backyard. This area may not be visible from the road but can be just as important as front yard. Keep toys and garden tools stored away so they don’t distract from the overall feel of the yard. Make sure patio and walkways are kept swept and clean. A few quick ways to brighten up the backyard include coloring existing concrete, adding seasonal color to flower beds and adding lights to brighten the yard and patio area.

Lighting can be a quick fix to enhance evening curb side appeal. Outdoor lights can be placed along driveways and walks to welcome guests. They can also be strategically placed to illuminate shrubbery and other landscape elements. The shadows cast by lighting can create a beautiful look for a home. Lights can also be added to the exterior of the house to enhance the visibility of an entry way and add architectural interest. The yard is a good place to spend a little extra time and money when trying to sell your home. A well planned and visually appealing landscape will not only assist in the sale of a home but add value too. The landscape is one of the few areas around the home that you can be sure to see your invested money returned but be careful not to over do it.

When adding improvements you probably won’t get value out of adding features that enhance your home well beyond that of your surrounding neighborhood. Take the time to explore the surrounding homes and plan a beautiful landscape that will be comfortable, inviting and competitive with the homes in your community.

Remember a potential buyer will form opinions of your home from the instant they see it whether it is in a photo or from the street. Hopefully, these suggestions can help you to improve your curb appeal, and create a lasting impression with a warm welcoming home.

1.2 Landscaping slopes

There are several ways to avoid erosion problems and create a stable beautiful slope; they’re not mutually exclusive.

Before approaching this type of landscape project it is necessary to determine the drainage patterns that exist. Look around your home to determine what type of drainage is in place.

You will not want to disturb the drainage patterns created in your yard. If the drainage is a problem or needs to be changed to incorporate a planting plan you should consider the advice of a professional as you may disrupt the drainage causing further problems in the yard.

Once you have determined how the water is draining off your slope, you can begin creating a design. An easy and attractive way to decorate the shape and hide the swales is to create flowing river beds within the drainage. The sedrainage areas are usually straight cutouts in the landscape that are a few inches lower than the surrounding grade.

Choosing woody, low growing shrubs that have fibrous root systems will help to stabilize the slopes soil. As the plants mature the roots will hold the soil in place eliminating the concern for future erosion problems.

Another consideration when landscaping a slope is the possible use of walls and terracing. There are a few options that can be contemplated when choosing the type of retaining wall you will build to contain and enhance your slope. Choosing the material that will be used to build them can become a visual obstruction if not blended into the surrounding environment. Consider using natural materials.

These will blend better into the surrounding landscape and can create nooks and cracks within the wall for placing small, interesting plants.

The various levels of wall can be painted, staggered, and different materials can be used to create visual interest. There are many cascading and climbing plants that look extraordinary when placed on a terraced wall; as this vertical placement allows the plants to become highly visible in the landscape.

There are a variety of ways that the 'slope' can be incorporated into the surrounding landscape. In some cases this can simply be done by covering the slope and stabilizing it with rock mulch.

1.3 Small space gardening

Many gardeners are presented with the challenge of small space gardening. With little space to utilize it is important to carefully analyze the space and how it will be used. Even though your yard may be small it will be important to pay attention to the details as you add them to your yard. This will ensure that you are able to incorporate every aspect of your ideas and create a space that is welcoming, comforting as well as visually appealing.

There are a few key components to keep in mind when working in a small space. First, it is a good idea to have only one focal point in the garden. This can be a piece of art, water feature, an interesting specimen tree. The focal point must remain the main attraction of the yard.

To continue planning the small spaces choose a palette that will use only a few colors limiting the spectrum in the garden.

Depending on your vision you could choose vibrant colors like reds, purples, and pinks or mix cooler blues with yellow and white. The limited palette will allow you to create the illusion of more space. Large plantings of single colors will appear larger to the eye. Also, try planting lighter colored flowers in the background and bring brighter colors to the front. This will trick the eye into elongating the view, making the space appear larger.

