ENGLISH
FOR MECHANICAL
ENGINEERING

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SRI YULIANI ENGLISH FOR MECHANICAL ENGINEERING

Aswaja

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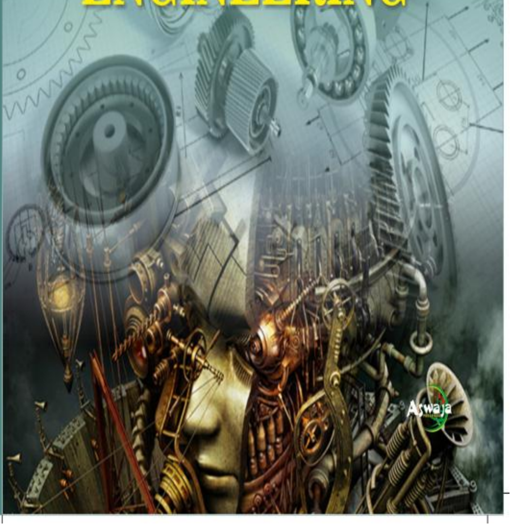

Aswaja

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SRI YULIANI

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About this book

The Author realized over the years that no single book in the market covers English for Mechanical Engineering in Indonesia, hence the author who has analyzed the gap goals have come with this revolutionary book that provides all the English for Mechanical contents essential for Mechanical Engineering students. With the overwhelming response that the author has received within days of launching the book in itself tells the historical leap she has taken.

This book contains Mechanical Engineering's term and the concepts that are asked in Mechanical Engineering subject matters. The book intends to provide the students with quick guidance to complete the whole stream in matter of hours.

Pekanbaru, January 2017

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UNIT 1
ENGINEERING

I. LESSON PREPARATION

A. BASIC COMPETENCES

After completing this learning, students are expected to have basic competence to understand engineering matters to define mechanical engineering; to describe the subfields of mechanical engineering; and to distinguish mechanical engineering from other types of engineering.

B. CONTENTS OBJECTIVE OF LEARNING

Students will be able to

1. Mention the definition of engineering
2. Describe and divide the characteristics of engineering field,
3. and to differentiate mechanical engineering compare other types of engineering.

C. LANGUAGE OBJECTIVE

Students will be able to read the Engineering text and comprehend the reading texts given by using multi-leveled reading group texts.

II. PARTS OF ACTIVITIES

A. READING ACTIVITY (Students and Lecturer)

Task One. *Study the following pictures below (in group). They show some areas of engineering works. Can you describe the following pictures? What are they doing?*

Picture 1

Picture 2

Picture 3

Picture 4

Task Two. *Read the following reading texts below (together with your lecturer) and then please choose 10 key words in the texts.*

Text 1

Engineering is largely a practical activity. It is about putting ideas into action. Civil engineering is concerned with making bridges, roads, airports, etc. mechanical engineering deals with designs and manufacture of tools and machines. Electrical engineering is about the generation and distribution of electricity and its many applications. Electronics engineering is concerned with developing components and equipment for communications, computing, and so on.

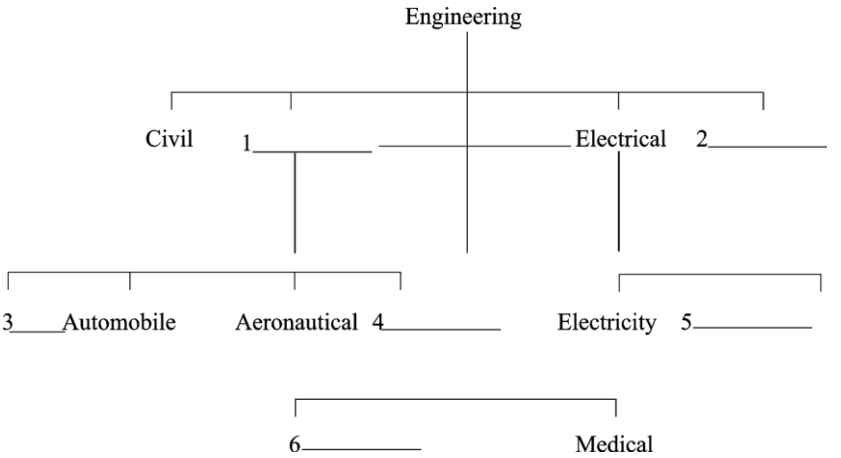
Mechanical engineering includes marine, automobile, aeronautical, heating and ventilating, and others. Electrical engineering includes electricity generating, electrical installation, lighting, etc. Mining and medical engineering belong partly to mechanical and partly to electrical. (Source : Adopted from www.http//What is Engineering _ Engineering.htm//).

Text 2

Engineering is based on many other sciences, such as physics, chemistry, mathematics but also mechanics, thermodynamics and analysis. It is a science, discipline, art and profession of acquiring and applying technical, scientific and mathematical knowledge to design and implement materials, structures, machines, devices, systems, and processes that safely realize a desired objective or inventions. Its main focus is to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly or in combination; or to construct or operate the same with full cognizance of their design; or to forecast their behavior under specific operating conditions; all as respects an intended function, economics of operation and safety to life and property.

This broad discipline can be further divided into sub disciplines, each with a more specific emphasis on certain fields and particular areas, for example: civil, mechanical, electrical, electronic, marine, automotive, aeronautical, heating and ventilation, mining and medical engineering. One who practices engineering is called an engineer**.** (Source : Adopted from www.http//What is Engineering _ Engineering.htm//).

Task Three. *In group, please use the key words to complete the the following chart below.*



Task Four. *Answer the following questions based on the texts above.*

1. What is engineering?
2. Who is an engineer?
3. Which sciences are closely connected with the engineering?
4. Is working as an engineer an interesting profession?
5. Give reasons why/why not engineers are as an interesting profession?

B. WRITING ACTIVITY

Task Five. *Write the summary of the texts above by using the key words choosen (together with your lecturer).*

Writing Info

Example of a General-to-Specific Pattern

Writing is a complex socio cognitive process involving the construction of recorded messages on paper or on some other material, and, more recently, on a computer screen. The skills needed to write range from making the appropriate graphic marks, through utilizing the resources of the chosen language, to anticipating the reactions of the intended readers. The first skill area involves acquiring a writing system, which may be alphabetic (as in European languages) or

non alphabetic (as in many Asian languages). The second skill area requires selecting the appropriate grammar and vocabulary to form acceptable sentences and then arranging them in paragraphs. Third, writing involves thinking about the purpose of the text to be composed and about its possible effects on the intended readership. One important aspect of this last feature is the choice of a suitable style. Because of these characteristics, writing is not an innate natural ability like speaking but has to be acquired through years of training or schooling. (Swales and Feak, 1994, p. 34)

Task Six. *Please write a complete paragraph to summary the texts above by creating main idea and topic sentence at the beginning of the sentences.*

C. SPEAKING ACTIVITY

Task Seven: *Please complete the dialog by using some clues words given. Practice together with your partner.*

marine	civil	aeronautical	air conditioning	medical

(Situation : The students are talking about the engineering's knowledge. They discuss this outside the classroom)

Iwan : Doni, Let's have a break.

Doni : Ok… by the way. Do you know Ridwan, our classmates? He is studying at . . . Engineering. His university subjects deal with roads and bridges.

Iwan : That' s a good program. Our subjects are also quiet great related with planes. All . . . matters to be handled well during flight.

Doni : Not only planes and flight, but all engineering programs should be carefully handled. Like

doctors and nurses are concerned with . . . , they should take care their patients very well. In addition, . . . which is concerned with ships also related to people safety.

Iwan : That's right, in our daily life also needs an . . . , and you know that our Indonesia climate is quiet hot. Of course, this equipment is contributed much to us.

D. GRAMMATICAL REVIEWS ACTIVITY

DEAL and CONCERN WITH

There are several types of statement which require deal and concern with terms. These terms are used in explaining the performance and the groups or characteristics of something.
Examples :

Machinery deals with machine.

Doctors are concerned with patients.

Task Eight. (In pairs)**.** *Please match the following each item in column A which are appropriate with column B below.*

No	A	B
1	Electricity generating	Trucks, cars, and motorcycles
2	Automobile	Medicals
3	Electrical installation	Machine
4	Mechanical Engineering	Electricity
5	X-tray	Cables and switchgear

E. LISTENING ACTIVITY

Task Nine. *Please answer the following questions based on the short message you listen.*

1. Mention one of the writer's profession!
2. What are the writer's activities in the workshop?
3. Does the writer have any tools to be used?

4. What tools does the writer need?
5. Does the writer also need wires?

Task Ten. *Please fill the empty words by listening to your lecturer dictation.*

If you enjoy a _____challenge and doing_____, hands on work, this type of _____may just fit your style. Fitting work requires the use of _____skills for the assembly and _____ of equipment found throughout a wide range of_____. These include manufacturing industries such as metal_____, plastics, food and beverage and _____products to name a few. Other industries such as _____and forestry, involving the maintenance of mobile equipment, also provide job opportunities. Fitting work is performed in a wide range of environments such as production facilities, mechanical workshops, _____and outdoors or underground in a mine.

III. EVALUATION ACTIVITY

A. PERFORMANCE TEST

Every student is asked to make a dialog in pairs in front of the class to describe each function of engineering groups.

B. WRITTEN TEST

- ***LISTENING SECTION***

A. Pictures

1. 
2. 
3. 
4. 

B. Question – Response

5. Mark your answer on your answer sheet.
6. Mark your answer on your answer sheet.
7. Mark your answer on your answer sheet.
8. Mark your answer on your answer sheet.

C. Short Conversations

9. Who is the man talking to?
   A. A teller
   B. A conductor
   C. A ranch hand
   D. An accountant
10. When can they meet?
   A. At 3 : 00
   B. At 4 : 00
   C. At 5 : 00
   D. At 10 : 00
11. What would the woman prefer?
   A. To take a direct flight
   B. To change planes in Denver
   C. To exchange her money
   D. To go by car
12. Where will they go after visiting the museum?
   A. To a shrine
   B. To some stores
   C. To a famous street
   D. To the government buildings

D. Short Talks

13. Where should you stand when a train car come?
   A. By the doors
   B. By the windows
   C. In the centre
   D. At either end
14. Where is the train located?
   A. In the airport
   B. In a city
   C. Along the coast
   D. At an amusement park
15. When on Sundays is the museum open?
   A. In the morning
   B. In the afternoon
   C. In the evening
   D. All day

- **READING**

SECTION E. Complete the Sentences

16. The plane will be landing _____New York in thirty minutes
    A. with C. in
    B. into D. for
17. Our goal is to turn _____into success
    A. failing C. failed
    B. fail D. failure
18. The workshop will be cancelled if the invitations are not _____in time.
    A. printer C. printing
    B. printed D. print
19. The meeting in postponed _____Mr. John's flight was late.
    A. although C. because
    B. while D. with

F. Reading Comprehension

Questions 20 – 23 refer to the following advertisement

MARKETING MANAGER

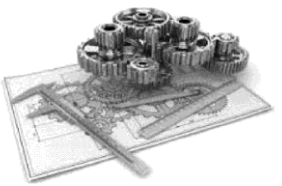
A multinational company seeks a marketing manager for its office products division. Candidate should have 10 years experience in Marketing development and management in the field and the ability to motivate and training incoming marketing staff. Good salary and benefit package. Qualified candidate should send their resumes to : The Head News, Box 5664, 1543 Alde Street, Adelaide, Switzerland

20. Which segment of the business is looking for Marketing Manager?
    A. The office product division
    B. The multinational company
    C. The personnel division
    D. The overseas staff
21. Where should the applicants send their resume?
    A. To the company
    B. To the division manager
    C. To the vice president of marketing
    D. To the newspaper
22. What type of experience is required for the job?
    A. Product development
    B. Expanding marketing
    C. Ten years in office management
    D. Research in the field
23. Where is the location of Switzerland?
    A. Australia
    B. America
    C. Europe
    D. Middle East

Questions 24 – 25 refer to the text as below.

> The company provide a benefit pension plan covering all employees. Benefits are based on years of service and on the employee's highest salary. Both the company and the employee make contributions to the plan according to government regulations. Employers eligible to receive pension funds are paid monthly trough the plan

24. Who determines the rules of contributions?
    A. The Manager of the benefit pension plans
    B. Anyone who is eligible to receive funds
    C. The company and the employee
    D. The government
25. Who determines the profit?
    A. Years at the company and salary
    B. Bonuses
    C. Start salary
    D. Company profit



UNIT 2
MATERIALS

I. LESSON PREPARATION

A. BASIC COMPETENCES

After completing this learning, students are expected to have basic competence to understand engineering matters to describe important components of engineering design and project management.

B. CONTENTS OBJECTIVE OF LEARNING

Students will be able to

1. describe the use of materials in engineering,
2. differentiate kinds of material and their characteristics used in mechanical engineering field.

C. LANGUAGE OBJECTIVE

Students will be able to comprehend the reading texts given by using multi-leveled reading group texts.

II. PARTS OF ACTIVITIES

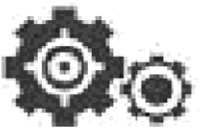
A. READING ACTIVITY

Task One. *Study the following pictures below. They show some materials used in mechanical engineering. Can you describe the following pictures? What are they and what are their functions?*

Picture 1

Picture 2

Picture 3



Picture 4

Picture 5

Picture 6

Task Two. *Read the following reading texts below (together with your lecturer) and then please choose the key words in the text (at least 10 key words).*

Text 1

There are different materials that we come across on daily basis. Material is synonymous with substance, and is anything made of matter - hydrogen, air and water are all examples of materials. Sometimes it is used more narrowly to refer to substances or components with certain physical properties which are used as inputs to production or manufacturing. In this sense, materials are the pieces required to make something else, from buildings and art to everyday products, such as computers. A material can be anything: a finished product in its own right or an unprocessed raw material.

Raw materials are first extracted or harvested from the earth and divided into a form that can be easily transported and stored, then processed to produce semi-finished materials. These can be input into a new cycle of production and finishing processes to create finished materials, ready for distribution, construction, and consumption. They are divided in different ways: nature, artificial, solids and liquids or fluids, each of them having certain properties.

Task Three. *From the text above, please write summary by using the following pattern for presenting information.*

From the reading text above, it can be summarized that there are

……
……
……
……
……
.....

Text 2

All materials are exposed to external stimuli that cause some kind of response (while in use). A property is a material characteristic that describes the kind and magnitude of response to a specific stimulus. For example, a specimen exposed to forces will experience deformation, or a metal surface that has been polished will reflect light. In general, definitions of property are made independent of material shape and size.

