Course title:	Machine Structures and Design
Neptun code:	GEGET501M-A

Status: core, specialization, optional, other:	core
Type : lecture/seminar (practical)	lecture and seminar
Number of credits; hours per week	3; 2 and 1
Name and position of lecturer:	Dr. Péter József, professor, PhD
Contact of lecturer:	Institute of Machine and Product Design
Prerequisite course(s):	Mechanical drawing, Machine Elements I. & II.
Language of the course:	English
Suggested semester: autumn /spring, 1-6	spring semester
Requirements (exam/practical mark/signature/report, essay)	signature and exam
Course objectives (50-100 words):	Significant computations to eliminate the fatigue failure. Fundamentals of design theory and methodology. Theory of three-dimensional gearing. Axoids and axes of meshing. Gear drives connecting intersecting axes. Geometrical design and manufacturing methods for bevel gears. Generating and forming processes. Strength calculation of straight and spiral bevel gears. Gears connecting nonparallel nonintersecting axes using cylindrical and bevel gears. Design of crossed helical gears. Design of hypoid gears. Types of worm gearing. Geometric calculation and manufacturing methods. Strength calculation of worm gearing.

Course content:

Week	Lectures	Practices
1.	Check of screw and nut due to allowable stresses. Guide for the 1st problem and elaboration	Principal units used in mechanics, conversions, ISO metric, ISO trapezoid and BS Whitworth threads, electric motors in 50 and 60Hz systems, kinematic transmission ratio, inch ratio.
2.	Design of screw and nut due to allowable stresses. Elaboration of the 1st problem	Load carrying capacity of Dowel pin (ISO8734), HRC60, loaded by double shear Quality classes of the members of bolted joints
3.	Main dimensions of a shaft due to the allowable stresses. Submission of the first final report	Modelling of threaded fasteners
4.	Fatigue of machine parts. Modifying factors of the endurance limit. Guide for the 2nd problem and elaboration	Thread profiles, load carrying capacity of bolts, loaded by tension and torque
5.	Check of shafts for fatigue. Elaboration of the 2nd problem	Analysis of the elements of a clutch with torque limiting and free-running functions. Practical calculations
6.	Damage of antifriction bearings. Selection of rolling bearings. Elaboration and submission of the 2nd problem	DIN 2093 Disc springs, load-deflection diagram, Square thread analysis
7.	Elastic deflection of machine parts. Guide for the 3rd problem and elaboration	Analysis of the elements of a clutch with torque limiting and free-running functions. Practical calculations Analysis of disk clutch

8.	Calculation of the elastic deflection of machine parts. Elaboration and submission of the 3rd problem	holidays, ordained by the Dean
9.	Meshing of gears with involute profile. Guide, elaboration and submission of the 4th design problem	Involute gear base profile, base circle and involute curve generation, span measurement in practice
10.	Damage of the gear drive. Calculation of the main dimensions of a pair of gears due to the fatigue limit of the flank. Simple variants of epicyclic gear drives. Transmission ratio and the main dimensions of an internal-exterenal type epicyclic gear drive. Elaboration of the 5th design problem	Involute gear, generating span measurement formula. Practical calculations.
11.	Traction drives - classification, similiarities to the gear drives. Fixed ratio drives. Calculation of contact stress. Elaboration of the 6th design problem	Involute gear, generating profile correction factor formula. Practical calculations and measurements.
12.	Loading mechanisms - classification of designs, Calculation of axial force proportional to the output torque. Elaboration of the 7th design problem	Involute gear, generating the tooth thickness at an arbitrary circle and also at the addendum circle. Practical calculations and measurements
13.	Traction drives with highly elastic elements - function integration and simplicity. Load distribution and stresses in the elastic elements. Elaboration of the missed problems.	Thresses at the foot of involute teeth, deriving the formula of module Practical calculations of an outer+inner meshing type planetary gear drive.
14.	Summary and repetition. Preparing for the exam.	Three-speed hub gear – kinematic diagram. Speed diagram, calculation of transmission ratio. Controllability