Now that you have chosen the colors you'd like to see in your yard, you can begin to assemble a list of plant species that will meet these requirements. When choosing your plants remember the space with which you are dealing. Small spaces can be overwhelmed with the addition of many large specimens and random plant placement. This will require a well thought plan to ensure plants are positioned strategically into the landscape. The small garden is a good opportunity for gardeners to use one of the many dwarf plant varieties that are now available at nurseries.

When finalizing the list of plants pay attention to the variety of leaf shapes, green tones and textures that each species offers. This is the time to consider the contrast the greenery in the landscape will provide. Plants that have intricate detail and fragrant scents are great choices for small spaces. Most landscape plantings are placed around the perimeter of a patio or outdoor entertaining area. If possible try to pick neutral or consistent materials when installing hard scape features. Place plants here that have intricate flower or leaves. This is also a good place to put fragrant plants that will attract the nose of those nearby.

Container gardening is another option that can be considered as they can provide color and create space for herbs and vegetables on a patio, balcony or in any small space. When selecting containers to place be sure to have one element that will tie the garden together. This

can be as simple as using one plant that is repeated in each container or choosing various sized pots that are the same color and material.

When planting your containers be sure to incorporate a mix of flowering plants and those with showy, leafy foliage. This will create contrast and interest in your pots.

For night time entertaining consider lighting to highlight details in your landscape. Shadows created from the lighting will draw the eye towards the lighted area they will also make the yard appear larger by not highlighting the defined areas of the space. Try using both ground and down lighting to create a visually stimulating impact on the space. Choose carefully and place lights sparingly.

Remember one of the most important aspects of small gardens is to pay attention to the details.

Small space gardens can provide an oasis of color, texture, interest and appeal. As with most landscape projects it is important to plan and design your space to get the most out of it. This is even more important when conquering a small space.

1.4 Xeri's cape

With less than 9" of annual rainfall our deserts manage to bloom with dazzling color from spring to fall.

This is an important fact to consider when planning your landscape. The unpredictable weather leaves us wondering each year if we will meet our annual water needs or be headed towards spells of drought. We can prepare for these dry spells by designing our landscapes with drought tolerant plants, using an efficient irrigation design, and properly maintaining our landscapes. This practice is commonly known as xeris cape.

To begin the xeris cape process start taking notice of the many native plants available that will provide color, year round interest and be water thrifty, too

One of the more important aspects of laying out your xeris cape is identifying the needs of the plants you have chosen to use. As you read about the plants you are considering planting, make lists of those with similar requirements (ex: sun, shade, moderate water, etc.). Now you can group your plants by need and place them on your drawing, or in your yard, in the same manner. This step is actually defining the hydro zones you will be using for irrigation. Doing this allows you to irrigate more effectively by grouping plants with high water demands dedicated to one zone and those with less water needs on a separate zone.

Consequently, all your plants will receive the water they require without over watering to compensate for some or putting stress on other plants by under watering them. A good plan keeps more densely planted, water loving plants near the home and disperses the plant groupings as they move towards property lines, limiting the water used in the background.

Now that the plants have been placed and irrigation hydro zones established, it's time to look at mulching options. This is an important part of the xeris cape design. Mulch helps protect your plants by keeping soils cooler, decreases water evaporation while allowing your plants to utilize every drop provided to them, and suppresses weed populations that may sprout up in your yard. There are two types of mulch available—organic and inorganic. You will want to look at both and choose one that complements your design and needs. Inorganic choices include rocks, decomposed granite, and pebbles all of which have a place in the landscape. An organic choice would be compost which adds nutrients and organic matter to your soil and improves its structure. Both are great choices and can be used together in the landscape. Remember that xeris cape can include turf areas. To maintain the theme of a water wise landscape, choose your turf area based on necessity instead of size. Turf can be a great addition to a home landscape; it can create an area for children to play, animals to run, or just add a small splash of green to the surroundings.

Depending on the shape and size of your yard there are new irrigation technologies that can assist you with your water conservation needs. New spray heads and subsurface irrigation options allow us to use our water more efficiently and dramatically increase the efficiency of the water being applied to the lawn.