Virtually all important properties of solid materials may be grouped into six different categories:

– mechanical

– electrical

– thermal (including melting and *glass transition temperatures*)

– magnetic

– optical

– deteriorative (from Callister, modified and abridged)

Text 3

One of classification of Materials is solid materials can be grouped into three basic classifications: metals, ceramics and polymers.

This classification is based primarily on chemical makeup and atomic as well as molecular structure. Most materials fall into one distinct grouping, although there are some intermediates. More engineering components are made of metals and alloys than of any other class of solid. But increasingly, polymers are replacing metals, because they offer a combination of properties more attractive to designers.

New ceramics are developed worldwide, which will permit materials engineers to devise more efficient heat engines and lower friction *bearings*. Ceramics have been found that become superconducting (showing electrical conductivity with very limited resistance) at extremely low temperatures (about 100 K, approximately minus 170 °C). If this phenomenon is ever achieved at *ambient temperature*, it may increase the use of ceramics and revolutionize electronics.

The best properties of materials can be combined to make composites which often combine two or more materials from these three basic classes. In high-technology applications, a new classification called advanced or smart materials emerges. These materials are semiconductors, biocompatible materials, and nano-engineered materials. Natural materials like wood or leather should also be mentioned, since they offer properties that, even with the innovations of today's materials scientists, are hard to beat. (from Callister and Ashby/Jones, modified and abridged).

Task Four

Work with a partner. Refer to the texts, then answer the questions.

1. What is a material's property?
2. Do mechanical properties deal with deformation?
3. How can the thermal behavior of solids be characterized?

B. WRITING ACTIVITY

Task Five. *Write the summary of the texts above by using the key words choosen (together with your lecturer).*

Task Six. *Read the text then decide whether the statements are true or false. Rewrite the false statements if necessary.*

1. Polymers belong to a distinct material group.
2. Ceramics will increasingly be used for applications in electronics because of their hardness.
3. Man-made materials are superior to natural materials.

Writing Info

Patterns for Presenting Information

General-to-Specific Pattern

The general-to-specific pattern is probably one of the more common patterns in college writing. It may be used in any of these familiar places:

- introduction to a paper
- background in a research paper
- opening paragraphs for a discussion or an analysis
- essay examination answers

As the name suggests, this pattern is characterized by a movement in your thinking from a generalization to specific details. Your opening paragraph would begin with a general statement and then add details that explain it. The details may continue to become increasingly more specific. The pattern ends with a broad statement that summarizes your thinking that resulted from the details. (Swales and Feak, 1994, p. 35)

C. SPEAKING ACTIVITY

Task Seven: *Please practice the dialog in pairs.*

(Situation : The students are talking about the engineering's materials in the workshop. They discuss this during practical field in workshop)

Rizky : This wrench is harder than this plastic. Plastic is so soft, it's easy to be bent.

Naufal : That's right, Rizky. This wrench is made of iron. You know that the characteristics of iron is heavy, stiff, hard, rigid, rough, non-combustible, brittle, not very corrosion-resistant.

Rizky : No wonder, we have to use this wrench carefully. Many accidents might happen in workshop if we use the tools carelessly.

Naufal : I heard that some accidents happened in production area. Most of the problem is from misuse and mis place of materials.

Rizky : Yeah . . . That's right. Hey Naufal, Pak Jhony is coming to us . . . let's continue our job.

D. GRAMMATICAL ACTIVITY

Grammar: Comparison

Comparing Two or more Things in English.

Add **-er** and **–est** to adjectives with one syllable
Example : strong – stronger – strongest
to adjectives with two syllables and ending with **-y**
Example : oily – oilier – oiliest
Use **more** and **most** for adjectives with more than two syllables and not ending with -y
Example : resistant – more resistant – most resistant.
for adverbs
Example: Polyethylene is more frequently produced than poly (tetrafluoro ethylene).

Task Eight. *Fill the gaps in the table with the correct forms.*

Irregular Forms:

1. good ....
2. bad ....
3. far ....
   (when referring to distance)
4. far ....
   (when referring to extent/degree)
5. little ....
   (when referring to amount)
6. little ....
   (when referring to size)
7. much/many ....

E. LISTENING ACTIVITY

Task Nine. *Please complete the following questions based on the dialog you listen.*

A: Good morning. _____and lamps. Can I help you?

B: Good morning. I would like to _____to Mr. Green, please.

A: One moment, I'll put you_____.

C:_____Department, Green speaking. How can I_____you?

F. EVALUATION OF ACTIVITY

A. PERFORMANCE TEST

Every student is asked to make a dialog in pairs in front of the class about the materials around the classroom.

B. WRITTEN TEST

- ***LISTENING SECTION***

A. Pictures

1. 

2. 

3. 

4. 

B. Question – Response

5. Mark your answer on your answer sheet.
6. Mark your answer on your answer sheet.
7. Mark your answer on your answer sheet.
8. Mark your answer on your answer sheet.

C. Short Conversations

9. Who is the man waiting for?
   A. A sales clerk C. A waitress
   B. His children D. His wife
10. When must the man's copies be done?
   A. At 12 : 00 C. At 2 : 00
   B. At 1 : 00 D. At 2 : 30
11. What does the man ask about?
   A. The view B. His room
   C. The city D. His luggage

D. Short Talks

Questions 12-13 refer to the following talk

12. Which items does the man mention?
   A. Decorations B. Carpeting
   C. Wallpaper D. Furniture
13. What does the advertisement encourage you to do?
   A. Take a holiday B. Redecorate your office
   C. Look at your office again D. Save some money

Questions 14-15 refer to the following talk

14. What is this announcement for?
   A. Schoollecturers
   B. Schoolchildren
   C. Volunteer tutors
   D. Businesspeople

15. How much time does it take to participate?
    A. A minimum of 2 hours a week
    B. A maximum of 2 hours a week
    C. One week a year
    D. One day a week

❑ **READING**

SECTION E. Complete the Sentences

16. _____is the key to efficiency.
    A. Organized C. Organizer
    B. Organizer D. Organization

17. Hotel employees are _____to knock before entering the rooms.
    A. requited C. requisite
    B. required D. repulsed

18. The billing clerk was not able to find the invoice _____ the order.
    A. or C. but
    B. and D. though

19. Is the annual report _____yet?
    A. avail C. availability
    B. available D. availing

F. Reading Comprehension

Questions 20– 22 refer to the following advertisement

In order to expand into the lucrative entertainment market,

ARC Computer Company

Is pleased to announce the formation of an entertainment division,

Interactive Films Company

ARC shareholder of record as of August 30, 2005, will be issued one share of Interactive Films Company common stock for every five ARC shares held. No action is required on the part of shareholders to receive Interactive Films shares

20. Why is ARC going into the entertainment business?
    A. It is popular B. It. Is profitable
    C. It is productive D. It is powerful
21. If a person own 5 shares of ARC, how many shares of Interactive Films will he receive?
    A. 1 B. 5
    C. 10 D. 25
22. What do ARC shareholders need to do to receive stock in Interactive Films?
    A. Verify ownership B. Fund another division
    C. Reply by August 30 D. Nothing

Questions 23 – 25 refer to the text as below.

Data Entry/Clerk

Insurance firm seeks reliable, detail-oriented person for operations division. Responsibilities include data entry, filing and word processing. Good salary and benefits. Pleasant atmosphere. Room to advance.

23. What is one responsibility of this job?
    A. Answering the phone B. Data entry
    C. Selling insurance D. Operating a division

24. What is one benefit of the position?
    A. They'll give you your own office
    B. You can work toward promotions
    C. Benefits apply to dependents
    D. You can earn commissions
25. What is the position available?
    A. Secretary
    B. Clerk
    C. Sales
    D. Marketing

UNIT 3
DRILLING MACHINE

I. LESSON PREPARATION

A. BASIC COMPETENCES

After completing this learning, students are expected to have basic competence to understand engineering matters to list various drill series, to sharpen a twist drill.

B. CONTENTS OBJECTIVE OF LEARNING

Students will be able to

1. State the basic purposes of use of drilling machines
2. Classify the types of drilling machines
3. State and visualise the various common and other possible applications of drilling machines

C. LANGUAGE OBJECTIVE

Students will be able to comprehend the reading texts given by using multi-leveled reading group texts.

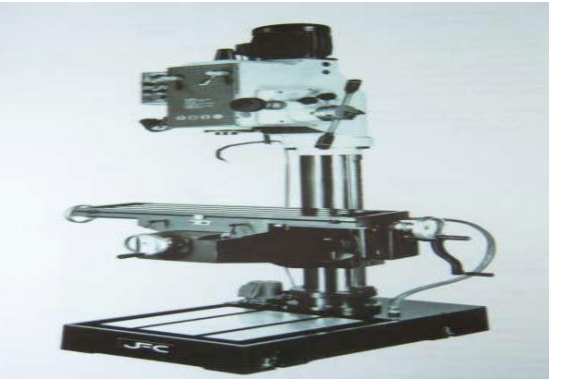
II. PARTS OF ACTIVITIES

A. READING ACTIVITY

Task One. (Together with your Lecturer). *Study the following pictures below. They show some materials used in mechanical engineering. Can you describe the following pictures? What are they and what are their functions?*

Picture 1

Picture 2



Picture 3

Task Two. *Read the following reading texts below (together with your lecturer) and then please make list 10 key words in the texts.*

Text 1

Basic purposes of use of drilling machines

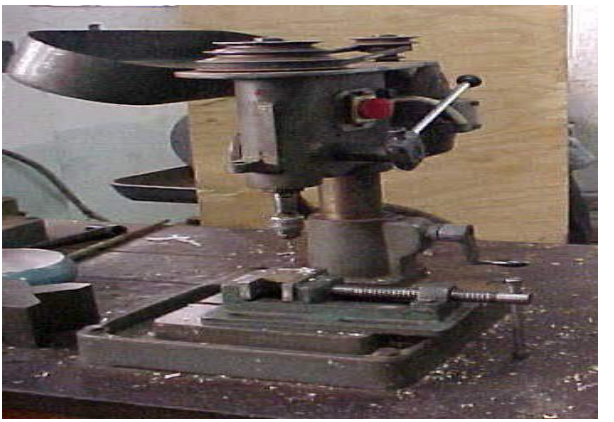
Drilling machines are generally or mainly used to originate through or blind straight cylindrical holes in solid rigid bodies and/or enlarge (coaxially) existing (premachined) holes :

a. of different diameter ranging from about 1 mm to 40 mm
b. of varying length depending upon the requirement and the diameter of the drill
c. in different materials excepting very hard or very soft materials like rubber, polythene etc.

Classification of drilling machines.

a. Table top small sensitive drilling machine

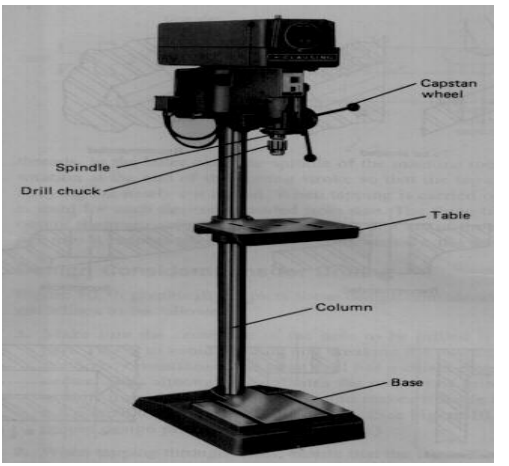
These small capacity (≤ 0.5 kW) upright (vertical) single spindle drilling machines are mounted (bolted) on rigid table and manually operated using usually small size (ϕ≤ 10 mm) drills. typically shows one such machine in the picture below.



(Table top sensitive drilling machine)

b. Pillar drilling machine

These drilling machines, usually called pillar drills, are quite similar to the table top drilling machines but of little larger size and higher capacity (0.55 ~ 1.1 kW) and are grouted on the floor (foundation). Here also, the drill-feed and the work table movement are done manually. The picture below typically shows a pillar drill. These low cost drilling machines have tall tubular columns and are generally used for small jobs and light drilling.



(Pillar Drilling machine)

c. Column drilling machine

These box shaped column type drilling machines as shown in Fig. 4.2.3 are much more strong, rigid and powerful than the pillar drills. In column drills the feed gear box enables automatic and power feed of the rotating drill at different feed rates as desired. Blanks of various size and shape are rigidly clamped on the bed or table or in the vice fitted on that. Such drilling machines are most widely used and over wide range (light to heavy) work.

(Column drilling machine)

d. Radial drilling machine

This usually large drilling machine possesses a radial arm which along with the drilling head can swing and move vertically up and down as can be seen in picture below. The radial, vertical and swing movement of the drilling head enables locating the drill spindle at any point within a very large space required by large and odd shaped jobs. There are some more versatile radial drilling machines where the drill spindle can be additionally swivelled and / or tilted.

(Radial drilling machine)

Application of drilling machines.

Drilling machines of different capacity and configuration are basically used for originating cylindrical holes and occasionally for enlarging the existing holes to full or partial depth. But different types of drills are suitably used for various applications depending upon work material, tool material, depth and diameter of the holes.

General purpose drills may be classified as;

a. According to material :

1. High speed steel – most common
2. Cemented carbides (Without or with coating or In the form of brazed, clamped or solid)

b. According to size:

1. Large twist drills of diameter around 40 mm
2. Microdrills of diameter 25 to 500 μm
3. Medium range (most widely used) diameter ranges between 3 mm to 25 mm.

c. According to number of flutes

1. Two fluted – most common
2. Single flute – e.g., gun drill (robust)
3. Three or four flutes – called slot drill

d. According to helix angle of the flutes

1. Usual – 200 to 350 – most common
2. Large helix : 45o to 60o suitable for deep holes and softer work materials
3. Small helix : for harder / stronger materials
4. Zero helix : spade drills for high production drilling micro-drilling and hard work materials.

e. According to length – to – diameter ratio

1. Deep hole drill; e.g. crank shaft drill, gun drill etc.
2. General type : $L/\phi \simeq$ 6 to 10
3. Small length : e.g. centre drill

f. According to shank

1. Straight shank – small size drill being held in drill chuck
2. Taper shank – medium to large size drills being fitted into the spindle nose directly or through taper sockets

g. According to specific applications

1. Centre drills: for small axial hole with 60° taper end to accommodate lathe centre for support

Task Three. *(In Group of 5). From the text above, please write summary by using the following pattern for presenting information.*

From the reading text above, it can be summarized that there are ……
……
……
……
……
……
……
……

Text 2.

