REPUBLIC OF SOUTH AFRICA

ADMINISTRATION: HOUSE OF ASSEMBLY

DEPARTEMENT OF EDUCATION AND CULTURE

POST-SCHOOL EDUCATION IN TECHNICAL COLLEGES

NATIONAL EXAMINATIONS

S Y L L A B U S

FOR

FLUID MECHANICS

N5

DATE OF IMPLEMENTATION: JANUARY 1990

DATE OF FIRST EXAMINATION: APRIL 1990

AFRIKAANS OP KEERSY

FLUID MECHANICS N5

1. GENERAL OBJECTIVES

1.1 To introduce students to such hydraulic calculations as they might come into contact with in their work situation.

1.2 To give students insight into the design and maintenance of hydraulic plants and equipment.

2. SPECIFIC OBJECTIVES

2.1 To provide the artisan or maintenance supervisor with the neccessary theoretical knowledge.

2.2 To introduce the person who specializes in maintenance, modification and design of hidraulic plants and equipment to the basic principles and theories of fluids.

3. AIMS

The student must be able to:

3.1 define a fluid and the properties of a fluid and do applicable calculations in this respect

3.2 describe the concept of pressure in a fluid and do calculations in this respect

3.3 do calculations in connection with simple hydraulic systems

3.4 do calculations about hydrostatic forces on different areas and buoyant bodies

3.5 describe the different tipes of flow and do calculations in this respect

3.6 apply Bernoulli's equation on different types of flow meters

3.7 apply Bernoulli's principle on different hydraulic systems that transmit power

3.8 do calculations determining the forces on different hydraulic parts and hydraulic turbomachinery.

4. EXAMINATION

4.1 One three hour question paper with a maximum of 100 percent will be set.

4.2 The question paper will consist of six questions of 20 marks each of which five have to be answered.

5. PRESENTATION

5.1 One trimester of 11 weeks

5.2 Teaching time is 7,5 hours per week full time and 6 hours per week part time

6. ENTRANCE REQUIREMENTS

A pass in Engineering Science N4

7. CONTENTS

GENERAL INTRODUCTION

7.1 Macroscopical definition of a fluid and a fluid as a continuum

7.2 Dimensional systems (SI); dimensions and units to qualify and quantify physical properties

7.3 Definitions and classification of fluid systems; practical examples of hydraulic systems

7.4 Definitions and applicable calculations of the following hydraulic properties (properties of the hydraulic state of a system): pressure, density, relative density, temperature, viscosity (dynamic and kinematic coefficient of viscosity), bulk modulus, vapour pressure and surface tension

HYDROSTATICS

7.5 The concept of pressure
Definitions and calculations of pressure intensity and pressure head
Proof of Pascal's principle
Calculations involving the measurement of pressure, pressure at a point, difference in pressure, barometric pressure, absolute and gauge pressure, vacuum pressures (including the effect of vapour pressure)

7.6 Descriptions and calculations of simple hydraulic systems, the hydraulic press, actuator, pressure intensifier (including the concepts of power transfer like work done, efficiency, etc.)

7.7 Calculations of hydrostatic forces on areas immersed in liquids, pressure distribution diagrams, hydrostatic forces and centre of pressure as applied to simple geometric surfaces (vertical and slanted) and simple curved surfaces

Buoyancy; Archimedes' principle applied to practical problems.

HYDRODYNAMICS.

7.8 The nature and type of flow, including Reynold's number Calculations of the volumetric flow, mass flow and weight flow. The conservation of mass and velocity of flow applied to round pipes (with branches)

Calculations on the conservation of energy, energy of flowing fluids (kinetic, potential and pressure energy) The application of Bernoulli's equation. Energy loss and hydraulic power calculations

7.9 Calculations and explanations of the general application of Bernoulli s equation on flow measurement in the venturi meter, pitot static tube, small orifices (introduction to flow coefficients), venturi tube, nozzle and the rotameter

7.10 Calculations of power transmission in hydraulic systems (closed channels). Friction loss in viscous (laminar) flow by using Poiseuille's equation and in turbulent flow by using Darcy's equation. Power transmission by pipeline (condition of maximum power transmission), shock loss expressed in terms of dynamic head, equivalent lengths (and length ratios) of shock losses. The calculations of friction and shock losses applied to practical systems

7.11 Calculations and descriptions of the conservation of momentum (fluid momentum). Newton's second law applied to fluid flow, reaction of a jet, impact of a jet on flat and curved surfaces and the forces on reducers, bends and reducing bends. Principles applied to hydraulic turbo-machinery

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S Y L L A B U S

FOR

FLUID MECHANICS

N6

DATE OF IMPLEMENTATION: MAY 1990

DATE OF FIRST EXAMINATION: AUGUST 1990

AFRIKAANS OP KEERSY

FLUID MECHANICS N6

1. GENERAL OBJECTIVES

1.1 To introduce the students to such hydraulic calculations as they might come into contact with in their work situation.