Lastly, there is no such thing as a maintenance free yard and xeris cape is no exception. A yard with plants and irrigation will need some maintenance on a yearly basis. Check for

leaks in your system yearly and change out leaky o-rings on your hose bibs when needed. Maintain your plants by pruning trees, deadheading flowers, and controlling weed and pest problems.

1.5 Spring color

The trees have flowered and gone to leaf, lining the streets and filling our yards with shades of green to keep us cool in the upcoming summer months. To keep your yard filled with color through the growing season it's time to place perennials.

Color can make a strong impact in a landscape if placed strategically around the yard. Choose areas that will be seen by cars passing by or neighbors taking a late afternoon stroll down the street.. Add drifts of color along your walkway that will cheerfully lead people to your door.

The annual and perennial garden is something that should not be left for others to only enjoy. Add splashes of color around your patio area making the space more inviting and intriguing to those enjoying the outdoors. The many nooks around the typical yard can be planted and enjoyed by a homeowner through a window or while out in the yard.

There is more than one way to exploit the beauty of the annual flower. Many people like to plant them in the ground but others prefer to make them mobile and move them around the landscape. This option allows you to create change in the landscape as the growing season moves towards fall. Annuals are a perfect match for summer pots. There are a variety of pots from large ceramic urns to small and bright colored containers. Use these to add color, interest, and draw attention to the plants placed within.

Hanging baskets are another option to brighten your yard and home. There are a variety of new and old favorites that will add spectacular color around a landscape. Baskets, like pots, come with a range of options. Use large hanging baskets to frame an entry or place small baskets to adorn a patio for a gathering. The options for hanging basket use are great and the display provided will be vast.

Now that you've considered the options for your color it's time to prepare the space in which they will be established. The first step when preparing a planting bed is to choose a space and begin clearing out the area. With a good rake remove any existing plant litter, preparing the site for soil amendments. If possible, till up the native earth loosening the soil which prepares it for the addition of organic nutrients. Spread a four inch layer of a good compost material such as mushroom compost or Kelloggs Amend and blend it into the native soil. You should have a deep colored soil left behind that is now ready for the annuals and perennials to be planted. You will undoubtedly encounter many rocks; if you have the patience, remove as many as possible to make future digging easier.

When placing the plants in the newly prepared flower bed arrange them in large groups by type. This will create waves of flowers and be more interesting and pleasing to the eye. Don't be afraid to mix colors but try to be consistent throughout your landscape when choosing your plant color palette. This will create the most visual impact in your yard.

Consider the coming months when choosing your flowering plants and pick varieties that will bloom at various times and throughout the growing season. This will allow you to have a wonderful display from spring through fall.

1.6 Winters cape

The key to creating an intriguing garden is to have areas of visual interest. Designate areas in your garden to place evergreens. Try using a variety of tree shapes from columnar to prostrate to weeping. There are a variety of plants that can add hues of green to your yard from the dark jade of the yew to the blue sparkle of a spruce tree. The Evergreen trees will also capture snow on their branches, creating color contrast and beauty in the stark winter surroundings.

Don't stop with evergreen trees; there are many shrubs, groundcovers and deciduous trees that can provide winter beauty in the yard. To add some holiday color and festiveness think about adding plants like cotoneaster, witch hazel, bearberry, and mountain ash some of which will have bright red berries in the winter months. Berries from these plants will also attract birds to your yard.

Our Deciduous trees provide us shade and color during the warmer months play a role in the winter season too. Trees like hawthorns, can provide texture in the yard with a variety of barks and branch structures and many of these trees will hold snow on their limbs.

With the onset of winter our trees go dormant and can be successfully moved in the garden. Take advantage of the season to change your garden by add in gor relocating interesting plants to more appealing positions.

Hard scape features in the yard also provide a point of interest in the winter. In many yards have gazebos, trellises and arbors to provide shade. These structures will maintain their attractive appeal throughout the winter months. Stone and paver walls also add interest as they protrude from the snow covered ground creating depth in the yard. Another popular landscape feature in this region is the dry creek bed. Rock gardens are also an opportunity to add permanent color and texture to the landscape. Rocks offer a variety of hues and shapes that can cheer up any winters cape.