THE DRILLING PROCESS

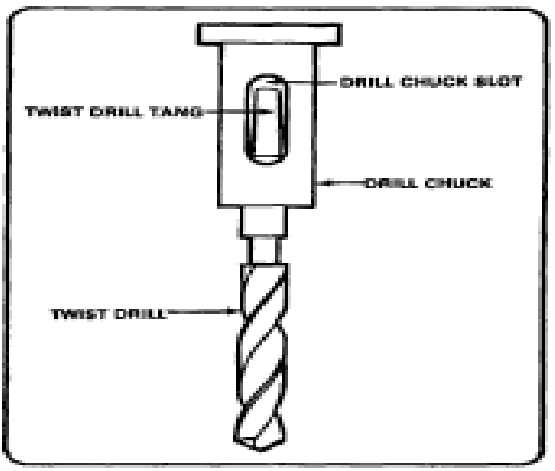
The drilling process, or complete operation, involves selecting the proper twist drill or cutter for the job, properly installing the drill into the machine spindle, setting the speed and feed, starting the hole on center, and drilling the hole to specifications within the prescribed tolerance. Tolerance is the allowable deviation from standard size. The drilling process must have some provisions for tolerance because of the oversizing that naturally occurs in drilling. Drilled holes are always slightly oversized, or slightly larger than the diameter of the drill's original designation. For instance, a l/4-inch twist drill will produce a hole that may be several thousandths of an inch larger than l/4-inch.

Oversizing is due to several factors that affect the drilling process: the actual size of the twist drill, the accuracy of the drill point, the accuracy of the machine chuck and sleeve, the accuracy and ri-

gidity of the drilling machine spindle, the rigidity of the entire drilling machine, and the rigidity of the workpiece and setup. Field and maintenance shop drilling operations allow for some tolerance, but oversizing must be kept to the minimum by the machine operator A twist drill is a manually or machine rotated tool with cutting edges to produce circular holes in metals,plastics, wood, etc. It consists of a hardened steel bar with usually two helical grooves or 'flutes' ending in two angled cutting edges. The flutes permit many regrinds and assist in removal of cuttings. Drills vary in size from a fraction of a millimetre to over 10 cm**.** As with a lathe turning tool, the cutting edges must have top rake and clearance. Grinding is best done on a special drill grinding machine.

First, selecting the drill, selecting the proper twist drill means getting the right tool for the job. The material to be drilled, the size of that material, and the size of the drilled hole must all be considered when selecting the drill. Also, the drill must have the proper lip angles and lip clearances for the job. The drill must be clean and free of any burrs or chips. The shank of the drill must also be clean and free of burrs to fit into the chuck. Most drills wear on the outer edges and on the chisel point, so these areas must be checked, and resharpened if needed, before drilling can begin. If the twist drill appears to be excessively worn, replace it.

Second, installing the drill, before installing the drill into the drilling machine spindle, clean the spindle socket and drill shank of all dirt, chips, and burrs. Use a small tile inside the socket to remove any tough burrs. Slip the tang of the drill or geared drill chuck into the sleeve and align the tang into the keyway slot. Tap the end of the drill lightly with a soft hammer to seat firmly. Another method used to seat the drill into the sleeve is to place a block of wood on the machine table and force the drill down onto the block. See the picture below represent installing the drill.



(Picture of installing the drill)

Third, selecting drill speed. Speed refers to the revolutions per minute (RPM) of the drilling machine spindle. For drilling, the spindle should rotate at a set speed that is selected for the material being drilled. Correct speeds are essential for satisfactory drilling. The speed at which a drill turns and cuts is called the peripheral speed. Peripheral speed is the speed of a drill at its circumference expressed in surface feet per minute (SFPM). This speed is related to the distance a drill would travel if rolled on its side. For example, a peripheral speed of 30 feet per minute means the drill would roll 30 feet in 1 minute if rolled on its side. It has been determined through experience and experiment that various metals machine best at certain speeds; this best speed for any given metal is what is known as its cutting speed (CS).

Task Four. *Discuss the reading text above in group (5 membes in a group) then answer the following questions.*

1. What should the mechanist consider in drilling process?
2. How to prevent from oversizing in the drilling.
3. How many tolerance sizes might be acceptable in drilling.

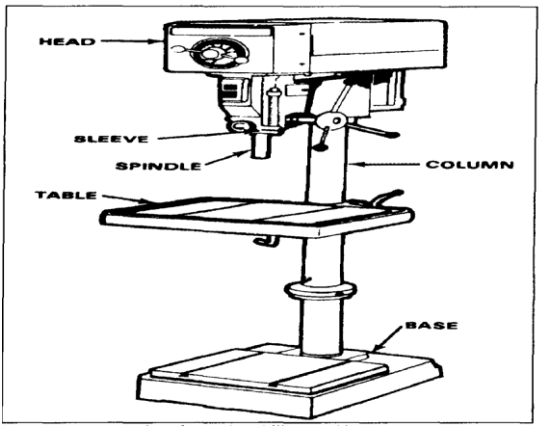
B. WRITING ACTIVITY

Task Five. *Write the summary of the texts above by using the key words choosen (together with your lecturer).*

Task Six. *Use the key words from the reading text to make a paragraph. (work in group project).*

Task Seven. *From the reading text below, please write summary by using the following pattern for presenting information.*

From the reading text above, it can be summarized that all drilling machines ……
……
……
……
……
……
……



All drilling machines have the following construction characteristics: a spindle, sleeve or quill, column, head, worktable, and base.The spindle holds the drill or cutting tools and revolvesin a fixed position in a sleeve. In most drilling machines, the spindle is vertical and the work is supported on a horizontal table. The sleeve or quill assembly does not revolve but may slide in its bearing in a direction parallel to its axis. When the sleeve carrying the spindle with a cutting tool is lowered, the cutting tool is fed into the work: and when it is moved upward, the cutting tool is withdrawn from the work. Feed pressure

applied to the sleeve by hand or power causes the revolving drill to cut its way into the work a few thousandths of an inch per revolution.

The column of most drill presses is circular and built rugged and solid. The column supports the head and the sleeve or quill assembly. The head of the drill press is composed of the sleeve, spindle, electric motor, and feed mechanism. The head is bolted to the column. The worktable is supported on an arm mounted to the column. The worktable can be adjusted vertically to accommodate different heights of work. or it may be swung completely out of the way. It may be tilted up to 90° in either direction, to allow for long pieces to be end or angled drilled.

The base of the drilling machine supports the entire machine and when bolted to the floor, provides for vibration-free operation and best machining accuracy. The top of the base is similar to a worktable and maybe equipped with T-slots for mounting work too large for the table.

Writing Info

RULES OF FORMAL WRITING

Since you probably (at least a bit) discussed some of these rules in secondary school, we will only revise them shortly. Business correspondence writing belongs to the most important and exacting of professional activities. A correspondent is a professional who knows well all the problems of business events about which he/she wants to inform his/her partner.

Business correspondence is formed according to established rules, and expressed in a lively language. There is an emphasis on the vocabulary of the special branch of business. We have to say more about the so called business style: a more frequent use of foreign words is concerned and many times concessions to grammar have to be made, connected with the requirements for professional expression. Grammar rules also have to be applied in business writing. Wrongly made sentences cannot clearly express our thoughts, and in business writing such mistakes could be fatal. It is important to line up your ideas systematically – with the use of paragraphs which

separate different thoughts and ideas. What you always have to remember is that not contractions are allowed in formal writing (can't – cannot, don't – do not, isn't – is not …). Think also about the correct salutation (Dear Sir or Madam – Yours faithfully, Dear Mr. Brown – Yours sincerely). The punctuation is also very important – there are no exclamation marks in formal letters. Layout is very important! The letter should also be attractive for the reader.

C. SPEAKING ACTIVITY

Task Eight: *Please practice the dialog in pairs.*

(Situation : The students are talking about the drilling process in the workshop. They discuss this during practical field in workshop)

Dedi **:** Iam confused how to set this point.

Zikri : Iam also confused Ded...but Pak Jhony said that we have to set the point to be drilled based on the size of the hole ex pected. First, we draw the point before we drill.

Dedi **:** I heard that the failure of drilling in mecahnical field is quite high. The tendency of the failure increases because the mechanics do not get enough training.

Zikri : That's true Ded ... you know the price of broken ma terial spend a lot. So we have to be careful when we are going to use this drilling machine.

Dedi : Ok...let's continue to practice how to drill the metal. Hopefully, we success to practice it.

D. GRAMMATICAL ACTIVITY

Giving Suggestions
(Should, ought to, had better)

SHOULD
Should express the idea of avoidable obligation. Should also used to state of obvious conclusion or a logical deduction.
Example:
He took engineering lessons for years. He should be an excellent engineer.
He studied for years. He should have passed the examination.

OUGHT TO
It expresses desirability, avoidable obligation, or duty.
Example:
You failed; you ought to hav e studied more.

HAD BETTER
Implies a warning or a threat of possible bad consequences.
Example:
The gas tank is almost empty. We had better stop at the next service station.

Task Nine. *Please complete the following sentences.*

1. I should study tonight because……..
2. I ought to study tonight because…….
3. I had better study tonight, if I don't ……...
4. It looks like rain. If you're going out, you'd better …….
5. You'd better obey the speed limit. If ……
6. You shouldn't stay up late tonight because …….
7. It's beautiful today. We ought to……
8. I have a test tomorrow. You should……
9. I'd better wash my clothes today, or …….
10. You had better take care of that cut on your hand soon, or……

E. LISTENING ACTIVITY

Task Ten. Please fill the empty words by listening the conversation in telephone.

A : Good morning PT. ABC, Mary is speaking. May I help you?

B : Good morning, please

A : Are you enjoying your . . . ?

B : That's wonderful! I can get along with all of you here . . . and this company is really . . . me to implement my experience.

A : Oh great, it is a good feedback. I hope you can . . . your job well here.

B : Thank you, I need your support and cooperation.

A : With my pleasure.

III. EVALUATION OF ACTIVITY

A. PERFORMANCE TEST

Ask each student to describe a process of the following alternative tittles in front of the class!

a. Training process for new employee
b. Drilling process in a workshop
c. An accident of drilling machine

B. WRITTEN TEST

❖ **LISTENING SECTION**

A. Pictures

1. 

2. 

3. 

4. 

B. Question – Response

5. Mark your answer on your answer sheet.
6. Mark your answer on your answer sheet.
7. Mark your answer on your answer sheet.
8. Mark your answer on your answer sheet.

C. Short Conversations

9. What was wrong with the convention?
   - A. It was too serious
   - B. It was too conventional
   - C. It was too crowded
   - D. It was too big

10. When should the woman call?
    - A. After 10 AM
    - B. Around noon
    - C. After 4 : 00
    - D. After dinner

11. Where does the conversation take place?
    - A. In a bus
    - B. In a taxi
    - C. In a store
    - D. In an office

D. Short Talks

12. What is the approximate temperatures today?
    A. About 15 degrees
    C. About 60 degrees
    B. About 65 degrees
    D. About 90 degrees
13. What does the weather forecaster suggest that people do?
    A. Stay inside
    C. Go outdoors
    B. Take sunglasses
    D. Wear a sweater
14. What is included in the cost of the lodge?
    A. Breakfast and dinner
    B. Sky equipment
    C. Ski lift tickets
    D. A rental shop
15. What does the hotel offer if you don't know how to ski?
    A. A beautiful view
    B. Ski instruction
    C. Low prices
    D. A rental shop

❖ **READING SECTION**

E. Complete the Sentences

16. Mr Arifin will train the student how to make a good handicraft. He is preparing some tools _____.
    A. yesterday
    C. at the moment
    B. tomorrow
    D. seldom
17. Alex : Have you _____to Shinta?
    John : Yes twice! And I got her reply this morning
    A. sending
    C. to send
    B. send
    D. sent
18. People _____that the pride goes before a fall.
    A. say
    C. said
    B. is saying
    D. says
19. Is your vacation _____?
    A. enjoy
    C. enjoyable
    B. enjoys
    D. enjoyed

F. Reading Comprehension

Questions 20 – 22 refer to the following letter

Abdul Rahman
Orchard Road Block 12, Singapore
12th September 2014

Dear Rahman,
Thanks for your letter last week. You asked me about Indonesia. Here, most people eat rice for breakfast, lunch and even dinner.
For us, it is quite difficult to eat bread, meat or fish and potatoes for our daily meal.
Keep in touch.

With best wishes
Your pen friend

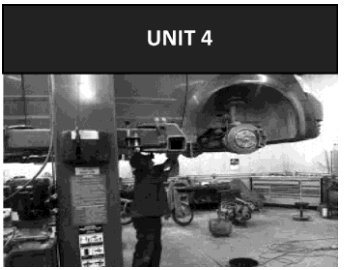
Muhammad Syukron

20. What does nearly everyone eat in Indonesia?
    A. Potatoes
    C rice
    B. vegetables
    D. bread
21. *A* : *Keep in touch*
    B : _____.
    A. don't mention it
    B. I don't know
    C. Ok, I'll call you
    D. I want to touch you
22. Who is the writer of the above letter?
    A. M. Syukron
    B. Abdul Rahman
    C. pen friend
    D. best wishe

Questions 23 – 25 refer to the report as below.

The profits for the MITRA Company more than doubled in the fourth quarter over profit levels of a year ago. This is due in part to lower operating and administrative expenses. The electronics store chain earned $42.6 million, compared with $21.1 in the fourth quarter of last year. Total profits for the year are$122.8 milli on, compared with $48.5 million last year.

23. How do fourth quarter profits for this year compare to those of last year?
    A. Stayed the same
    B. Increased by twice at much
    C. Increased by more than twice as much
    D. Decreased by half
24. What kind of business is Mitra Company?
    A. Business supplies
    B. Manufacturing
    C. Storage and shopping
    D. Retail electronics
25. How much is the difference the total profit of last year with this year?
    A. $ 74.3
    B. $ 21.5
    C. $ 171.3
    D. No difference



UNIT 4
AUTOMATIVE ENGINE

I. LESSON PREPARATION

A. BASIC COMPETENCES

After completing this learning, students are expected to have basic competence to understand the knowledge of the automotive vocabulary, be able to describe the outside and inside of a car, talk about the different types of vehicles, their advantages and disadvantages

B. CONTENTS OBJECTIVE OF LEARNING

Students will be able to

1. differentiate kinds of automotive engines used in cars
2. the characteristics of automotive engines used in mechanical engineering field.