1.2 To give students insight into the design and maintenance of hydraulic plants and equipment.

2. SPECIFIC OBJECTIVES

2.1 To provide the artisan- or maintenance supervisor-to-be, with the neccessary theoretical knowledge.

2.2 To introduce the person who specializes in maintenance, modification and design of hydraulic plant and equipment, to the basic principles and theories of fluids.

3. AIMS

The student must be able to:

3. describe a fluid and define the different properties of a fluid

3.2 do calculations about the hydraulic gradient and the flow of fluids in pipes

3.3 do calculations about the flow of water in open channels

3.4 do advanced calculations about orifices

3.5 do calculations about different types of pumps including the hydraulic ram, reciprocating pumps and sentrifugal pumps

3.6 do calculations about ventilation and air conditioning

3.7 describe different types of water turbines and do calculations of water turbines

3.8 describe the different components of Pelton wheels and do applicable calculations of these wheels.

4. EXAMINATION

4.1 One three hour question paper with a maximum of 100 percent will be set.

4.2 The question paper will consist of six questions of 20 marks each of which five have to be answered.

5. PRESENTATION

5.1 One trimester over a period of 11 weeks

5.2 Teaching time is 7,5 hours per week full-time and 6 hours per week part-time.

6. ENTRANCE REQUIREMENTS

A pass in Fluid Mechanics N5

7. CONTENTS

7.1 General introduction

7.1.1 Fluid (liquids and gases); criteria for compressability; the continuum-principle

7.1.2 The relevant properties of fluids (definitions and units)

7.2 Flow in pipes and the hydraulic gradient

7.2.1 The formuli of Chezy and Darcy; Bernoulli s equation

7.2.2 Losses at pipe inlets, outlets, and sudden contractions and expansions

7.2.3 A syphon between two reservoirs on different levels

7.2.4 Parallel and branch pipes between different reservoirs

7.3 Water flow in open canals

7.3.1 Hydraulic gradient and Chezy s formula; Flow Rate

7.3.2 Flow rate measurement with the aid of notches and weirs: rectangular notches, V-notches, trapezuim-shaped notches and Cipolleti weirs; the formulas of Francis and Bazin

7.4 Advanced calculations concerning the flow of water through orifices

7.5 Describtions and calculations of Pumps

7.5.1 Hydraulic ram:

General outlay of a simple ram, causes of losses

7.5.2 Reciprocating Pumps (plunger- and pistonpumps):

Single and three throw single action ram pumps
Double action piston pumps

Calculations of maximum acceleration head and maximum friction head
Function of air containers
Limiting conditions on the inlet side (suction side) of pumps
Calculations of power with or without air containers, including pipe lengths between the pump and air container

7.5.3 Centrifugal Pumps:

Operation principles, installation and application
Pump properties: Drawing and reading of graphs; pump delivery, pressure head and power absorbed for maximum efficiency
Limitations of suction head at atmospheric pressure, temperature and friction
Arrangement of suction- and delivery pumps
Choice of valves and accessories
Maintenance of pumps
The lay-out of a total pump plant. Sketches and descriptions
Pumps which are connected in series and parallel: difference in power required
Delivery through parallel and branched pipes. The influence of leaks in pipes.

7.6 Calculations and descriptions of ventilation and air conditioning

7.6.1 The flow of air in ducts: Flow velocities, friction in ducts (Atkinson's formula), multi-branched ducts.

7.6.2 Fans:

Types of fans and their properties: Advantages of a propeller
Pressure created: Power and efficiency
Fan outlets (evasee) and the conversation of energy
Ratios of capacity, pressure and power in relation to the velocity ratio of fans
Fans in series and in parallel