Now is the time to prepare for a living Christmas tree. This is a great opportunity to decorate inside your home for the holidays while later adding a great evergreen to your existing landscape. A hole for the living tree will need to be dug now before the ground freezes. The average living tree is between 4 and 5 feet tall and will need to be placed in a hole with a 3' diameter by 2' deep. Once the hole has been dug fill it with straw, burlap, or cover with a board to avoid a hazard in your yard. Keep enough soil in the garage or shed to ensure there is unfrozen soil for planting the tree when it is time.

Think about the placement of the hole and the tree in the landscape where the evergreen can be enjoyed in the winters cape now and at its full maturity.

A well thought out landscape can provide intrigue, beauty, and visual interest throughout the year. Now is the time to accent your yard for the holidays and coming winter months as well as to start planning your new yard for the seasons to come.

1.7 Edible landscapes

Many generations before us lived off the fruits, nuts, berries, and herbs provided in the surrounding landscape. With a little thought and creativity the edible landscape of the past can be re-created in your yard, no matter what size, leaving an edible harvest of color, fragrance, interest, and delight throughout the years.

The edible landscape is an opportunity to bring native and fruiting plants in to your yard with lots of reward. To start with, like any good landscape, it is always best to create a plan. For those with established landscapes this may mean identifying existing plants in the yard that will be replaced with edible varieties over the years.

When choosing trees pick hardy varieties that bloom later in the season to give tree blossoms a chance to survive our occasional late season frost. Also, be sure to check if trees are "self-pollinating" or "need a pollinator" to ensure you take care of their pollination needs and have an abundant harvest of fruit on your trees.

Grapes are becoming more common in our area as many varieties enjoy our cool dry climate. They are beginning to flourish around town and can be seen growing in residential and commercial landscapes in greater Reno-Tahoe. The first step in choosing grapes is deciding between table grape and wine varieties. They two varieties have very different characteristics and if it is your intention to use your grapes for wine you will want to make sure you chose the right variety. The grape vines can be placed around the posts of a trellis or placed orchard style draped over rows of single set posts. With many edible plant options left it's time to consider shrubs that will begin to transform the landscape into mouthwatering sight. Let's consider the addition of berries. These delightful plants will provide flavorful fruits that can be eaten plain, made into jellies, jarred and even used for pies.

There are many flowers in our landscape that are not only beautiful but edible.

The flowers are edible and can be used to dress up salads or placed on top of other dishes to add vibrant color and interest. The same goes for rose petals and a variety of other flowering annual and perennial plants.

There are many varieties of plants and trees that grow here that can provide edible material whether it is fruit, flowers, leaves, or roots. Always check with a knowledgeable professional before assuming something can be consumed.

It is important to protect the plants in your yard that you plan on eating from chemical sprays, animal wastes and other contaminants during the growing process. Be sure to always thoroughly wash an items picked from your yard to make sure they are clean before eating.

Creating an edible landscape is a fun and fulfilling task that can turn your backyard into a palette of gourmet tastes and colors. Take the time to discover the many wonderful trees, plants, and flowers.

1.8 Wild landscape

Many homeowners are meticulous in their efforts to attract the native world into their space. To begin assessing your yard for its wildlife value let's start by contemplating the needs of the creatures co-existing in your landscape.

To attract birds, butterflies, and wildlife to your yard you must invite them in. The essentials for all wildlife include food, water, habitat, and protection. To begin you need to know what plants will attract which type of wildlife. The best place to start is with native vegetation.

Many people can design their entire yard with native plants. These plants are ideal for our climate and are attractive to our native wildlife species. However, most homeowners complement our native plants with trees, shrubs, and perennials that are well suited to the high desert.

To invite hummingbirds and butterflies into your yard, try planting some of the following plants. For butterfly larvae, plant yarrow, veronica and asters; for adult butterflies plant butterfly bush, lavender and cinquefoil. Hummingbirds can be found flying around plants like coral bells, hollyhock and currant. There are many other varieties of annuals, perennials, shrubs, and trees that will attract hummingbirds and butterflies.