C. LANGUAGE OBJECTIVE

Students will be able to comprehend the reading texts given by using multi-leveled reading group texts.

II. PARTS OF ACTIVITIES

A. READING ACTIVITY

Task One. *(Together with your Lecturer)***.** *Study the following pictures below. They show some automative engines used in mechanical engineering. Can you describe the following pictures? What are they?*

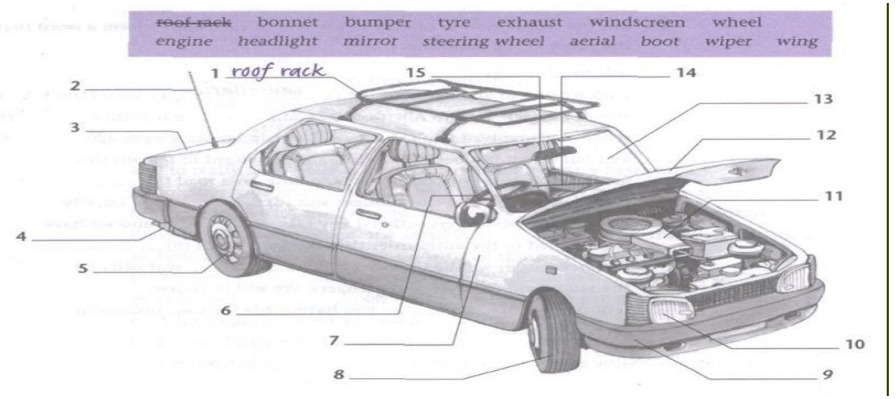
(Source: www.london.gov.uk)

Task Two. *Please read the following reading to get more ideas about the pictures above (Together with you Lecturer) and find at least 10 important words to support the ideas.*

Text 1

CARS

An automobile or motor car is a wheeled motor vehicle used for transporting passengers, which also carries its own engine or motor. Most definitions of the term specify that automobiles are designed to run primarily on roads, to have seating for one to eight people, to typically have four wheels, and to be constructed principally for the transport of people rather than goods. However, the term automobile is far from precise, because there are many types of vehicles that do similar tasks.



(Source: Vince: Advanced language Practice, 1994)

(Source: www.cartuningcentral.com)

Task Three. *Complete the story below with the appropriate words given.*

Components	Exterior	Welded	Data	Quality	Shell	assembly	rear
wirelessly	sched-ules	date	shop	frame	specific	suppliers	

Almost every car is produced to the customer's *specific* requirements – a built-to-order car. As soon as a car is ordered and a delivery _____agreed, weekly and daily production _____ are created and sent to outside _____and the company's own pre-assembly stations. This is to make sure that all the necessary _____arrive on time. First of all, a small _____ carrier is attached to the floor pan in the body _____. This data carrier contains all the customer's specifications and communicates _____with control units along the production line. In the body shop the floor pan, wheel arches, side panels and roof are _____together by robots to make the _____ of the car. The add-on parts – the doors, boot lid and bonnet – are then mounted to make the body-in-white. The finished body _____then goes into the paint shop where the data carrier determines the colour. In final _____, the _____ parts (for example the front and _____bumpers, headlights, windscreen and other windows) are fitted. After _____control and a final check, the finished car can be released. It is now ready for delivery to its new owner.

Text 2

Over the last ten years people have got used to the sight of very small cars parked in tiny parking spaces. Smart is one of the world's youngest car makes and yet the *smart fortwo* is such a distinctive car that it has already been included as an exhibit in the Museum of Modern Art in New York – one of only six cars to attain this distinction. In April 1994, the Micro Compact Car AG was founded in Switzerland as a joint venture between Mercedes-Benz and Swatch. Nicolas Hayek, the inventor of the Swatch watch, brought his idea for an ultra-short small car, and Mercedes-Benz contributed expertise and experiences from more than a hundred years of building cars.

Engineers devised a car which is not only extremely mobile and efficient, but also very economical. Its other key feature is safety, with its unique tridion cell. After starting development in 1994, the *smart fortwo* celebrated premiere at the Frankfurt Motor Show in 1997. Production in Humpback, France, started in July 1998, and in October

sales took off in other European countries. In 1998, smart became a 100% subsidiary of what was then Daimler-Benz AG.

There is no doubt that the smart fortwo is a leader in urban mobility. All smart vehicles embody the same brand values and have the same 'DNA': innovation, functionality and 'joie de vivre'. They appeal to people who are sporty, independent and young at heart, people who love clever solutions and are open to new idea. What are the advantages and disadvantages of the smart fortwo? Advantages are: it's easy to park, it's mobile and efficient, economical and safe; disadvantages are: it's expensive, it's sometimes too small.

Task Four. *Work with a partner. Refer to the texts, then answer the questions below.*

1. Where was *smart fortwo* exhibited?
2. Whose idea to create such a car?
3. When did the car have its first premiere at the motor show?
4. Who were the owners at the beginning?
5. Who are the main customers?

Text 3

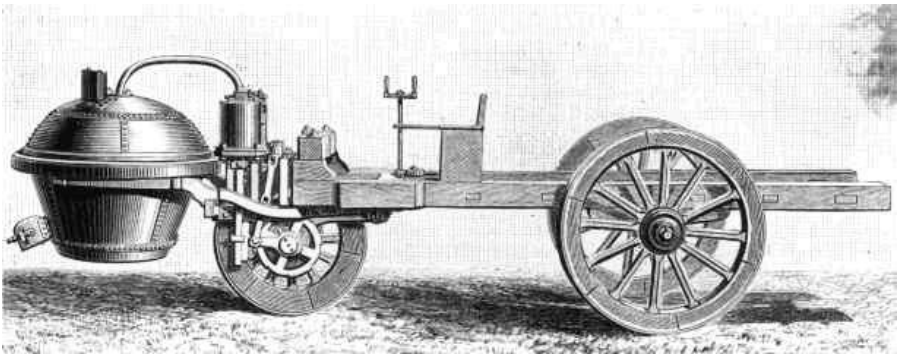
HISTORY OF AUTOMOTIVE ENGINES

Automobiles through the Years - Since they originated in the late 1800s, automobiles have changed and developed in response to consumer wishes, economic conditions, and advancing technology. The first gas-powered vehicles looked like horse buggies with engines mounted underneath because this was the style to which people were accustomed. By 1910, however, features like the front mounted engine were already established, giving the automobile a look that was all its own. As public

demand for cars increased, the vehicles became more stylized. The classic cars of the 1920s and 1930s epitomize the sleek, individually designed luxury cars called the "classic cars." During the 1940s and 1950s, automobiles generally became larger until the advent of the "compact" car, which immediately became a popular alternative. The gasoline crisis is reflected in the fuel efficient cars made in the 1970s

and 1980s. Current designs continue to reflect economy awareness, although many different markets exist.

The history of the automobile actually began about 4,000 years ago when the first wheel was used for transportation in India. In the early 15th century the Portuguese arrived in China and the interaction of the two cultures led to a variety of new technologies, including the creation of a wheel that turned under its own power. By the 1600s small steam-powered engine models had been developed, but it was another century before a full-sized engine-powered vehicle was created. In 1769 French Army officer Captain Nicolas-Joseph Cugnot built what has been called the first automobile. Cugnot's three-wheeled, steam-powered vehicle carried four persons. Designed to move artillery pieces, it had a top speed of a little more than 3.2 km/h (2 mph) and had to stop every 20 minutes to build up a fresh head of steam



The picture of Cugnot Steam Tractor -the first selfpropelled road vehicle, thus, the earliest automobile. Powered by steam, the three-wheeled tractor- invented in 1769 by Nicolas- Joseph Cugnot. designed to carry artillery, but similar vehicles soon found many other uses in industry.

As early as 1801, successful but very heavy steam automobiles were introduced in England. Laws barred them from public roads and forced their owners to run them like trains on private tracks. In 1802 a steam-powered coach designed by British engineer Richard Trevithick journeyed more than 160 km (100 mi) from Cornwall to London. Steam power caught the attention of other vehicle builders. In 1804 American inventor Oliver Evans built a steam-powered vehicle

in Chicago, Illinois. French engineer Onésiphore Pecqueur built one in 1828. British inventor Walter Handcock built a series of steam carriages in the mid-1830s that were used for the first omnibus service in London.

By the mid-1800s England had an extensive network of steam coach lines. Horse-drawn stagecoach companies and the new railroad companies pressured the British Parliament to approve heavy tolls on steam-powered road vehicles. The tolls quickly drove the steam coach operators out of business.

During the early 20th century steam cars were popular in the United States. Most famous was the Stanley Steamer, built by American twin brothers Freelan and Francis Stanley. A Stanley Steamer established a world land speed record in 1906 of 205.44 km/h (121.573 mph). Manufacturers produced about 125 models of steam-powered automobiles, including the Stanley, until 1932.

Internal-Combustion Engine

Development of lighter steam cars during the 19th century coincided with major developments in engines that ran on gasoline or other fuels. Because the newer engines burned fuel in cylinders inside the engine, they were called internal-combustion engines.

In 1860 French inventor Jean-Joseph-Étienne Lenoir patented a one-cylinder engine that used kerosene for fuel. Two years later, a vehicle powered by Lenoir's engine reached a top speed of about 6.4 km/h (about 4 mph). In 1864 Austrian inventor Siegfried Marcus built and drove a carriage propelled by a twocylinder gasoline engine. American George Brayton patented an internal-combustion engine that was displayed at the 1876 Centennial Exhibition in Philadelphia, Pennsylvania.

In 1876 German engineer Nikolaus August Otto built a four-stroke gas engine, the most direct ancestor to today's automobile engines. In a four-stroke engine the pistons move down to draw fuel vapor into the cylinder during stroke one; in stroke two, the pistons move

up to compress the vapor; in stroke three the vapor explodes and the hot gases push the pistons down the cylinders; and in stroke four the pistons move up to push exhaust gases out of the cylinders. Engines with two or more cylinders are designed so combustion occurs in one cylinder after the other instead of in all at once. Two-stroke engines accomplish the same steps, but less efficiently and with more exhaust emissions. Automobile manufacturing began in earnest in Europe by the late 1880s.

German engineer Gottlieb Daimler and German inventor Wilhelm Maybach mounted a gasolinepowered engine onto a bicycle, creating a motorcycle, in 1885. In 1887 they manufactured their first car, which included a steering tiller and a four-speed

gearbox. Another German engineer, Karl Benz, produced his first gasoline car in 1886.

Early Car - The first practical car, built by German engineer Karl Benz in 1885, initiated the era of automobile manufacturing. Benz made improvements to the internal combustion engine and invented the differential drive and other automotive components. The company Benz founded grew into one of the largest automobile manufacturers in Germany.

In 1890 Daimler and Maybach started a successful car manufacturing company, The Daimler Motor Company, which eventually merged with Benz's manufacturing firm in 1926 to create Daimler-Benz. The joint company makes cars today under the Mercedes-Benz nameplate. In France, a company called Panhard-Levassor began making cars in 1894 using Daimler's patents. Instead of installing the engine under the seats, as other car designers had done, the company introduced the design of a front-mounted engine under the hood. Panhard-Levassor also introduced, a clutch and gears, and separate construction of the chassis, or underlying structure of the car, and the car body. The company's first model was a gasoline-powered buggy steered by a tiller.

French bicycle manufacturer Armand Peugeot saw the Panhard-Levassor car and designed an automobile using a similar Daimler engine. In 1891 this first Peugeot automobile paced a 1,046-km (650-mi) professional bicycle race between Paris and Brest. Other French automobile manufacturers opened shop in the late 1800s, including Renault. In Italy, Fiat (Fabbrica Italiana Automobili di Torino) began building cars in 1899.

Early Electric Cars

For a few decades in the 1800s, electric engines enjoyed great popularity because they were quiet and ran at slow speeds that were less likely to scare horses and people. By 1899 an electric car designed and driven by Belgian inventor Camille Jenatzy set a record of 105.8810 km/h (65.79 mph). Early electric cars featured a large bank of storage batteries under the hood. Heavy cables connected the batteries to a motor between the front and rear axles. Most electric cars had top speeds of 48 km/h (30

mph), but could go only 80 km (50 mi) before their batteries needed recharging. Electric automobiles were manufactured in quantity in the United States until 1930.

Automobiles in the 20th century

For many years after the introduction of automobiles, three kinds of power sources were in common use: steam engines, gasoline engines, and electric motors. In 1900 more than 2,300 automobiles were registered in New York City; Boston, Massachusetts; and Chicago, Illinois. Of these, 1,170 were steam cars, 800 were electric cars, and only 400 were gasoline cars. Gasoline-powered engines eventually became the nearly universal choice for automobiles because they allowed longer trips and faster speeds than engines powered by steam or electricity.

Improvements in the operating and riding qualities of gasoline automobiles developed quickly after 1900. The 1902 Locomobile was the first American car with a four-cylinder, water-cooled, frontmounted gasoline engine, very similar in design to most cars today. Built-in baggage compartments appeared in 1906, along with weather resistant tops and side curtains. An electric self-starter was introduced in 1911 to replace the hand crank used to start the engine turning. Electric headlights were introduced at about the same time.

Most automobiles at the turn of the 20th century appeared more or less like horseless carriages. In 1906 gasoline-powered cars were produced that had a style all their own. In these new models, a hood covered the front-mounted engine. Two kerosene or acetylene lamps mounted to the front served as headlights. Cars had fenders that covered the wheels and step-up platforms called running boards, which helped passengers, get in and out of the vehicle. The passenger compartment was behind the

engine. Although drivers of horse-drawn vehicles usually sat on the right, automotive steering wheels were on the left in the United States.

In America, automobile designers borrowed features for their cars that were normally found on aircraft and ships, including tailfins and portholes. Automobiles were produced that had more space, more power, and smoother riding capability. Introduction of power steering and power brakes made bigger cars easier to handle. The Buick Motor Car Company, Olds Motor Vehicle Company (Oldsmobile), Ca-

dillac Automobile Company, and Ford all built enormous cars, some weighing as

much as 2,495 kg (5,500 lb). The first import by German manufacturer Volkswagen AG, advertised as the Beetle, arrived in the United States in 1949. Only two were sold that year, but American consumers soon began buying the Beetle and other small imports by the thousands.

