

Prince of Songkla University
The Faculty of Engineering

Midterm Examination Semester I

Academic Year: 2008

Date: August 01, 08

Time: 13:30 -16:30

Subject: 225-602 Human factors engineering

Room: A 401

ทูลงการสอบ โทษขันด้าคือ ปรบดกในรายวิชานัน และพักการเรียน 1 ภาคการศึกษา

DIRECTIONS

1. Only short note on an A4 piece (both sides), dictionary and calculator are allowed.
2. 6 questions are given on 5 pages and must be done.
3. Total score is 100.
4. Your answers could be in English or Thai.
5. Please check all questions before start working.

Good Luck
Asst.Prof. Angoon Sungkhapong, PhD.



1. It was reported by the Ergonomists that “Ergonomics has two parts: (1) an interdisciplinary research activity based on the human sciences of anatomy, physiology and psychology; (2) an operational activity which sometimes functions independently but more usually finds expression through one of the two established technologies of medicine and engineering. The purposes of particular projects vary from an academic need to know, to direct support for an urgent practical decision. The criteria vary from health through safety to operational effectiveness.”

Question: What do you think about the above statements? Do you agree with them? Express your opinion and state your reasonable support. (10 points)

2. We have known that most of muscles in human body are striated(skeletal) muscle, so called because of their striped appearance under a microscope. They are composed of many long, thin cells called muscle fibres. Each fibre is composed of a number of fibrils and each fibrilis, in turn, composed of a series of protein filaments arranged geometrically. In addition, data from Table 1-3 concern the muscular energy.

Table 1: Calorific equivalent of oxygen

<i>Respiratory quotient</i>	<i>Energy yield (kcal) per litre of oxygen uptake</i>
0.7	4.69
0.8	4.80
0.9	4.92
1.0	5.09

Table 2: Inter-relationships between units employed in exercise philology

1 kcal	100 cal
1 cal	4.186 Joules (J)
1 joule	1 watt (W)
1 watt	6.12 kilopond-metres/minute (kpm/min)
746 watts	1 horse-power (h.p.)

Table 3: Oxygen cost of various activities

<i>Activity</i>	<i>Oxygen cost (l/min)</i>
Sleeping	0.25
Sitting at rest	0.34
Typing	0.46
Ironing	0.88
Gardening	1.16
Digging	1.78
Cycling (about 13 m.p.h.)	2.00
Stair climbing	2.40

Question: How many factors that affect the efficiency use of energy?
 Could you describe briefly about the use of energy in human activities? (10 points)

3. *Question:* Explain the definition of fatigue in term of muscular fatigue and general fatigue. According to data given in Fig 1, explain the relationship between muscular effort and fatigue. How do you apply this information for better human work ? (20 points)

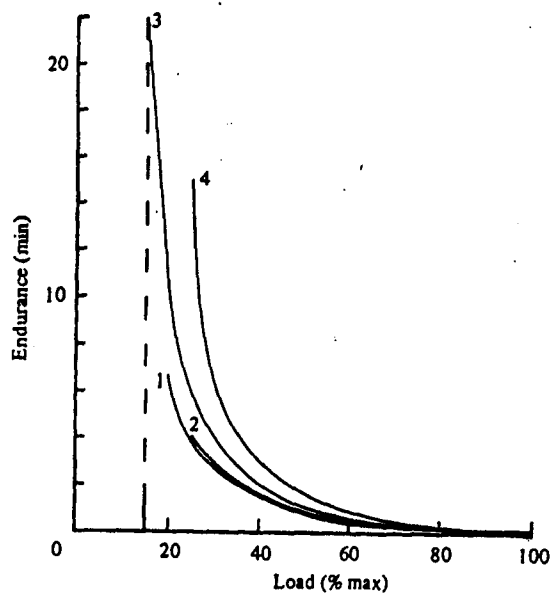


Fig. 1 . Load-endurance curves of human muscle groups: 1, 'arm, leg and trunk muscles' (Rohmert, 1960); 2, upper limb pulling task (Caldwell, 1963); 3, 'biceps brachii, triceps brachii, middle finger flexor, quadriceps femoris' (Monod and Scherrer, 1965); 4, trunk extensors (Jørgensen, 1970).

4. It's realized that limitation and capacity of human work are affected by the anthropometry. However, different population provides different anthropometric data.

Question: what are the main factors that affect to anthropometric data which related to human capacity? Explain and show some examples from each factor. (20 points)

5. The human body must maintain the balance between external demands of the work and of related internal capacities. The body is an "energy factory" converting chemical energy derived from nutrients into externally useful physical energy. Final stages of this metabolic process take place at skeletal muscle, which needs oxygen transported from the lungs by the blood. The blood flow also removes byproducts generated in the energy conversion, such as carbon dioxide, water, and heat, which are dissipated in the lungs, where oxygen is absorbed into the blood. Heat and water are also dispelled through the skin (sweat). The blood circulation is powered by the heart. A person's capacity may be limited by muscular strength, by the ability for movement in body joints, and in manual material handling often by the stress responses of the spinal column. While handling material, the force or torque exerted with the hand must be transmitted through the body, that is via wrists, elbows, shoulders, trunk, hips, knees, ankles, and feet to the floor. In this chain of force vectors, the weakest link determines the capability of the whole body to the job. If the muscles are weak, or if they have to pull under mechanical disadvantages, the available handling force is reduced.

Question: - Explain more clearly about the metabolic process . (10 points)

- Where is the weakest link in human body? Why do you think it is? (10 points)



6. There are no comprehensive and sure shot rules for “safe lifting” which is a complex combination of moving body segments, changing joint angles, tightening muscles, and loading the spinal column.

Some guidelines for proper lifting :

- Design manual lifting (and lowering) out of the task and workplace. If it needs to be done by a person, perform it between knuckle and shoulder height.
- Be in good physical shape. If not used to lifting and vigorous exercise, do not attempt to do difficult lifting or lowering task.
- Think before acting. Place material conveniently. Make sure sufficient space is cleared. Have handling aids available.
- Get a good grip on the load. Test the weight before trying to move it. If it is too bulky or heavy, get a mechanical lifting aid, or somebody else to help, or both.
- Get the load close to the body. Place the feet close to the load. Stand in a stable position, have the feet point in the direction of movement.
- Involve primarily straightening of the legs in lifting.
- Do not twist the back, or bend sideways.
- Do not Lift or lower, push or pull, awkwardly.
- Do not Hesitate to get help, either mechanical or by another person.
- Do not Lift or lower with arms extended.
- Do not Continue heaving when the load is too heavy.

Question: To reveal that you got the excellent understanding in **each guideline** shown above, do explain in more details and give me good examples. [Hint: NIOSH Lifting equation concept may be referred.] (20 points)