To create a bird friendly landscape try introducing an assortment of plants that will provide a year round food source. Fruiting trees can provide four seasons of food for birds and plants with flowers, seeds and sap are resources for many avian species.

Having trees and shrubs in your yard that create a protective habitat for birds and other wildlife will keep some species around through the year. Pine trees and junipers create a dense habitat where birds can duck for cover when needed.

They will also use dense leafed deciduous trees and shrubs as well as weed and debris areas in the yard. If all else fails there are a variety of decorative and simply designed birdhouses which can be placed in the yard as a new home for the birds and create a subtle statement in your landscape. Although more rare sightings are deer. Some homeowners love them and others spend hours chasing them out of there yards. Deer can be a detriment to a landscape. Like humans there are some food plants that they prefer over others. If this is a problem in your yard you may want to try planting deer resistant choices. Barberry, flowering quince, spiraea and holly are good choices for shrubs. Pine trees, spruce, oaks and hawthorns will deter browsing deer as well. Beware that, like most animals if hungry enough, the deer will eat most anything.

Whether you love the wildlife or can do without, remember they are an integral part of our environment and play a positive role in our surroundings. If you choose to invite nature into your yard, be careful when maintaining your landscape and keep chemical controls to a minimum. Browsing animals can become ill if eating harmful elements sprayed in the yard.

1.9 Tips to deter rabbits and deer from your landscape

Summer is practically here and it's time to spruce up our yards with annual color, get our tomatoes in the ground, and replace plants that didn't survive the Nevada winter. As we begin to plant and replenish our landscapes many of us will start to fend off wildlife which mistakenly assume that we're providing plant material just for them to graze upon.

With all the hard work and effort that goes into our landscape we want to make sure we protect our yards from nibbling rabbits and voracious deer. A first step is to take a drive around your neighborhood to get an idea of which plants grow well where you live. Then visit your neighborhood nursery or the internet for a list of trees, shrubs, perennials and annuals that deer

and rabbits don't like. However, keep in mind that these animals don't read the list and when hungry enough, most animals will eat any living plant.

Another alternative for diverting rabbits and deer is the use of repellants. There are a variety of brands on the market.

Each product uses a different mixture of chemicals, some natural, some not, to create an unpleasant odor to the animals.

These types of repellants are usually sprayed on the plants and need to be re-applied through the season and after rain events, though there is an organic product Plants kydd which lasts several months and comes in both liquid and granular form. Many people that swear by these repellants and while others have little success.

If you have severe deer and rabbit problems you can try covering your material with netting. The thin black netting will blend into your landscape and keep animals from being able to get to the leaves and graze through your planters. Gently tuck the netting under the plants at the base and bring them up to grazing height.

If the animals are getting to your trees use some fencing around the base. A roll of metal fencing can be wrapped loosely around the base of a tree to keep the animals at bay. This is also a good way to protect your garden. The fencing can be set up to protect your vegetables and be easily accessible for their maintenance and harvest.

One of the most effective deterrents for animals in the yard is a pet. If you have a cat or dog, its scent will be present in your garden and frequently the scent alone will help keep wildlife out. Some believe that planting catnip within your landscape will also help keep rabbits out. Catnip is a favorite of cats and can attract the neighboring cats for a romp through your yard and their very presence will deter rabbits and other animals from its surroundings. A more permanent and effective way to protect your yard from animals is to enclose it with a fence. Many of our northern Nevada homes have split rail or other permeable fences placed around their front or back yards.

Installing chicken wire inside your fence 12" below the soil level and at least two feet above is a good solution. Remove any large rocks that are near the fence to prevent the rabbits from using them to jump over the fence. (They are very resourceful animals). To ensure rabbits are not getting in your yard you'll need to walk around and look for burrows and holes that may be dug by rabbits, keeping in mind that rabbits are able to squeeze through very small holes in and under a fence.