(Source: By B Dinesh Prabhu, Assistant Professor, P E S College of Engineering, Mandya, KARNATAKA)

B. WRITING ACTIVITY

Writing Info

PARAGRAPH

It is essential to divide your writing into paragraphs. A paragraph normally contains several sentences but they are all concerned with the theme contained in the topic or key sentence (i.e. the main sentence) . The key sentence is usually the first one, which contains the main idea or topic. The other sentences support it by adding further information or examples. A paragraph is self contained but should link logically with the previous and following paragraphs so that the flow and cohesion of the writing is maintained.

1. Look at the paragraph at the end of Stage
2. Which is the key sentence?
3. The following sentences are in mixed order. To form a paragraph they need to be reorgan ised. Underline the key sentence and put the sentences i n the correct order by numbering them 1-5.
   a) It is mainly formal, impersonal and objective.
   b) In most of these the writer is expected to include references to other writing or research.
   c) Academic writing is a particular kind of writing that can berecognised by its style.

d) These include essays, research reports and articles, case studies,surveys, dissertations, theses, and examination papers.

(Source: Academic Writing: R.R Jordan, 2003)

Task Five. *Look at this extract from a tour of a car factory. Complete the text with the missing words: clutch, combustion, power, crankshaft, explosion, cylinders, distribution, fuel, piston, spark plug, rotational.*

"Now we come to the engine. The principle of the internal *combustion* engine has not changed in the last 100 years. The engine takes in _____ and air which is compressed in a combustion chamber. Then this mixture is ignited by a _____to produce an _____, which moves the _____in the cylinder. The up and down motion of the piston in the cylinder is converted into rotation motion by the _____. The _____force generated by the engine is known as torque. The size of the engine determines the _____. The more _____ there are, the more powerful the engine. This power is transmitted through the _____, the gearbox, the propeller shaft and the axles to the wheels. The position of the engine can vary, but generally speaking it is mounted at the front. In some sport cars, the engine is mounted at the rear or in the middle because of weight _____. So, that's enough about the engine for the moment, let's move on to the next stage."

C. SPEAKING ACTIVITY

Task Six: *Please practice the dialog in pairs.*

(Situation : The students are talking about their problem in their cars. They are talking in the park area),

Dodi **:** Siska... what are you doing?. What's wrong with your car?. Why smoke come from your car.

Siska : Dod ... help me please, I don't know. Iam afraid Dod...

Dodi **:** Calm down Siska. I check it first. Oh...your car engine is lack of water. Can you get some water, Siska?

Siska : (in a hurry, Siska finds some water nearby). Dodi ... here is the water. Iam so nervous now.

Dodi : Ok, it's fine now. . . let the bonnet of hood engines open. Let the water in radiator cooling your car engine.

Task Seven. *(A Project Assignment in Group of 5). Please report the automotive workshop process around you. The project will be presented in front of the classroom.*

D. GRAMMATICAL ACTIVITY

Cause – Effect

Because is used to express expected result. Cause and effect are shown because one side it causal and the other is result.

Example:

1. The flight did not arrive on time because the radar system of the airport didn't function well.
2. She was so confident with her preparation that she could perform very well in the seminar.
3. As the analysis of the report has not been done, the meeting had to be cancelled.

Task Eight. *Complete the sentences by using because.*

1. The letter was returned to the sender _____it didn't have enough postage.
2. Susan spoke Spanish _____she lived in Mexico for a year.
3. We postponed our trip _____the weather was bas.
4. She missed the class _____she was ill.
5. _____it was hot weather. We went swimming.

E. LISTENING ACTIVITY

Task Nine. *Listen to the conversation and match vocabularies with suitable words in the conversation.*

Dialog 1

a. Clean and smooth
b. Firm and well formed
c. Glossy and clean
d. Clean and bright
e. Normal for height and bone structure
f. Body held guardedly when walking, and sitting
g. Clear and Bright
h. Can sleep well
i. Optimistic about life
j. Able to overcome the stress of everyday life

BODY	DESCRIPTION
Muscles	
weight	
Attitude	
Sleep	
Eyes	

Behaviour	
Posture	
Skin	
Teeth	
hair	

III. EVALUATION OF ACTIVITY

A. PERFORMANCE TEST

very student is asked to make a dialog in pairs in front of the class to express certainty!

B. WRITTEN TEST

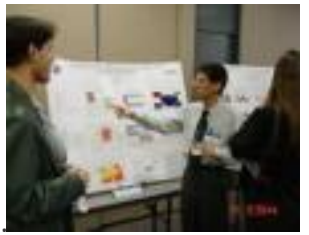
- ***LISTENING SECTION***

A. Pictures

1. 

2. 

3. 

4. 

B. Question – Response

5. Mark your answer on your answer sheet.
6. Mark your answer on your answer sheet.
7. Mark your answer on your answer sheet.
8. Mark your answer on your answer sheet.
9. Mark your answer on your answer sheet.

C. Short Conversations

10. What is the woman occupation?
    A. Running coach
    B. Baseball player
    C. Telephone operator
    D. Telephone installer
11. What is the relationship of the speakers?
    A. Bankers and client
    B. Accountant and cashier
    C. Waiter and customer
    D. Coffee grower and bean picker
12. How much longer will the man stay?
    A. 10 minutes
    B. 15 minutes
    C. 30 minutes
    D. 60 minutes

D. Short Talks

Questions 13-14 refer to the following

13. What is wrong with water supply?
    A. There is no water
    B. The water tastes bad
    C. The water is contaminated
    D. The water is rusted

14. How can residents make the water safe?
    A. Boil it
    B. Freeze it
    C. Put tablets in it
    D. Let sediment settle before drinking

Question 15 refer to the following talk

15. Who will listen to this announcement?
    A. Chefs
    B. Restaurant patrons
    C. School children in cafeteria
    D. Guests at dinner party

- **READING**

SECTION E. Complete the

Sentences

16. Everyone left the building _____the security guard
    A. except C. excess
    B. access D. accept
17. Plane tickets _____when the fuel prices increase
    A. ascend C. rise
    B. grow D. elevate
18. Mr. Robert _____a pencil from Mrs. Jean.
    A. give C. borrow
    B. send D. offer
19. Our lecturer reminded us not to _____sport shoes in the class.
    A. have C. using
    B. taking D. wear

F. Reading Comprehension

Questions 20 – 23 refer to the following advertisement

Company Index

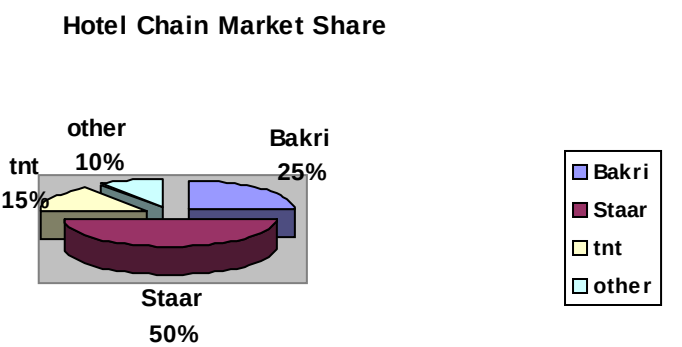
This index lists businesses mentioned in this issue of Global Economy

Acme Power and Light	**44**
Allied Steel	**53**
Best Iron Ore Supply	**56**
Canadian Rail Service	**83**
Chemical Times	**15**
Consumer's Electric	**41**
Ford Gas	**4**
Health Inc.	**12**
International Oil	**16**
Liberty Funds	**46**
Network Travel	**52**
Pride Hotels	**76**
TNT Air	**34**

20. This index is most likely found in?
    A. A magazine
    B. An interoffice memo
    C. A newsletter
    D. A book
21. What type of industries not represented?
    A. Travel
    B. Computer
    C. Heavy industries
    D. Utilities industries

22. What type of business has index less than 10?
    A. Health Inc.
    B. Ford Gas
    C. TNT Air
    D. Chemical Times
23. What percentage is the difference between Ford gas and health inc.?
    A. 75 percent
    B. 25 percent
    C. 100 percent
    D. 50 percent

Questions 24 – 25 refer to the graph as below.



24. Who would be most interested in reading this graph?
    A. Tourists
    B. Competing hotels
    C. Landscape architects
    D. Job hunters

25. According to the graph, Bakri _____
    A. is the top ranking of market share
    B. is only in Latin America
    C. has less of a share than tnt
    D. has one-quarter of the market

Questions 23 – 25 refer to the memo as below.

MEMORANDUM

To : Farhan Stanford
Purchasing Division
From : Frans Dove
Personnel
Ref : Additional Requests
Date : April 10th, 2005

We need computers for use in th e office, answering machines for our consultants, fax machines for the shipping department and additional photocopier for personnel administration before April 28th or at latest 2 days after it.

23. Who sent the memorandum?
    A). Personnel
    B). Farhan Stanford
    C). Purchasing Division
    D). Marketing staff

24. Who is asked to buy the equipments for office?
    A). Personnel
    B). Farhan Stanford
    C). Purchasing Division
    D). Marketing staff

25. When was the memo written?
    A). 2 days
    B). April 10th
    C). April 28th
    D). Today

UNIT 7
HEALTH AND SAFETY AT WORK

I. LESSON PREPARATION

A. BASIC COMPETENCES

After completing this learning, students are expected to have basic competence to understand the key features of health and safety symbols based on regulations and how these are applied in engineering to ensure safe working conditions.

B. CONTENTS OBJECTIVE OF LEARNING

Students will be able to

1. Understand the key symbols of health and safety based on regulations
2. Know how to identify and control hazards in the workplace
3. Understand the methods used when reporting and recording accidents and incidents.

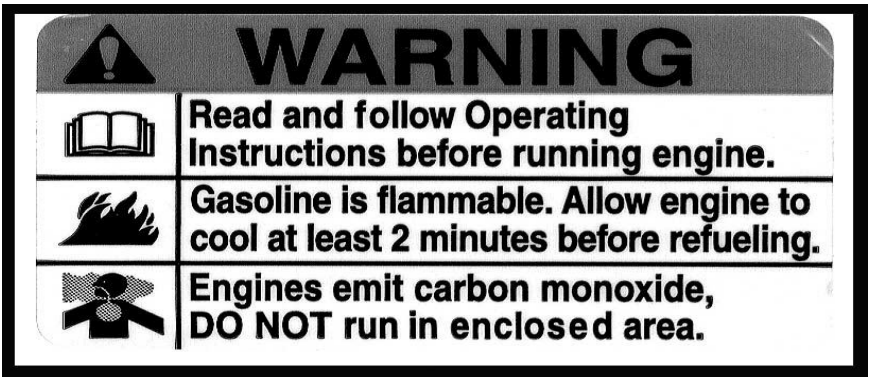
C. LANGUAGE OBJECTIVE

Students will be able to comprehend the reading texts given by using multi-leveled reading group texts.

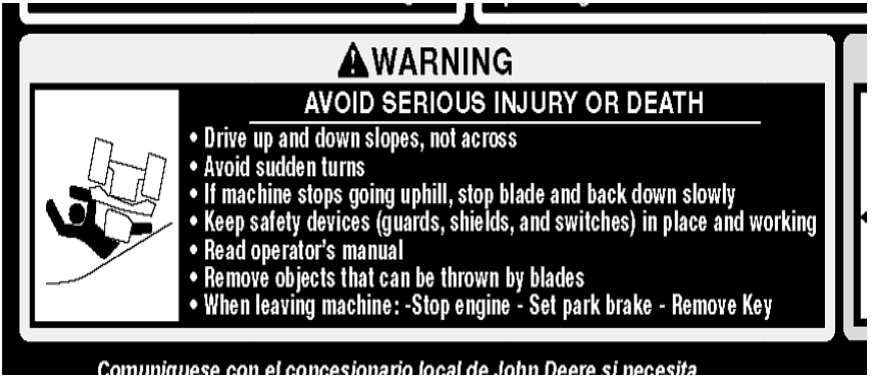
II. PARTS OF ACTIVITIES

A. READING ACTIVITY

Task One. *Study the following pictures below (in group). They show some areas of health and safety at work. Can you describe the following pictures? What are they?*



Picture 1



Picture 2

Task Two. *Read the following reading texts below (together with your lecturer) and then please choose 10 key words in the texts.*

Text 1

Safety and health is an area concerned with protecting the safety, health and welfare of people engaged in work or employment. The goal of all occupational safety and health programs is to foster a safe work environment. As a secondary effect, it may also protect co-workers, family members, employers, customers, suppliers, nearby communities, and other members of the public who are impacted by the workplace environment. The average person finds it difficult to assess risks and that is why work practices need to be regulated.

Safety in the workplace is critical to the success of your business, no matter what size it is. As a business owner you have responsibilities regarding health and safety in your workplace. Even if you don't have any employees, you must ensure that your business doesn't create health and safety problems for your customers and the general public.

Knowing and understanding the Occupational Health and Safety laws can help you avoid the unnecessary costs and damage to your business caused by workplace injury and illness. There are many examples of dangerous activities at your workplace, such as welding without goggles, working at a construction site without the protection of a hard hat, working in noisy environments without ear plugs or mufflers, working in production with different possibly hazardous materials without protective gloves and/or clothes, smoking near inflammable substances…

There are different risky or hazardous situations, such as: combustion, contamination, dust, the possibility of explosion, poisonous fumes, gas leakages, toxic vapors, the danger of electrical shock … which can all have effects on us and can cause lethal or very serious damage to our body (for example: vomiting, dizziness, burns, birth defects, cancer, genetic damage). All around risky environments or materials there are warning signs that people have to take seriously. Below you can see three such examples.


(Source: www.pharmaininfo.net, www.ehs.uky.edn, Pictures of Warning signs)

Task Three. *In group (together with your lecturer), please name and mention the the following pictures and identify if a worker is absent without them.*


Picture 1


Picture 2


Picture 3


Picture 4


Picture 5

Text 2

How do you know if something in your workplace is a hazard? Hazards are... dangers at work. You might have a hazard to do with machinery, equipment, raw materials, workplace, other workers, your job, and poor housekeeping. How can these things affect you and make you less safe at work?. The hazard from machinery when

you might work too close to machines that make lots of noise. The hazard from raw materials when you might use chemicals or be near chemicals where you can breathe the fumes or where they could be spilled on your body. The hazard from equipment where equipment and tools may not be put away correctly and could fall down or people could get hit by them. The hazard from workplace where there could be oil or water spilt on the ground where you work that could make you slip and fall. Your job In your job you may have to do a lot of lifting or twisting with your body or arms.