7.6.3 Air conditioning: Control of humidity and temperature: Typical air conditioning plants (Only background knowledge)

7.7 Descriptions of and calculations concerning water turbines

7.7.1 Types of turbines: Axial flow, parallel flow, radial flow and mixed flow (Sketches and description of each)

7.7.2 Cavitation and pitting of runners

7.7.3 Draft tubes: Types, construction and purpose

7.7.4 Comparison between impulse and reaction turbines

7.7.5 Sketches of turbine blades

7.8 Descriptions and calculations concerning Pelton wheels

7.8.1 Basic parts and materials which are used

7.8.2 Construction and attachment of buckets

7.8.3 Sources of loss of power

7.8.4 Purpose and methods of control of discharge

7.8.5 Calculations and line diagrams:

Calculations of power and the hydraulic efficiency of the machine
Calculations of the theoretical bucket speed for maximum hydraulic efficiency; the hydraulic efficiency at this speed and the power developed

REPUBLIEK VAN SUID-AFRIKA

ADMINISTRASIE: VOLKSRAAD

DEPARTEMENT VAN ONDERWYS EN KULTUUR

NASKOOLSE ONDERWYS IN TEGNIESE KOLLEGES

NASIONALE EKSAMENS

S I L L A B U S

VIR

FLUÏEDMEGANIKA

N5

IMPLEMENTERINGSDATUM	EERSTE EKSAMENDATUM
JANUARIE 1990	APRIL 1990

ENGLISH OVERLEAF

FLUÏEDMEGANIKA N5

1. ALGEMENE DOELSTELLINGS

1.1 Om studente kennis te laat maak met hidrouliese berekeninge wat moontlik in sy werksituasie mag voorkom.

1.2 Om studente insig in die ontwerp en onderhoud van hidrouliese aanlegte en toerusting te gee.

2. SPESIFIEKE DOELSTELLINGS

2.1 Om die voornemende vakman en instandhoudingstoesighouer die nodige teoretiese kennis te gee.

2.2 Om die persoon wat spesialiseer in instandhouding, modifikasie en ontwerp van hidrouliese aanlegte en toerusting bloot te stel aan die basiese beginsels en teorie van fluïede.

3. DOELWITTE

Die student moet in staat wees om:

3.1 fluïede en hulle eienskappe te defineer en toepaslike berekeninge in die verband te doen

3.2 die konsep van druk in fluiede te kan beskryf en berekeninge in die verband te kan doen

3.3 berekeninge te kan doen in verband met eenvoudige hidrouliese stelsels

3.4 hidrostatiese kragte te bereken op verskillende oppervlakke en drywende liggame

3.5 verskillende tipes vloei te beskryf en berekeninge in die verband te doen

3.6 Bernoulli se vergelyking toe te pas op verskillende vloeimeters

3.7 Bernoulli se vergelyking toe te pas op verskillende hidrouliese stelsels wat drywing oordra

3.8 berekeninge te doen in verband met die kragte op verskillende dele van hidrouliese turbomasjiene.

4. EKSAMINERING

4.1 Een drie uur vraestel wat 'n maksimum van 100 persent tel sal gestel word.

4.2 Die vraestel sal bestaan uit ses vrae van 20 punte elk waarvan vyf vrae beantwoord moet word.

5. AANBIEDING

5.1 Een trimester oor 'n tydperk van 11 weke

5.2 Onderrigtyd is 7,5 uur per week voltyds en 6 uur per week deeltyds

6. TOELATINGSVEREISTES

6.1 'n Slaagpunt in Ingenieurswetenskap N4

7. INHOUD

ALGEMENE INLEIDING

7.1 Makroskopiese definisie van 'n fluïed en 'n fluïed as 'n kontinuum

7.2 Afmetingstelsels (SI); afmetings en eenhede om fisiese eienskappe te kwalifiseer en kwantifiseer

7.3 Definisies en klassifikasie van fluïedstelsels; praktiese voorbeelde van hidrouliese stelsels

7.4 Definisies en toepaslike berekeninge van die volgende hidrouliese eienskappe (eienskappe van die hidrouliese toestand van 'n stelsel) soos druk, digtheid, relatiewe digtheid, temperatuur, viskositeit (dinamiese en kinematiese koëffisient van viskositeit), saampersbaarheidsmodulus, dampdruk en oppervlaktespanning

HIDROSTATIKA

7.5 Die konsep van druk. Definisies en berekeninge van drukintensiteit en drukhoogte. Die bewys van Pascal se beginsel. Berekeninge in verband met die meting van druk, druk by 'n punt, verskil in druk, barometriese druk, absolute en meterdruk, vakuumdrukke (insluitende die effekte van dampdruk).