Whether you love the wildlife or can do without it, remember they are an integral part of our environment and play a positive role in our surroundings. Try following some of the simple methods suggested or ask the experts at your local nursery for advice. Most professionals can suggest deer and rabbit resistant plant material and repellants that will work for you and your home environment.

1.10 Holiday landscape

The last of the leaves have fallen off the trees and landscape is now accentuated by the surrounding mountains glistening from the first dusting of snow. The winter season is once again upon us and it's time to prepare our landscapes for festive gatherings and colorful holiday events.

There are numerous ways to begin planning your landscape for the coming months. Many people associate this season with the addition of evergreens to their home and surroundings. This can be as simple adding a wreath. A beautiful accent in our cold climate, the wreath adds bright color to any home. These often round shaped decorations come in an abundance of sizes and are made using many types of materials. From evergreen cuttings to deciduous branches a wreath can be made simply or somewhat elaborately using berries, pine cones, ornaments, ribbon, feathers, etc. These warming accents will make any outside space welcoming and inviting in the harsh winter months ahead.

For something a little different you can spruce up your yard by placing potted evergreens in the landscape. Almost all evergreen plants will grow well when potted and they can be moved around the landscape or introduced to the ground at a later date. There are a variety of evergreen shapes and sizes that will add texture, form and diverse effects to a yard.

If a potted evergreen isn't for you, you can still make use of your pottery and planters. Instead of storing pots in your garage till the next growing season try placing some around your entry as if they were large vases.

You can fill them with bright colored branches, twigs with berries, and evergreen branches. The arrangements can be decorated with lights and changed throughout the season for special occasions or everyday splendor.

They can brighten a landscape and bring life to your yard. There are many types, shapes, colors and sizes of lights that can be used in your landscape. They don't have to be confined to the branches of trees and evergreen shrubs. Patio furniture, posts, and sculptures can be used as accent pieces in the yard. For a more energy conscious choice, take a look at windproof outdoor candles and use them to light a path.

From bows to trinkets there are many sparkling and eye catching ornaments that can be placed, safely, on tree branches outside. It is important to anchor them carefully to the plant material so that they won't blow off or rub the tree's branches.

For many, the winter months offer a time to focus on their inside landscape –making the space within their home a more comfortable and relaxing environment. Many people choose to give holiday plants such as poinsettias, cyclamen, Christmas cactus, flowering azaleas, amaryllis, as gifts. For the best selection of unique, quality blooming plants, visit your local garden center. These brightly colored plants set the mood for the holiday season and add vibrant hues to the inside living space. Indoor plants will also benefit your surroundings by increasing the humidity and improving the air quality in your home year round.

From the simple addition of evergreens to rows of sparkling lights, your landscape can be a welcome sight for the shorter and colder days to come. With the last warm days upon us, now is the time to prepare your landscape for the holiday season and winter months ahead.

<i>Номера контрольных вопросов (ситуаций) из общего перечня</i>		
<i>Пороговый уровень</i>	<i>Достаточный уровень</i>	<i>Повышенный уровень</i>
<i>Перевод 100% текста, допущено не более двух стилистических ошибок, текст перевода отредактирован не до конца – имеются грамматические и пунктуационные ошибки (не более четырех). В оформлении текста допущены незначительные ошибки.</i>	<i>Перевод 100% текста, допущено не более двух стилистических ошибок, текст перевода отредактирован, имеется не более двух пунктуационных ошибок. Текст оформлен согласно стандарту.</i>	<i>Перевод 100% текста, допущено не более одной стилистической ошибки, текст перевода отредактирован тщательно, без ошибок. Работа оформлена строго в соответствии со стандартом.</i>

7.4. Методические материалы, определяющие процедуры оценивания умений, навыков и (или) опыта деятельности, характеризующих этапы формирования компетенций

Рекомендуемый объем отчета составляет 25-27 страниц формата А4 машинописного текста. Отчет по практике является основным документом студента, отражающим, выполненную им работу во время практики, полученные им переводческие навыки и умения. Материалы отчета студент в дальнейшем будет использовать в своей работе.