Task Four. *In Group investigation. List some of the potential dangers in your laboratory, workshop, or place work. How is the risk of these hazards reduced?.*

Text 3

Task Five. *Study the safety instructions from a workshop below, then answer the questions.*

SIGNS

The term “sign” includes signboards and acoustic, verbal or hand signals. Signboards are signs that use a combination of shape, colour and a symbol or pictogram. Signboards should not contain text as the symbols or pictograms on a signboard are intended to be understood, independently of the literacy or language ability of the worker viewing it.

Text may be included on a supplementary signboard provided that it does not adversely affect the effectiveness of the safety signboard. The system for signs and signboards is based on the familiar “traffic light” colours:

- red for prohibition
- yellow for caution
- green for positive action.

A fourth colour, blue, is used for mandatory signs and to convey information such as

the location of a telephone. The shapes of the signboards are standardised:

- discs for prohibitions and instruction
- triangles for warnings
- squares and rectangles for emergency and informative signs.

Examples of prohibition signs

Examples of mandatory signs

Examples warning signs

Design of Safety Signboards

Prohibition signboards

Shape: Round

Background: White

Symbol/pictogram: Black

The safety colour red must appear around the edge and in a transverse bar and must cover at least 35% of the surface of the sign.

Warning signboards

Shape: Triangular

Background: Yellow with black edging

Symbol/pictogram: Black

A yellow triangle must have a black edge. The safety colour yellow must cover at least 50% of the surface of the sign.

Mandatory signboards

Shape: Round

Background: Blue

Symbol/pictogram: White

The safety colour blue must cover at least 50% of the surface of the sign.

Emergency escape or first-aid signboards

Shape: Rectangular or square

Background: Green

Symbol/pictogram: White

The safety colour green must cover at least 50% of the surface of the sign.

Fire-fighting signboards

Shape: Rectangular or square

Background: Red

Symbol/pictogram: White

The safety colour red must cover at least 50% of the surface of the sign.

Supplementary signboards

Background: White

Wording: Black or

Background: Safety colour

Wording Contrasting colour.

Symbols/pictograms

The design must be as simple as possible and details not comprehensible must be omitted.

Signs must be cleaned and checked to maintain their effectiveness and where they have a power supply they should be provided with a guaranteed back-up supply.

Where persons are present whose sight or hearing is impaired (including by the use of personal protective equipment) then other measures must be taken to ensure the effectiveness of the signs.

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www.cartuningcentral.com

Glossary of Terms

A

abrasion The process of rubbing, grinding or wearing away by friction using an abrasive such as emery, corundum, diamond, etc.

adhcsivc Substances used for joining materials, usually without the necessity for heat, based on natural substances (animal bone, casein, rubber, etc.) or synthetic resins.

a d d A body shaped **so as** to produce an appreciable 'lift', Le. a force normal to the direction of fluid flow relative to the body, and a small 'drag' force in the same direction **as** the flow. Aerofoil sections are used for turbine blades, wing sections, etc.

air-fuel ratio The ratio of the mass of air to mass of fuel entering an internal combustion engine, gas turbine or boiler furnace.

air motor A motor which converts the energy of compressed air into mechanical ***energy,*** usually **as** a rotation. The main types are axial or radial piston, and vane.

alloy A substance with metallic properties composed of two or more chemical elements, at least one of which is a metal.

alternator A type of a.c. generator driven at constant speed to generate the desired frequency.

anemometer A mechanical **or** electrical instrument for measuring the velocity of a fluid stream, particularly wind velocity. The main types are, cup, vane and hot wire.

angle gauges Sets of metal blocks with two opposite faces at various angles to one another, used separately or jointly to measure angles to a high degree of accuracy.

angular velocity The rate of change of angular displacement with respect to time, expressed in radians per second, dO/dt or **0** (rad **s-** ').

are wddiag A process for joining metals by fusion in which heat is produced by an electric arc. uitbmetic **mean** The sum of ***n*** numbers divided by ***n.***

axial flow machines Pumps, fans, compressors, turbines, etc., in which the fluid flows generally parallel to the axis of rotation.

B

balancing Measuring the static or dynamic outof- balance forces in a rotating part and adding or subtracting mass to cancel them out.

barometer Instrument for measuring atmospheric pressure, the main types being the aneroid and Fortin barometers.

beams Bars, rods, etc., of metal or other material carrying transverse loads with various types of support, e.g. simple supports, built-in ends, continuous supports.

bearing A fixed support for a rotating shaft or sliding part with minimum friction.

belt drive The transmission of power from one shaft to another by means of an endless belt which may be flat or of vee section, etc.

bending moment The algebraic sum of the moments of all the forces to either side of a transverse section of a beam, etc.

bending modulus A property of a section equal to the bending moment divided by the maximum bending stress.

bend loss The loss of pressure in a fluid flowing around a bend in a pipe or duct. Bernoulli **equation** States that in a pipe or duct in which a fluid flows, the sum of the pressure, potential and kinetic energies is equal at any point.

bevel gear A toothed wheel with teeth formed on a conical surface used for transmitting rotation from a shaft to one at an angle to it in the same plane, usually at right angles.

binary numbers A scale of numbers with 'radix' equal to **2** as opposed to the usual scale radix of **10** (decimal numbers). Only two symbols are used: 0 and **1.**

binomial coefficients Coefficients of terms of the expansion of **(1** + **x)"** using the binomial theorem.

binomial distribution A distribution used in statistics based on the binomial theorem which gives the probability of an event taking place.

black body In the study of radiation of heat, a body which completely absorbs heat or light falling on it.

black-body radiation The quantity or quality of radiation from a black body, e.g. from the inside of a cavity.

blade A curved plate often of aerofoil section used to deflect a fluid flow, e.g. airscrew or propeller blade, turbine blade, impeller vane.

blank A piece of sheet metal cut to a suitable shape to be subject to further pressing processes. A pressed sintered component requiring further machining, etc.

blower A rotating, usually air, compressor for supplying relatively large flows at a low pressure.

boiling point The temperature at which a liquid boils at standard atmospheric pressure of **101.325** kN m-2.

bolt A cylindrical partly screwed bar with a (usually) hexagonal head used in conjunction with a 'nut' to fasten two or more parts together.

bore Hole or cavity produced by a single- or multipoint tool, usually cylindrical.

boundary layer A thin layer of fluid adjacent to a surface over which the fluid flows, which exerts a viscous drag on the surface due to the large velocity gradient.

boundary lubrication A state of partial lubrication in a plain bearing where there is no oil film, only an adsorbed monomolecular layer of lubricant in the surfaces.

Boyle's law States that, for a 'perfect gas' the volume of a given mass varies inversely as the pressure at constant temperature.

brake A device for applying resistance to the motion of a body, either to retard it or to absorb power (dynamometer).

brazing The joining of metals by a thin capillary layer of non-ferrous metal filler in the space between them. Carried out above about 800 "C.

brittle fracture Fracture of a material with little or no plastic deformation.

broaching The cutting of holes of various shapes or cutting of an outside surface, with a 'broach'consisting of a tapered bar with cutting edges. The broach moves in a reciprocating axial manner.

buckling Sudden large-scale deformation of a strut, thin cylinder, etc., due to instability when loaded, e.g. an axial load on a strut.

bulk modulus The ratio of pressure (three-dimensional stress) to volumetric strain of a material.

butt welding The welding together of abutting members lying in the same plane.

C

cam A sliding mechanical device used to convert rotary to linear (usually) motion, and vice versa.

capacitor An electrical component having capacitance usually consisting of two conducting surfaces of large area separated by a very thin (usually) dielectric.

case hardening The production of a hard surface on steel by heating in a carbonaceous medium to increase the carbon content, and then quenching.

casting An object at or near-finished shape obtained by the solidification of a molten substance in a 'mould'. The name of the process.

cast iron Iron containing carbon suitable for casting, e.g. grey, white, malleable, nodular.

cavitation The formation and sudden collapse of bubbles in a liquid due to local reduction in pressure. Cavitation erosion may be caused on local metal surfaces.

centre drilling Drilling of a conical hole in the end of a workpiece to support it while being rotated. **A** 'centre drill' is used.

centreless grinding The grinding of cylindrical or conical surfaces on workpieces running in rollers instead of centres.

centre of gravity (centre of mass) The imaginary point in a body at which the mass may be assumed to be concentrated.

centre of pressure The point on a submerged surface at which the resultant pressure may be taken to act.

centrifugal casting A casting made by pouring molten material into a rotating mould. This improves the quality of the casting.

centrifugal compressor A machine similar to the centrifugal pump used for increasing the pressure of gases such as air. It may have several stages.

centrifugal force A body constrained to move in a curved path reacts with a force (centrifugal force) directed away from the centre of curvature. It is equal and opposite to the force deviating the body from a straight line called the 'centripetal force'. Both are equal to the mass multiplied by the 'centripetal acceleration'.

centrifugal pump A pump, usually for liquids, which has a rotating 'impeller' which increases the pressure and kinetic energy of the fluid.

ceramics Non-organic, non-metallic materials of brittle nature, e.g. alumina, carbides.

chain drive A device consisting of an endless chain (usually a 'roller chain') connecting two wheels (sprockets) on parallel shafts.

charge A quantity of unbalanced electricity in a body, i.e. an excess or deficiency of electrons.

chip breaker A groove in a cutting tool used to break continuous chips for safety and handling reasons.

chuck A device for holding work or tools during machining operations.

clearance The gap or space between two mating components.

closed cycle gas turbine A gas turbine unit in which the working fluid continuously circulates without replenishment.

clutch A device used to connect or disconnect two rotating shafts, etc., either while rotating or at rest.

cold working Plastic deformation of metal below the recrystallization temperature.

column A vertical member with a compressive load; a strut.

combined stress A state of stress combining tensile (or compressive), shear, and bending stresses.

combustion equations Chemical equations used in the study of combustion of fuels for engines, boilers, etc.

combustion products Chemical products resulting from the combustion of fuels in air.

complex number A number of the form (a+ib) having a 'real' part **a** and an imaginary part ib where i = J-1. The symbol ***j*** is also used.

composite A material consisting of a mixture of two or more materials, e.g. glass or carbon fibres in a plastic matrix.

compressibility The reciprocal of 'bulk modulus'.

compression ignition engine An engine in which ignition takes place **as** the result of temperature rise in the air/fuel mixture due to compression.

compression ratio In an internal combustion engine, the ratio of the total volume in a cylinder at outer dead centre to the clearance volume. In powder metallurgy, the ratio of the volume of loose powder to the volume of the 'compact' made from it.

compressive strength The maximum compressive stress a material will withstand, based on the original cross-sectional area.

compressive stress Compressive force divided by area of cross-section.

compressor A rotary or reciprocating machine which compresses air or other gases.

condenser A heat exchanger in which a vapour, e.g. steam, is condensed, usually by water flowing in tubes over which the vapour passes.

conductance The property of a substance which makes it conduct electricity. The unit is the 'siemens' (symbol G). The reciprocal of resistance.

conduction of **heat** Heat transferred from one part of a medium to another without motion, the heat being passed from one molecule to another.

conductivity (electrical) Conduction (reciprocal of resistance) between opposite faces of a **1** m cube at a specified temperature. The unit is the 'ohm metre' (symbol a-m).

conductivity (thermal) A measure of the rate at which heat flows through a wall by conduction. The unit is watt per metre per kelvin **(W** m-I **K-** ').

conservation of **energy** The energy in a closed system cannot be changed but only interchanged, e.g. potential to kinetic energy.

conservation of matter Matter is neither created nor destroyed during any physical or chemical change.

constant-pressure cycle (Diesel cycle) An ideal engine cycle in which combustion is assumed to take place at constant pressure.

constant volume cycle (Otto cycle) An ideal cycle in which combustion is assumed to take place at constant volume. The basis for the petrol engine cycle.

contact *stresses* The localized stress between contacting curved surfaces and between a curved and a flat surface, such as occurs in ball and roller bearings.

continuous beam A beam supported on three or more supports.

continuous casting A process in which an ingot, billet or tube is produced continuously.

convection of **beat** The transfer of heat from one part of a fluid to another due to 'convection currents' often due to gravity (natural convection) or by induced flow (forced convection).

convergent-divergent nozzle A nozzle for fluid flow which decreases in area to a throat and then increases in area to the exit; the flow may be supersonicat outlet.

convergent nozzle A nozzle for fluid flow which decreases in area to a 'throat' at outlet. **core** A formed object inserted into a mould to shape an internal cavity.

core box In casting, a box in which cores are formed in sand, etc.

corrosion The deterioration of a metal by chemical or electrochemical reaction with its environment.

counterboring Drilling or boring a flat-bottomed hole, often concentric with other holes.

counterflow heat exchanger A heat exchanger in which the two fluids flow in opposite directions.

countersinking Forming a conical depression at the entrance to a hole for deburring, and for countersunk screw heads.

couple Two equal and opposite forces parallel to one another. The distance between them is the 'arm'. Its magnitude is the product of one force and the arm.

crank An arm on a shaft with a pin used to produce reciprocating motion with a connecting rod.

crankshaft A shaft carrying several cranks, usually at different angular positions, to which connecting rods are fitted in an engine, reciprocating pump, etc.

creep Slow plastic deformation of metals under stress, particularly at high temperatures.

creep resistance Resistance of metals to creep.

critical *speed* A rotational speed corresponding to a natural frequency of transverse vibrations of the member. Also called 'whirling speed'.

cutting fluid A fluid used in metal cutting to improve finish, tool life, and accuracy. It acts as a chip remover and a coolant.

cutting *speed* The linear or peripheral speed of relative motion between a cutting tool and workpiece in the principal direction of cutting.

cylindrical grinding Grinding the outer cylindrical surfaces of a rotating part.

D

damped Vibrations reduced in amplitude due to energy dissipation.

damping The reduction in amplitude of vibrations due to mechanical friction in a mechanical system or by electrical resistance in an electrical one.

deceleration Negative acceleration. The rate of diminution of velocity with time. The unit is metres per second per second (ms-*). dedemhn The radial distance between pitch circle and the bottom of a gear tooth.

density The mass of a unit volume of a substance. The unit is kilograms per metre cubed (kgm-3).

depth of *cut* The thickness of material removed from a workpiece in a machine tool during one pass.

die A tool used to impart shape in many processes, e.g. blanking, cutting, drawing, forging, punching, etc.

die casting A casting made in a die. A process where molten metal is forced by high pressure into a metal mould.

direet current (d.c.) An electric current which flows in one direction only.

draft tube Discharge pipe at a water turbine outlet which reduces the water velocity and improves efficiency.

drag The resistance to motion of a body moving through a fluid.

drag coefficient A non-dimensional quantity relating drag to projected area, velocity and fluid density.

drawing Forming recessed parts by the plastic flow of metal in dies. Reducing the diameter or wire by pulling through dies of decreasing diameter.

drill A rotating end cutting tool with one or more cutting lips used for the production of holes.

drop forging A forging made using a 'drop hammer'.

dry flue gas Gaseous products of combustion excluding water vapour.

dryness fraction The proportion by mass of dry steam in a mixture of steam and water, i.e. in 'wet steam'.

dynamic balancing The technique of eliminating the centrifugal forces in a rotor in order to eliminate vibration.

dynamic pressure Pressure in a moving fluid resulting from its instantaneous arrest equal to ***pv2/2,*** where p=fluid density, V=velocity.

dynamics A study of the way in which forces produce motion.

dynamic viscosity (coefficient of viscosity, absolute viscosity) In a fluid the ratio of shear stress tovelocity gradient. Units are newton seconds per square metre (N-s rn-').

dynamo An electromagnetic machine which converts mechanical to electrical energy.

dynamometer A device for measuring the power output from a prime mover or electric motor.