Required readings:	1. Budynas, R. – Nisbett, K.: Shigley's Mechanical Engineering Design. 8th edition. McGraw−Hill Primis, 2006. p. 260 – 348, p. 762 – 801. ISBN: 0−390−76487−6. 2. Hamrock, B. J. – Jacobson, B – Schmid, S. R.: Fundamentals of machine elements. WBC/McGraw-Hill, 1999. p. 257 – 306. ISBN 0-256-19069-0. 3. Juvinall, R. C. – Marschek, K. M.: Fundamentals of machine component design. 3rd edition. John Wiley & Sons, 2000. p. 301 – 353, p. 692 – 724. ISBN 0-471-24448-1. 4. Norton, R. L.: Machine Design. 3rd edition. Pearson Prentice Hall, 2006. p. 299-414, p. 714-738. ISBN 0-13-148190-8. Stephens, R. I. – Fatemi, A. – Stephens, R. R. – Fuchs, H. O.: Metal fatigue in engineering. 2nd edition. John Wiley & Sons, 2001. ISBN 0-471-51059-9.
Recommended readings:	2. Loewenthal, S.H., Zaretsky, E.W., Design of Traction Drives, NASA ReferencePubl. 1154, 1985. p1-47.
Assessment methods and criteria:	20% of the signature is the mark of the notebook. 80% of the signature is the results of the tasks of the practical course. The mark of the notebook and the mark of the practical course should be at least satisfactory. The minimum level of the mark of the exam is 40% of the problem.

Miskolc, 1st February 2020.

Dr. PÉTER József Ph.D.
professor

NÉMETH Géza
senior assistant

Machine Structures and Design

1. What is the load carrying capacity of Dowel pin (ISO8734), HRC60, loaded by double shear? The shaft diameter is 20mm, the outer diameter of the hollow cylinder is 30mm. The pin diameter is 3mm.

2. Do make a section about a load indicating screw and a hydraulic nut.

3. Do enumerate the thread profile angle of the ISO Metric, the ISO Trapezoid, the Acme and the BS Whitworth thread.

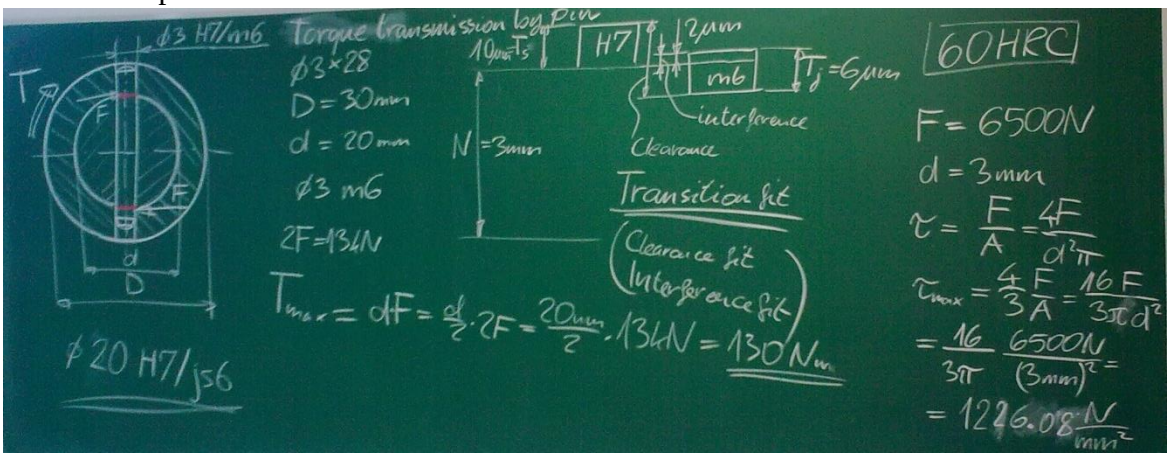
4. Draw the assembly drawing of an arbitrary torque limiting clutch. Do make the parts list.

5. The design processes are the dimensioning, the checking, the material selection and the calculation of load carrying capacity. Specify the relation between the material, the geometry, the safety and the loads for each design processes.

6. Do make a kinematic diagram around a three-speed hub gear. List the name of the main parts. Do plot it’s speed diagram and do calculate two of the transmission ratios. Do calculate its controllability. The number of teeth of both the sun and planet gears are 17, the module is 0.75mm.