В отчет включается:

- титульный лист

- содержание;
- оригинальный неадаптированный текст профессиональной направленности в объеме не менее 10 машинописных страниц;
- перевод текста на русский язык;
- заключение;
- список использованной литературы;

Отчет выполняется машинописным способом с помощью персонального компьютера с использованием текстовых редакторов (Microsoft Office Word шрифт: Times New Roman – 14 с интервалом – 1,5) с общим числом строк на одной странице не более 30, включая пропущенные. Выравнивание текста должно быть выполнено по ширине.

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При выполнении отчета необходимо сделать ссылку на используемую литературу (ставится в скобках в соответствии с номером, приведённом в списке литературы), список которой приводится в алфавитном порядке на последнем листе отчета.

Выполненный отчет оформляется титульным листом и брошюруется.

Титульный лист должен содержать: наименование министерства, наименование учебного заведения, факультета, на котором выполняется отчет, наименование направления (специальности), профиля (специализации), фамилию, имя и отчество студента; курс и группа.

8. Перечень учебной литературы и ресурсов сети «Интернет», необходимых для проведения практики

№ п/п	Учебная литература	Количество экземпляров в библиотеке или название ЭБС
	Основная литература	
1.	Белоусова А.Р., Мельчина О.П. Английский язык для студентов сельскохозяйственных вузов: Учебное пособие. 3-е изд., стр. – СПб. Издательство «Лань», 2008. – 352с.	50 экз.
2.	Новоселова И.З., Александрова Е.С. Учебник английского языка для сельскохозяйственных и лесотехнических вузов. – 5 изд. – РЕГИОН, 2010 – 344с..	50 экз.
3.	Мисуно, Е. А. Письменный перевод специальных текстов [Электронный ресурс]: учеб. пособие / Е. А. Мисуно, И. В. Баценко, А. В. Вдовичев, С. А. Игнатова. – М.: ФЛИНТА, 2013. – 256 с.	ЭБС Znanium.com
4.	Базылев, В. Н. Теория перевода. Кн. 1 [Электронный ресурс]: курс лекций / В. Н. Базылев. – 2-е изд., стер. – М.: ФЛИНТА, 2012. – 121 с.	ЭБС Znanium.com
5.	Базылев, В. Н. Теория перевода. Кн. 2 [Электронный ресурс]: практикум / В. Н. Базылев. - 2-е изд., стер. – М.: ФЛИНТА, 2012. – 200 с.	ЭБС Znanium.com
6.	Дидактика перевода. Хрестоматия и учебные задания [Электронный ресурс]: учеб. пособие / сост. В. Н. Базылев, В. Г. Красильникова; под ред. В. Н. Базылева. – 2-е изд., стер. – М., 2012. – 128 с.	ЭБС Znanium.com
	Дополнительная литература	
7.	Малышева Е.В., Новоселова О.В. Easy English. Английская грамматика в схемах и таблицах. Грамматический справочник. - Тверь: ТИПЛ и МК, ТГСХА, 2013. – 46 с.	20 экз.