E

effectiveness of a heat exchanger The ratio of the 'heat received by the cold fluid' to the 'maximum possible heat available in the hot fluid'.

efficiency A non-dimensional measure of the perfection of a piece of equipment, e.g. for an engine, the ratio of power produced to the energy rate of the fuel consumed, expressed as a fraction or as a percentage.

elastic constants The moduli of elasticity for direct stress, shear stress and hydrostatic stress and also Poisson's ratio.

elastic deformation Change of dimensions in a material due to stress in the elastic range.

elasticity The property of a material by virtue of which it recovers its original size and shape after deformation.

elastic limit The greatest stress that can be applied to a material without permanent deformation.

electrical resistance The real part of impedance which involves dissipation of energy. The ratio of voltage drop to current in a conductor.

electric strength The maximum voltage that can be applied to a piece of insulation before breakdown occurs.

electrochemical corrosion Corrosion due to the flow of current between anodic and cathodic areas on metal surfaces.

elongation In tensile testing the increase in length of a specimen at fracture as a percentage of the original length.

end milling Machining with a rotating peripheral and end cutting tool **(see** face milling).

endurance limit Same as 'fatigue limit'.

energy The capacity of a body for doing work. Types are: kinetic, potential, pressure, chemical, electric, etc.

energy fluctuation coefficient The ratio of the variation in kinetic energy in a flywheel due to speed fluctuation, to the average energy stored.

equilibrium The state of a body at rest or in uniform motion. A body on which the resultant force is zero.

erosion The destruction of metals, etc., by abrasive action of fluids usually accelerated by the presence of solids.

excess air The proportion of air used in excess of the theoretical quantity for complete combustion of a fuel.

expansion The increase in volume of a working fluid, e.g. in a cylinder with moving piston. The opposite is 'compression'. In mathematics the expression of a function as an infinite series of terms.

expansion coefficient (coefficient of expansion) The expansion per unit length, area, or volume, per unit increase in temperature.

explosive forming Shaping metal parts confined in dies using the pressure from an explosive charge.

extensometer A sensitive instrument for measuring the change in the length of a stressed body.

extrusion The conversion of a 'billet' of metal into lengths of uniform cross-section by forcing it through a die, usually when heated.

face mill A rotating milling cutter with cutting edges on the face to mill a surface perpendicular to the cutting axis.

F

facing Generating a flat surface on a rotating workpiece by traversing a tool perpendicular to the axis of rotation.

factor of safety The ratio between ultimate (or yield) stress for a material and the permissible stress. (Abbreviation FS or FOS).

failure The breakdown **of** a member due to excessive load. Several 'theories of failure' are used.

fan A device for delivering or exhausting large quantities of air or other gas at low pressure. It consists basically of a rotating axial or centrifugal impeller running in a casing.

fatigue Phenomenon leading to the failure of a part under repeated or fluctuating stress below the tensile strength of the material.

fatigue life The number of cycles of fluctuating stress required to produce failure in a fatigue test.

fatigue limit (endurance limit) The maximum stress below which a material can endure an infinite number of stress fluctuation cycles. This only applies to a specially made specimen with a high degree of surface finish.

feed The rate of advance of a cutting tool along the surface of the workpiece.

fibres In 'composites', fine threads of a long length of glass, carbon, metal, etc., used to reinforce a material (e.g. plastics, metals), known as the 'matrix'. filler **metal** Metal added in soldering, brazing and welding processes, usually in the form of a rod or stick.

film lubrication Lubrication where the shaft is separated from the bearing by a thin film of lubricant which is under pressure and supports the load.

fin One of usually a number of thin projections integral with a body (e.g. engine cylinder block, gearbox, cooler) which increase the cooling area.

finish The surface condition, quality and appearance of a metal, etc., surface.

finish machining The final machining of a component where the objectives are surface finish and accuracy of dimension.

fit The clearance **or** interference between mating parts. Also the term for a range of clearance suggested by standards such as British Standards.

fitting loss The pressure or head loss incurred by fittings in a pipe or duct such as valves, bends, branch, etc.

flame cutting The cutting of metal plate to a desired shape by melting with an oxygen-gas flame.

flame hardening Quench hardening where the heat is supplied by a flame.

flange A projecting annular rim around the end of a cylinder or shaft used for strengthening, fastening or locating.

flat-plate theory A study of the stresses and deflection of loaded flat plates. It is assumed that the plate is relatively thin and the deflections small.

flexible coupling A coupling usually joining rotating shafts to accommodate lateral or angular misalignment.

flowmeter An instrument for measuring the volumetric or mass flow of a fluid.

flow rate The rate of flow of a fluid. Units: cubic metres per second (m3 **s-')** or kilograms per second (kgs- ').

flux Material used in soldering, brazing and welding to prevent the formation of, dissolve, or facilitate the removal of, oxides, etc.

flywheel A heavy wheel on a shaft used either to reduce speed fluctuation due to uneven torque, or to store energy for punching, shearing, forming, etc.

force That quantity which produces acceleration in a body measured by the rate of change of momentum. Unit: newton (N).

forging Plastic deformation of metal, usually hot, into the desired shape using a compressive force with or without dies.

form cutter A cutter profile sharpened to produce a specified form of work.

four-stroke cycle An engine cycle of **4** strokes (2 revolutions) consisting of induction, compression, expansion (power) and exhaust strokes; e.g. in the Otto and Diesel cycles.

Francis turbine A reaction water turbine in which water flows radially inwards through guide vanes and a runner which it leaves axially.

frequency The rate of repetition of a periodicdisturbance. Units: hertz (Hz) or cycles per second. Also called 'periodicity'.

fretting corrosion Surface damage between surfaces in contact under pressure due to slight relative motion, especially in a corrosive environment.

friction The resistance to motion which takes place when attempting to move one surface over another with contact pressure.

G

gas welding Welding using the heat of an oxygen-gas flame.

gear ratio The **speed** ratio for a pair or train of gears determined by the number of teeth **on** each gear.

gear wheel A toothed rotating wheel used in conjunction with another wheel of the same or different diameter, to transmit motion to another shaft. The main types are spur, bevel, worm and epicyclic.

geometric factor A factor dependent **on** the shapes of bodies between which heat or light is radiated. This factor affects the heat-transfer coefficient.

geomehic Progression A **series** of numbers in which each number is derived by multiplying the previous number by a constant multiplier called the 'ratio'.

governor A **speed** regulator **on** variable-speed electric motors and prime movers, etc.

gravitation The attractive force between two masses. The force is proportional to the product of the masses and inversely proportional to the square of the distance between their centres of mass.

grinding The removal of metal, etc., using an abrasive 'grinding wheel'.

gas processes Changes in the properties of a substance, e.g. isothermal, isentropic, constant volume, etc.

gas refrigeration cycle A cycle using a reversed constant pressure cycle in which the working substance is always a gas.

gas shielded **arc welding** Arc welding with a shield of inert **gas,** e.g. argon, helium, to prevent oxidation.

gas turbine set A prime mover consisting of one or more axial or centrifugal compressors, combustion chamber(s) (or gas heater), and one or more axial or radial flow turbines. The compressor(s) are driven by one turbine and a turbine delivers useful power.

H

h a r k The resistance of metals to plastic deformation, usually by indentation. Measured by tests such **as** Brinell, Rockwell, and Vickers pyramid.

head The height of a liquid above a datum in a gravity field.

heat engine A system operating on a complete cycle developing net work from a supply of heat.

heat Bow rate Heat flow per unit time in a process. Unit: watt **(W).**

heat transfer The study of heat flow by conduction, convection and radiation.

heat transfer coefieint A coefficient h relating, heat flow ***q,*** area of flow path A and temperature difference AT for heat transfer between two phases: q=hAAT.

heat treatment Heating and cooling of solid metals to obtain the desired properties. helical gear A gear in which the teeth are not parallel to the axis but on a helix. helix A line, thread **or** wire curved into a shape it would assume if wrapped around a cylinder with even

spacing. Mix angle In screw threads, etc., the angle of the helix to a plane at right angles to the axis. honing The removal of metal, usually from a cylinder bore, by means of abrasive sticks on a rotating holder.

hot forming Forming operations such as bending, drawing, forging, pressing, etc., performed above the recrystallization temperature of a metal.

hydraulic cylinder A cylinder with piston and piston **rod** supplied by a liquid under pressure to provide a force with linear motion. The cylinder may be single or double acting.

I

illuminence The quantity of light **or** luminous flux on unit **surface** area. Unit: lux (Ix)= 1 lumen per square metre (Imm-2).

impact extrusion A high **speed** cold working process for producing tubular components by a single impact by a punch. A slug of material placed in a die flows up and around the punch into the die clearance.

impact test A test to determine the behaviour of materials subjected to high rates of loading in bending, torsion and tension. The quantity measured is the 'impact energy' required to cause breakage of a specimen.

impulse When two **bodies** collide the impulse of the force during impact is JFdt. Defined **as** the change of momentum produced in either body.

impulse reaction turbine A steam turbine with impulse stage followed by reaction **stages.**

impulse turbine A steam, ***gas*** or water turbine in which the working fluid is **accelerated** through **nozzles** and impinges on blades or buckets in which there is no pressure drop.

inductance The property of an electric circuit carrying a current is characterized by the formation of a magnetic field and the storage of magnetic energy.

induction heating The heating of conducting materials by inducing electric currents in the material, usually by a high-frequency source. induction motor An ax. motor in which the primary winding current sets up a magnetic flux which induces a current in the secondary winding, usually the rotor.

interchange factor When two bodies are involved in the interchange of heat radiation, the radiation depends upon the emissivities of both bodies. Interchange factor is a function of the emissivities which allows for this.

intercooler A cooler, usually using water, interposed between air compressor stages.

internal combustion engine (I.C. engine) An engine in which combustion takes place within a chamber, e.g. a cylinder, and the products of combustion form the working fluid, e.g. petrol engine, diesel engine, gas engine.

internal energy The difference between the heat energy supplied to a system and the work taken out. The energy is in the form of heat as measured by the temperature of the substance **or** its change of state.

investment casting Casting of metal in a mould produced by coating an expendable pattern made of wax, plastic, etc., which is removed by heating. Also 'lost wax process'.

involute gear teeth Gear-wheel teeth the flank profile of which consists of an involute curve. The commonest form of gear teeth.

J

jet A fluid stream issuing from an orifice, nozzle, etc.

jet engine An engine incorporating rotary compressor and turbine which produces a high-velocity jet for the propulsion of aircraft.

jig A device to hold a workpiece and guide a tool in cutting operations.

jig boring Boring carried out on a 'jig borer' on which the positions of holes can be positioned to a high degree of accuracy.

journal bearing A bearing which supports a journal.

K

Kaplan turbine A propeller water turbine with adjustable runner blades which are altered to suit the load.

key A piece of material inserted between usually a shaft and a hub to prevent relative rotation and fitting into a 'keyway'.

K factor A factor giving the proportion of, or number of, velocity head@) lost in a pipe or in pipe fittings.

kinematic viscosity The coefficient of viscosity divided by the fluid density.

kinetic energy The energy of a body arising from its velocity. For a mass ***m*** at velocity ***v*** the kinetic energy is ***$mv2.***

L

labyrinth gland A gland used on steam turbines, gas turbines, etc., with radial fins on a shaft or surrounding casing, with small radial or axial clearance to limit fluid leakage.

lagging Thermal insulation on the surface of a pipe, tank, etc.

laminar flow (viscous flow) Fluid flow in which adjacent layers do not mix. It occurs at relatively low velocity and high viscosity.

lapping The finishing of spindles, bores, etc., to fine limits using a 'lap' of lead, brass, etc., in conjunctionwith an abrasive.

latent heat The heat required to change the 'state' of a substance without temperature change, e.g. solid to liquid, liquid to gas. The latent heat per unit mass is the 'specific latent heat'.

lathe A versatile machine tool for producing cylindrical work by turning, facing, boring, screw cutting, etc., using (usually) a single-point tool.

lead The axial advance of a helix in one revolution, e.g. in screw thread or worm.

lift The component of force on a body in a fluid stream which is at right angles to the direction of flow. The force which supports the weight of an aircraft.

limit The maximum or minimum size of a component as determined by a specified tolerance.

linear bearing A bearing in which the relative motion is linear, as opposed to rotary.

lock nut An auxiliary nut used in conjunction with a normal nut to lock the latter.

lock washer A name for many types of washer used with nuts, etc., to prevent loosening.

lubricant Any substance, solid, liquid or gaseous, which may be used to reduce friction between parts.

M

machinability The relative ease of machining a particular material.

machine In mechanics, a device which overcomes a resistance at one point known as the 'load', by the application of a force called the 'effort' at another point; e.g. inclined plane, lever, pulleys, screw.

machining Removal of metal in the form of chips, etc., from work, usually by means of a 'machine tool'.

magnetism The science of magnetic fields and their effect on materials due to unbalanced spin of electrons in atoms.

mass flow rate The rate at which mass passes a fixed point in a fluid stream. Unit: kilograms per second (kgs- I).

matrix The material in a composite in which fibres, whiskers, etc., are embedded.

mechanical advantage In a 'machine', the ratio of load to effort.

mechanical efficiency In an engine, the ratio of useful power delivered to the 'indicated power', i.e. the efficiency regarded as a machine.