Machine Structures and Design

1. What is the load carrying capacity of Dowel pin (ISO8734), HRC60, loaded by double shear? The shaft diameter is 20mm, the outer diameter of the hollow cylinder is 30mm. The pin diameter is 3mm.



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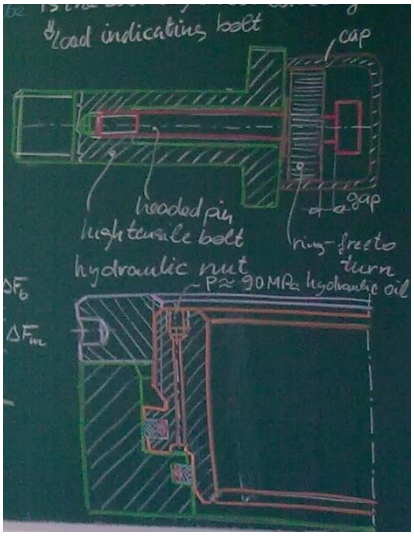
2. Do make a section about a load indicating screw and a hydraulic nut.



10 +10

3. Do enumerate the thread profile angle of the ISO Metric, the ISO Trapezoid, the Acme and the BS Whitworth thread.

ISO Metric $\beta = 60°$

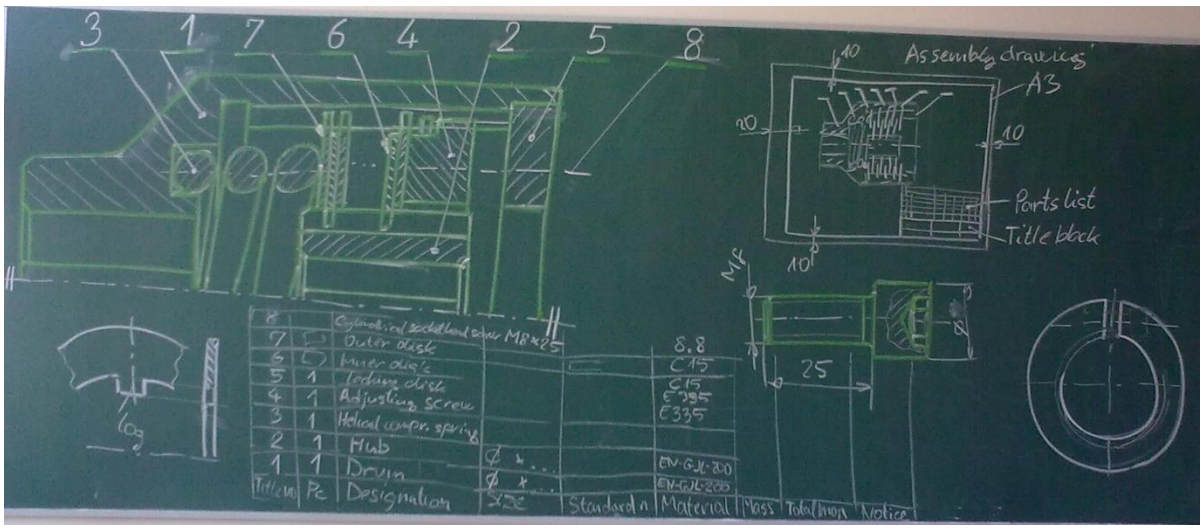
ISO Trapezoid $\beta = 30°$

Acme $\beta = 29°$

BS Whitworth $\beta = 55°$

2

4. Draw the assembly drawing of an arbitrary torque limiting clutch. Do make the parts list.



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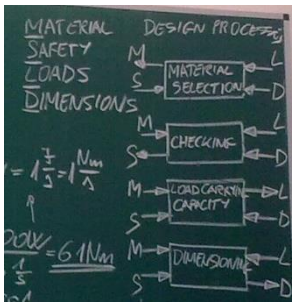