7.6 Beskrywings en berekeninge van eenvoudige hidrouliese stelsels, die hidrouliese drukpers, werksilinder, akkumulator, drukintensifiseerder (insluitende die konsepte van drywingoordrag bv. arbeid verrig, rendement, ens.)

7.7 Berekeninge in verband met hidrostatiese kragte op oppervlakke onder vloeistowwe, drukverspreidingsdiagramme, hidrostatiese kragte en drukmiddelpunte toegepas op eenvoudige geometriese vlakke (vertikaal en skuins) en eenvoudige geboë vlakke.

Dryfvermoë; Archimedes se beginsel toegepas op praktiese probleme.

HIDRODINAMIKA

7.8 Die aard en tipes vloei met inbegrip van Reynold se getal. Berekeninge in verband met die volumetriese vloei, massa-vloei en gewigvloei, ook die behoud van massa en snelheid van vloei met toepassings op ronde pype (met aftakkings).

Berekeninge in verband met die behoud van energie, energie van vloeiende fluïede (kineties, potensieël en drukenergie). Die toepassing van Bernoulli se vergelyking. Berekeninge ten opsigte van energieverlies en hidrouliese drywing

7.9 Berekeninge en verduidelikinge van die algemene toepassing van Bernoulli se vergelyking op vloeimeting in die venturimeter, pitot-statiese buis, gaatjiesvloei (inleiding tot vloeikoëffisiënte), venturibuis, spuitstuk en die rotameter

7.10 Berekeninge in verband met drywingoordrag in hidrouliese stelsels (toe kanale). Wrywingverlies in klewerige (laminêre) vloei met behulp van Poiseuille se vergelyking en in turbulente vloei met behulp van Darcy se vergelyking. Drywing oordrag in pype (toestand vir maksimum drywingoordrag), skokverliese uitgedruk in terme van dinamiese drukhoogte, ekwivalente lengtes (en lengte- verhoudings) van skokverliese en berekeninge van beide wrywing en skokverliese toegepas op praktiese stelsels

7.11 Berekeninge en beskrywings van die behoud van momentum (fluïedmomentum), Newton se tweede wet toegepas op fluïedvloei, reaksie van 'n straal, impak van 'n straal op plat en geboë oppervlakke en kragte op vernouers, boë en vernouende boë. Beginsels van toepassing op turbomasjiene.

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S I L L A B U S

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FLUÏEDMEGANIKA

N6

IMPLEMENTERINGSDATUM

MEI 1990

EERSTE EKSAMENDATUM

AUGUSTUS 1990

ENGLISH OVERLEAF

FLUÏEDMEGANIKA N6

1. ALGEMENE DOELSTELLINGS

1.1 Om die student kennis te laat maak met hidrouliese berekeninge wat moontlik in sy werksituasie mag voorkom.

1.2 Om die student insig in die ontwerp en onderhoud van hidrouliese aanlegte en toerusting te gee.

2. SPESIFIEKE DOELSTELLINGS

2.1 Om die voornemende vakman en instandhoudingstoesighouer die nodige teoretiese kennis te gee.

2.2 Om die persoon wat spesialiseer in instandhouding, modifikasie en ontwerp van hidrouliese aanlegte en toerusting bloot te stel aan die basiese beginsels en teorie van fluïede.

3. DOELWITTE

Die student moet in staat wees om:

3.1 'n fluïed te beskryf en die verskillende eienskappe van 'n fluïed te defineer

3.2 berekeninge te doen in verband met die vloei van fluïede in pype en die hidrouliese gradiënt

3.3 berekeninge oor watervloei in oop kanale te doen

3.4 meer gevorderde berekeninge te doen ten opsigte van openinge

3.5 berekeninge te doen in verband met verskillende tipes pompe waaronder ook die hidrouliese ram, wederkerige pompe en sentrifugale pompe

3.6 berekeninge te doen in verband met ventilasie en lugversorging

3.7 om verskillende waterturbines te beskryf en berekeninge te doen oor waterturbines

3.8 om die verskillende onderdele van Peltonwiele te beskryf en berekeninge te doen wat betrekking het op hierdie wiele.