Merchant's circle A diagram showing the forces on a single-point machine tool.

metal forming The shaping of metals by processes such as bending, drawing, extrusion, pressing, etc.

mild steel Carbon steel with a maximum carbon content of about 0.25%.

milling The removal of metal by a 'milling cutter' with rotating teeth on a 'milling machine'.

mixed-flow heat exchanger A heat exchanger in which the flow of one fluid is a mixture of types, e.g.alternatively counterflow and cross-flow.

mixed-flow pump A rotodynamic pump in which the general flow is a combination of axial and radial.

mixture strength The ratio of 'stoichiometric' air/fuel ratio, to the 'actual' air/fuel ratio, used for engines. 0.8 is 'weak' and 1.2 is 'rich'.

modulus of elasticity A measure of the rigidity of a material. The ratio of stress to strain in the elastic region.

molecular weight The mass of a molecule referred to that of a carbon atom (12.000). The sum of the relative atomic masses in a molecule.

moment The moment of a force (or other vector quantity) about a point is the product of the force and the perpendicular distance from the line of action of the force to the point.

multi-pass heat exchanger A heat exchanger in which one of the fluids makes a series of passes in alternate directions.

N

natural vibrations Free vibrations in an oscillatory system.

non-destructive testing Inspection by methods which do not destroy a part, to determine its suitability for use.

nozzle A convergent **or** convergent-divergent tube through which a fluid flows. Used to produce a high-velocity jet.

nut A metal (or other material) collar internally screwed to fit a bolt usually of hexagonal shape but sometimes round **or** square. oil seal A device used to prevent leakage of oil, e.g. from a bearing in a gearbox.

P

parallel-flow heat exchanger A heat exchanger in which the two fluids flow parallel to one another and in the same direction.

pattern A form made in wood or other material around which a mould is made.

pendulum The 'simple pendulum' consists of a small heavy mass or 'bob' suspended from a fixed point by a string of negligible weight. Its periodic time for small oscillations is *2n-,* where L=length of string, g = acceleration due to gravity. The 'compound pendulum'is any body which oscillates about a fixed point a distance ***h*** from the centre of gravity with radius of gyration ***k.*** It has an equivalent simple pendulum length of ***(hz*** + ***k2)/h.***

Perfect gas A gas which obeys the 'gas laws'. A gas behaves as a perfect gas **as** the pressure is reduced.

permanent set Plastic deformation in a material that remains after the load is removed.

pitch The linear distance between similar features arranged in a pattern, e.g. turns of a screw thread, distance between rivets in a row.

pitch circle An imaginary circle on gear wheels on which the teeth are constructed, a circle on which bolt holes, etc., are pitched, etc.

plain bearing A bearing consisting of a plain bush or sleeve, as opposed to a ball **or** roller bearing.

plastic deformation Deformation that remains after a load is removed.

plasticity The ability of a metal to deform nonelastically without rupture.

Poisson distribution A statistical distribution characterized by a small probability of a specific event occurring during observations over a continuous interval. A limiting form of 'binomial distribution'.

polar second moment of area The second moment for an axis through the centroid perpendicular to the plane. It is equal to the sum of any two second moments of area about perpendicular axes in the plane.

polymer A material built up of a series of smaller units (monomers) which may be relatively simple, e.g. ethane, or complex, e.g. methylmethacrylate. The mechanical properties are determined by molecular size ranging from a few hundred to hundreds of thousands.

power The rate of doing work. Unit: watt (W).

power cycle A thermodynamic cycle in which net power is produced, e.g. Otto cycle.

power factor The ratio of total power dissipation in an electrical circuit to the total equivalent voltamperes applied to the circuit. pres A machine tool with a fixed bed and a guided reciprocating, usually vertical, ram.

press fit An interference **or** force fit made through the **use** of a press. The process is called 'pressing'.

pressure At a point in a fluid, pressure is the force per unit area acting in all directions. That is, it is a scalar quantity; e.g. in a cylinder with a piston, pressure p is the force on the piston divided by the cylinder area. pressure **trPasdllcer** A device which produces a, usually electrical, signal proportional to the pressure.

probability The number of ways in which an event can happen divided by the total possibilities. Symbol:***P.***

proof stress The stress to cause a small specified permanent set in a material.

pump A machine driven by a prime mover which delivers a fluid, pumping it to a greater height, increasing its pressure, or increasing its kinetic energy. Main types: rotodynamic, positive displacement. punch A tool that forces metal into a die during blanking, coining, drawing, etc. The process is called 'punching'.

push fit A fit similar to a 'snug' or 'slip' fit defined by several classes of clearance in British and other standards.

R

radiatioa of heat A process by which heat is transferred without the aid of an intervening medium.

reaction The equal opposing force to a force applied to a system. The load on a bearing or beam support.

reaction turbine A water, steam or gas turbine in which the pressure drop is distributed between fixed and moving blades. Strictly an impulse-reaction turbine.

refining The removal of impurities from a metal after crude extraction from ore.

refrigerator A machine in which mechanical or heat energy is used to maintain a low temperature.

regenerative heat exchanger A heat exchanger in which hot and cold fluids, usually gases, occupy the same space alternately.

reheat The process of reheating steam or gas between turbines to obtain higher efficiency.

resistance thermometer A thermometer using the change of resistance with temperature of a conductor. Platinum is used, as are semiconductors (thermistor).

resistance welding and brazing A process in which the resistance of a pressurized joint causes melting of the parts in contact.

resistivity A property of electric conductors which gives resistance in terms of dimensions. Resistance

resistor An electrical component designed to give a specified resistance in a circuit.

resistor colour code A method for marking the resistance value on resistors using coloured spots or bands.

roller bearing A journal or thrust bearing with straight **or** tapered rollers running between two 'races'.

rolling Reducing the cross-section of metal stock or the shaping of metal products using 'rolls' in a 'rolling mill'.

rolling bearings The general name given to lowfriction bearings using balls and rollers running in 'races'.

roughness In machining, surface irregularities, the dimensions and direction of which establish the surface pattern. In fluid flow, the height of irregularities in pipes, etc.

running fit Any clearance fit in the range used for relative motion.

S

screw A general name for fasteners with a screwed shank and a head. Also any section of bar with an external thread .

screw jack A portable lifting machine for raising heavy objects a small height. It uses a nut which carries the load rotated, usually by hand, through a lever system.

screw thread A helical ridge of vee, square, or rounded section formed on or inside a cylinder the form and pitch being standardized under various systems.

seizing The stopping of a moving part by a mating surface due to excessive friction caused by 'galling'.

sets In mathematics, any collection of 'entities' (elements) defined by specifying the elements. *See:* 'Venn diagram'.

shaft A circular section solid or hollow bar used for the transmission of motion and/or power.

shaft coupling A solid **or** flexible device for connecting, usually coaxial, shafts.

shrink fit An 'interference fit' between a hub and shaft, for example obtained by heating an under-sized hub to give a clearance and allowing it to cool on the shaft. Alternatively, the shaft may be cooled, e.g. by using 'dry ice'.

silver solder A brazing alloy of low melting point containing silver.

single-point tool A machine tool which has a single cutting point as opposed to a number of points, e.g. a lathe tool.

slotting Cutting a groove with a reciprocating tool in a vertical shaper, broach or grinding wheel.

soldering A similar process to brazing, but with a low-melting-point filler, e.g. alloy of lead, tin, antimony.

specific fuel consumption The mass of fuel used in an engine per unit of energy delivered. Unit: kilograms per megajoule (kg **MJ-I).**

specific heat capacity The quantity of heat required to raise the temperature of unit mass of a substance by one degree. Unit: J kg-'K-'.

specific speed A dimensionless quantity used in the study of rotodynamic pumps and turbines. It is the same for geometrically similar machines.

specific volume The volume per unit mass of substance. Unit: cubic metres per kilogram (m3 kg-').

spinning Shaping of hollow metal sheet parts by rotating and applying a force.

spot facing Machining flat circular faces for the seating of nuts, bolts, etc.

stagnation temperature The temperature which would be reached by a stream of fluid if it were brought to rest adiabatically.

standard deviation The root of the average of the squares of the differences from their mean **X** of a number ***n*** of observations x: standard deviation

static balancing Balancing of a rotating mass in one plane only. See: 'dynamic balancing'.

static pressure The pressure normal to the surface of a body moving through a fluid.

a = J W statics The branch of applied mathematics dealing with the combination of forces **so** as to produce equilibrium.

steam plant A power plant operating on a steam cycle, e.g. steam power station.

steam turbine A turbine using steam as a working substance. ***See:*** 'turbines'. s t d Iron based alloy containing manganese, carbon and other alloying elements.

strain The change in shape or size of a stressed body divided by its original shape or ***size,*** e.g. 'linear strain', 'shear strain', 'volumetric strain'.

strain energy The work done in deforming a body elastically.

strain gauge A metal grid or semiconductor rod on a backing sheet which is cemented to a strained body. The increase in length alters the electrical resistance of the grid or rod from which the strain may be deduced.

stress Force per unit area in a solid. The area is perpendicular to the force for tensile stress and parallel to it for shear stress. Unit: newtons per square metre (Nm-2).

stress concentration factor The ratio of the greatest stress at a 'stress raiser' to the nominal stress in a component.

stress raiser A local change in contour in a part, e.g. a hole, notch, change of section, etc., which gives rise to an increase in stress.

stress diving Heating a material to a suitable temperature and holding it long enough to remove residual stresses, then slowly cooling.

sudden contraction A sudden decrease in the crosssectional area of a conduit, involving a loss of energy.

sudden enlargement A sudden increase in the crosssectional area of a conduit, involving an energy loss.

superheated steam Steam heated at constant pressure out of contact with the water from which it was formed, Le. at a temperature above saturation temperature. surface finish The condition of a surface after final treatment.

surface grinder A grinding machine which produces a flat surface on the workpiece which is mounted on a reciprocating table.

surface hardening Heat treatment such as nitriding, cyaniding, etc., which increases the surface hardness of a metal.

surface tension Interfacial tension between two phases, one of which is a gas.

T

tachometer An electrical or mechanical instrument which measures the rotational speed of a shaft, etc.

tap A cylindrical cutter used to produce an internal screw thread.

temperature The degree of hotness or coldness with reference to an arbitrary zero, e.g. the melting point of ice, absolute zero.

tempering The reheating of hardened steel or cast iron to a temperature below the eutectoid value to decrease hardness and increase toughness. tensile strength Ratio of maximum load to original cross-sectional area of a component. Also called 'ultimate strength'.

tensile stress Tensile load divided by cross-sectional area.

tension The state of stress in a part which tends to increase its length in the direction of the load.

thermal shock The development of a steep temperature gradient in a component and accompanying high stress.

thermal **stress** Stress in a body due to a temperature gradient.

thermodynamic process A gas process involving changes in pressure, volume, temperature or state.

thermometer An instrument for measuring temperature.

thermoplastic Any plastic which can be melted by heat and resolidified, the process being repeatable any number of times.

thick cylinder A cylinder in which the thickness of wall is large compared with the bore. Stress analysis is more complicated than for a 'thin' cylinder subject to internal pressure.

three phase An electric supply system in which the alternating potentials on the three wires differ in phase by 120".

thrust bearing A shaft bearing designed to take axial load through a collar on the shaft. It may be a flat surface or have balls or rollers.

timing belt A drive belt between two pulleys having teeth which engage with grooves in the pulleys.

timing diagram A circular diagram showing the angular positions of valve opening and closing in twoand four-stroke engines.

tolerance The specified permissible deviation from a dimension or permissible variation in the size of a component.

torque The algebraic sum of couples, or moments of external forces, about the axis of twist. Also called 'torsional moment'.

torsion A twisting action resulting in shear stress.

total bead pressure The sum of dynamic pressure and static pressure in fluid flow.

transformer An electrical device without moving parts which transfers alternating current energy, usually with a change in voltage.

transistor A three-electrode semiconductor device used to give a voltage, current or power gain.

turbine A prime mover running on steam, gas or water, in which energy is imparted to rows of moving blades on a rotor.

turbulent flow Fluid flow in which particle motion varies rapidly in velocity and direction; characterized by a high Reynold's number.

turning Removing material from a rotating workpiece using a single-point tool as in a lathe.

U

ultimate strength (ultimate tensile strength, UTS) The maximum tensile stress a material will

withstand before failure.

ultrasonics Relating to sound with a frequency above the audible range, i.e. above about **15** kHz.

V

vacuum forming A shaping process applied to a sheet of thermoplastic which is heated and sucked into a mould by vacuum.

vacuum pump General name for a pump which displaces a gas against atmospheric pressure.

vane A curved metal plate used in pumps and turbines for directing flow. Same as 'blade'.

vane pump A type of positive-displacement pump with sliding radial vanes in slots in a rotor running eccentrically in a fixed casing.

vapour cycle A thermodynamic cycle using a vapour as the working substance, e.g. steam.

vapour process A thermodynamic process using a vapour, e.g. steam.

vector A vector, or vector quantity, has magnitude, sense and direction, e.g. velocity, force.

velocity The rate of change of position of a point with respect to time. Unit: metres per second (m **s-** ').

velocity head The head equivalent of the kinetic energy of a fluid equal to ***u2/(2g).***

velocity pressure Velocity head expressed as a pressure equal to ***(puz)/2.*** The pressure realized by suddenly stopping a fluid stream.

velocity ratio In a 'machine' the ratio of distance moved by the 'effort' to that moved by the 'load'.

Venn diagram In logic and mathematics, a diagram consisting of shapes, e.g. circles and rectangles, that show by their inclusion, exclusion or intersection the relationship between 'classes' and 'sets'.

vibration damper A device fitted to a reciprocating engine crankshaft to minimize torsional oscillations.

viscosity The resistance of a fluid to shear force. The shear force per unit area is a constant times the velocity gradient, the constant being the coefficient of viscosity.

Units: newton-seconds per square metre (Ns rn-'). Symbol: ***p.***

W

washer An annular, usually flat, piece of metal, etc., used under a nut to distribute the load.

weir A dam in a water channel sometimes used in flow measurement.

weld A union made by welding.

weld group A group of welds used **to** make a joint.

welding The joining of two or more pieces of material by applying heat and/or pressure, with or without a filler material, to produce local fusion.

welding rod Filler in rod or wire form used in welding.

wet steam A steam-water mixture such as results from partial condensation of dry saturated steam.

workpiece A part upon which work is done in process operations.

worm A part of a worm gear with helical single or multi-start thread.

worm gear A high speed-ratio gear in which a single or multi-start worm engages with a worm wheel with circumferential teeth. The axes are at right angles and non-intersecting.

Y

yield stress (yield point) The stress at which a material exhibits a deviation from proportionality of stress and strain. Steels tend to have a definite yield point, for ductile metals an offset of typically 0.2% is used.