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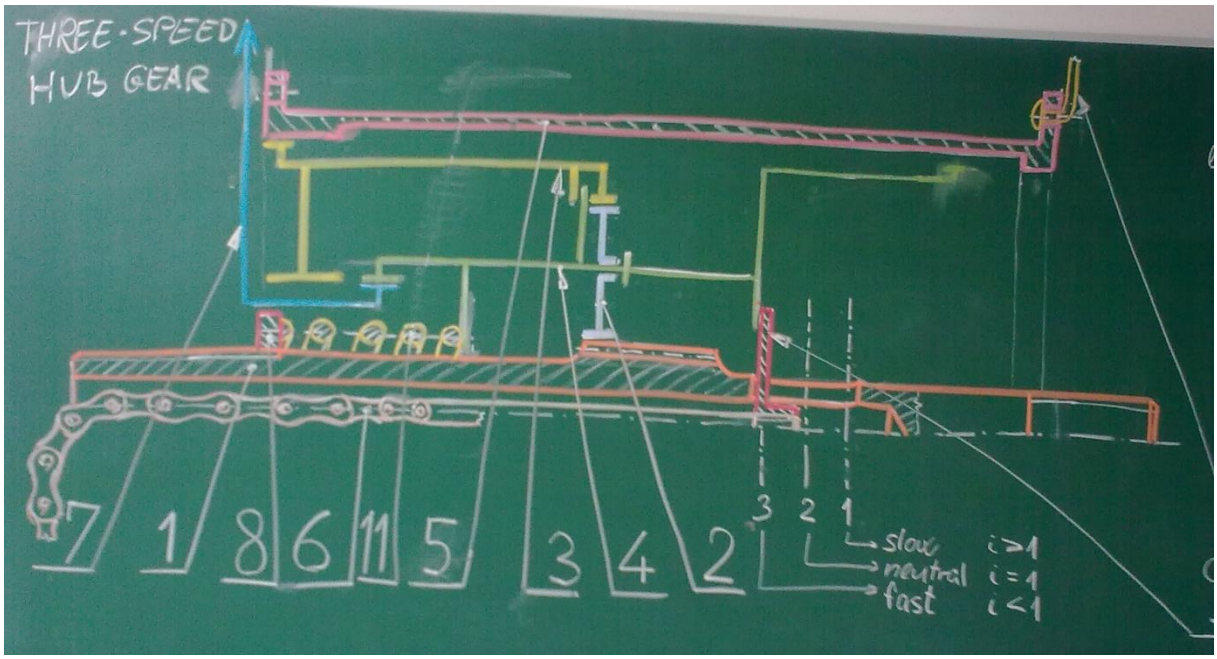

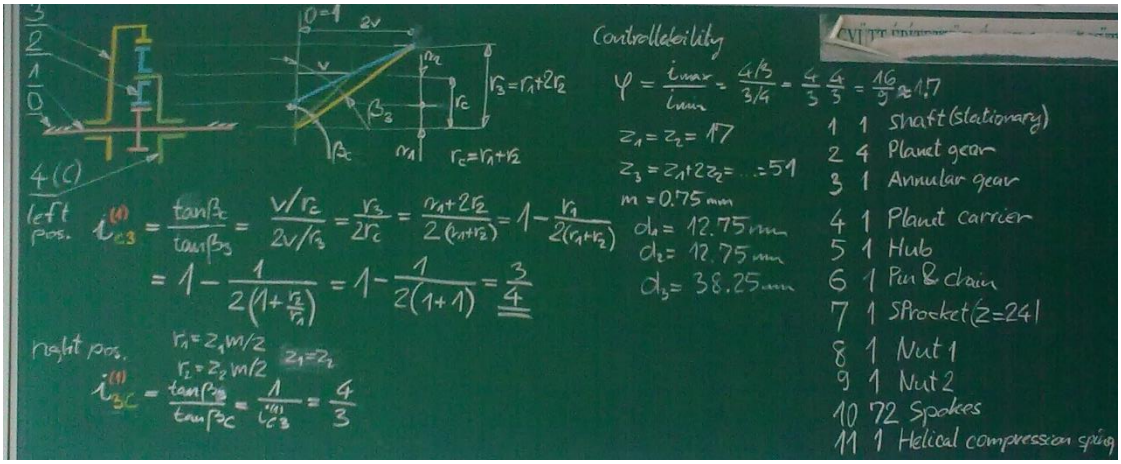

10+10

Σ66

0-26 failed

27-36 passed

37-46 average

47-56 good

57-66 excellent