4. EKSAMINERING

4.1 Een drie-uur vraestel met 'n maksimum van 100 persent sal gestel word

4.2 Die vraestel sal bestaan uit ses vrae van 20 punte elk waarvan vyf vrae beantwoord moet word.

5. AANBIEDING

5.1 Een trimester oor 'n tydperk van 11 weke

5.2 Onderrigtyd is 7,5 uur per week voltyds en 6 uur per week deeltyds.

6. TOELATINGSVEREISTES

'n Slaagpunt in Fluïedmeganika N5

7. INHOUD

7.1 Algemene inleiding

7.1.1 Fluïede (vloeistowwe en gasse); kriteria vir saampersbaarheid; die kontinuum-beginsel

7.1.2 Die relevante eienskappe van fluïede (definisies en eenhede)

7.2 Vloei in pype en hidrouliese gradiënt

7.2.1 Die formules van Chezy en Darcy; Bernoulli se vergelyking

7.2.2 Verliese by pypingange en -uitgange, by skielike vernouings en vergrotings

7.2.3 'n Hewel (siphon) tussen twee reservoirs op verskillende hoogtes

7.2.4 Paralellepype en takpype tussen verskillende reservoirs

7.3 Watervloei in oop kanale

7.3.1 Hidrouliese gradiënt en Chezy se formule; Vloeitempo

7.3.2 Die meet van vloeitempo met behulp van kepe en keerwalle: reghoekige kepe, V-kepe, trapesiumvormige kepe en Cipolleti-walle; die formules van Francis en Bazin

7.4 Meer gevorderde berekeninge met betrekking tot die vloei van water deur openinge

7.5 Beskrywing en berekeninge in verband met pompe

7.5.1 Hidrouliese ram:

Algemene uitleg van 'n eenvoudige ram, redes vir verliese.

7.5.2 Wederkerige Pompe (plunjer- en suierpompe):

Een- en drieslag enkelwerkende rampompe
Dubbelwerkende suierpompe
Berekeninge van maksimum versnellingshoogte en maksimum wrywingshoogte
Die funksie van lughouers
Beperkende toestande aan die suigkant van pompe
Berekeninge van drywing met en sonder lughouers, insluitende pyplengtes tussen die pomp en lughouer.

7.5.3 Sentrifugale Pompe:
Werkingbeginsels, installasie en toepassings,
Pompeienskappe: teken en lesings van grafiek; pomplewering, drukhoogte en drywing geabsorbeer vir maksimum rendement
Beperkings ten opsigte van suighoogte by atmosferiese druk, temperatuur en wrywing
Rangskikking van suig- en leweringspype
Keuse van kleppe en toebehore
Onderhoud van pompe
Die uitleg van 'n totale pompaanleg. Sketse en beskrywings
Pompe wat in serie en parallel gekoppel is: verskille in drywing wat vereis word
Lewering deur parallele en takpype. Die invloed van lekkasies in pype

7.6 Berekeninge en beskrywings in verband met ventilasie en lugversorging

7.6.1 Die vloei van lug inleigange: Vloeisnelhede, weerstand in gange (Atkinson se formule), veeltakkige leigange

7.6.2 Waaiers:
Soorte waaiers en hulle eienskappe: Voordele van die lugskroef
Druk wat opgewek word: drywing, rendement
Waaieruitgange (evasee) en die behoud van energie
Verhoudings van kapasiteit, druk en drywing teenoor snelheidsverhouding met betrekking tot waaiers
Werking van waaiers in serie en parallel

7.6.3 Lugversorging: Beheer van humiditeit en temperatuur: Tipiese lugversorgingaanlegte. (Slegs vir agtergrondkennis).

7.7 Beskrywings van en berekeninge met betrekking tot water-turbines

7.7.1 Tipes turbines: aksiaalvloei, parallelvloei, radiaalvloei en gemengde vloei (Sketse en beskrywing van elk)

7.7.2 Kavitasie en invreting van lopers

7.7.3 Suigbuise: Tipes, konstruksie en doel

7.7.4 Vergelyking van impuls en reaksie turbines

7.7.5 Sketse van turbinelemme

7.8 Beskrywing en berekeninge met betrekking tot Pelton-wiele

7.8.1 Basiese onderdele en materiale wat gebruik word

7.8.2 Konstruksie en vashegting van skoepe

7.8.3 Bronne van drywingverlies

7.8.4 Doel en metodes van beheer van lewering

7.8.5 Berekeninge en lyndiagramme:
Berekeninge van drywing en die hidrouliese rendement van die masjien
Berekeninge van die teoretiese skoepsnelheid vir maksimum hidrouliese rendement; die hidrouliese rendement teen hierdie snelheid en die drywing ontwikkel

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