8.	Романов А.А., Новоселова О.В., Малышева Е.В. Грамматический практикум по английскому языку. Учебное пособие. – Тверь: ТИПЛ и МК, ТГСХА, 2012. – 150 с.	20 экз.
9.	Romanov A.A., Morozova O.N., Romanova L.A., Malysheva E.V., Novoselova O.V. International business communication: ethics, relations, negotiations and business dialogues. - Tver: Tver Institute of applied linguistics and mass communications of TGSNA, 2013. – 170 p	20 экз.
10.	Романов А.А., Малышева Е.В., Новоселова О.В. Business correspondence in English. Деловая корреспонденция на английском языке. Учебное пособие. - Тверь: ТИПЛиМК, ТГСХА, 2014. – 62 с.	6 экз.
11.	Романова Л.А., Морозова О.Н. Brush up your talk. Практикум по развитию навыков устной речи. – Тверь «Агросфера», 2011. – 62 с.	7 экз.
12.	Голицынский Ю.Б., Голицынская Н.А. Грамматика. Сборник упражнений. 6-е изд. - СПб.: КАРО, 2010. - 288 с.	ЭБС Znanium.com
13.	Малышева Е.В., Новоселова О.В. Учебные материалы по развитию навыков устной речи на английском языке. – Тверь: ТИПЛ и МК, ТГСХА, 2012. – 60 с.	20 экз.
14.	Новоселова О.В., Малышева Е.В. Английский язык. Учебные материалы для подготовки к тестированию. – Тверь: ТИПЛ и МК, ТГСХА, 2012. – 85 с.	20 экз.
	Ресурсы сети «Интернет»	
15.	http://www.multilex.ru – электронный мультязычный словарь;	
16.	http://www.lingvo.ru – электронный словарь с возможностью перевода большого количества терминов и словосочетаний;	
17.	http://www.google.com/translator/ – электронный словарь и онлайн-переводчик	
18.	http://www.slovari.ru – Ресурс, содержащий обширную коллекцию онлайн-словарей русского языка;	

9. Перечень информационных технологий, используемых при проведении практики, включая перечень программного обеспечения и информационных справочных систем

9.1. Перечень программного обеспечения

- Microsoft Windows 7;
- Microsoft Office 10;
- SunRav Test Office Pro;
- Цифровая лингафонная система “Nord”

9.2 Перечень информационных справочных систем

- информационно-правовое обеспечение «Гарант» [Электронный курс] // Режим доступа: <http://www.garant.ru>;
- информационно-правовая система «КонсультантПлюс» [Электронный курс] // Режим доступа: <http://www.consultant.ru>;

10. Описание материально-технической базы, необходимой для проведения практики

Название и № корпуса, № аудитории (с указанием площади помещения)	Предназначение аудитории	№ аудитории по техническому паспорту	Перечень оборудования
Учебно-лабораторный корпус № 5, ауд. 403 (47 м ²)	Для практических занятий	№ 7	Доска учебная – 1 шт.; жалюзи – 3 шт.; стол учебный – 19 шт.; стул мягкий – 1 шт.
Учебно-лабораторный корпус № 5, ауд. 405 (49,9 м ²)	Для практических занятий	№ 9	Доска учебная – 1 шт.; стол учебный – 19 шт.; стол одностумбовый – 1 шт.; стул мягкий – 1 шт.; стул ученический – 10 шт.; мультимедийный проектор BenQ – 1 шт.; интерактивная доска IQ-board 1 шт.
Учебно-лабораторный корпус № 5, ауд. 115 (47,5 м ²)	Для практических занятий	№ 25	Стол компьютерный – 15 шт.; стол преподавателя – 1 шт.; жалюзи – 2 шт.; вешалка 1 шт.; банкетки круглые – 17 шт.; компьютер (моноблок) – 16 шт.; мультимедийный проектор Optima – 1 шт.; ауди колонки (Swen) 1 комплект; роутер WiFi D-link – 1 шт.; проекционный экран – 1 шт.
Учебно-лабораторный корпус № 7, ауд. 237 (35,3)	Для самостоятельной работы	№ 26	Доска учебная – 1 шт.; стол учебный – 6 шт.; стол компьютерный – 4 шт.; стол одностумбовый – 1 шт.; стул – 13 шт.; банкетки круглые – 5 шт. компьютер AMD Athlon 3000+ - 4 шт.; ЭЛТ монитор Samsung – 4 шт.
Учебно-лабораторный корпус № 5, ауд. 403 (47 м ²)	Для самостоятельной работы	№ 7	Доска учебная – 1 шт.; жалюзи – 3 шт.; стол учебный – 19 шт.; стул мягкий – 1 шт.

**Лист
изменений и дополнений, внесенных в программу практики**

Номер и название раздела программы практики	Изменения, дополнения	Обоснование	Дата и № протокола заседания кафедры	Подпись зав. кафедрой

Программа допускается к использованию в учебном процессе в 20 – 20 учебном году

Декан _____ факультета

/Ф.И.О/