# UNIVERSITY OF ZAMBIA

## SCHOOL OF ENGINEERING

## FIRST SEMESTER EXAM PAPERS

## POST GRADUATE

## 2011/2013 ACADEMIC YEAR

1. AGF 2501 - Computer Science
2. ME 6108 - Advanced Automobile Engineering
3. MEC 6041 - Combustion Engineering
4. MEC 6061 - Advanced Fluid Mechanics I
5. MEC 6061 - Advanced Fluid Mechanics II

# THE UNIVERSITY OF ZAMBIA

## SCHOOL OF ENGINEERING

## DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATIONS

SEMESTER I – February /March 2013

# AGF2501
## Computer Science

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**TIME** : Three (3) hours

**INSTRUCTIONS** : Answer All the Questions

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**Question 1.**

A. Define the following terms

i. Data type
ii. Networking
iii. Variable Name
iv. IP address
v. Transmission media

**[5marks]**

B. For a computer to communicate with one another a network system is required. List down the layers of the open system interconnectivity (OSI) in **order** which are used to show how communication takes place within a simple network

**[7marks]**

C. From the listed layers State the function of each layer

**[8marks]**

**Question 2**

In a network system a method called **topology** is used as a framework to connect network devices.

A. list down any three topologies which are used in networking

**[3marks]**

B. With the help of a diagram. Draw clearly three different topologies showing how the topologies are used.

**[6marks]**

C. In a table form list down the advantages and disadvantages in the three topologies listed in part (A)

**[8marks]**

D. List down the three types of transmission media which are used in computer networking

**[3marks]**

**Question 3**

A. Define the following

i. Variable
ii. Int
iii. Char
iv. string

**[4marks]**

B. In programming the logical operators = and = = are used to work with the statements within a program.
What is the difference with examples in use between the two operators?

**[4marks]**

C. To convert temperatures written in Fahrenheit to Celsius (Centigrade), you subtract 32, multiply by 5 and then divide by 9. To convert Celsius to Absolute Value (Kelvin), you add 273.15. Write a program that displays a temperature conversion chart on the screen as follows:

```
Fahrenheit        Celsius       Absolute Value

    0              -17.78          255.37
```

**[12marks]**

**Question 4**

A. Define a protocol.

[1mark]

B. Open system interconnectivity is made up of seven layers. Among the seven are application, transport and network (internet). Name three protocols which are located at each layer and state there functions.

**[6marks]**

C. What are the three major network devices(tools), which are use to connect network components on a network

**[3marks]**

D. Networks are divided into three main types depending upon their location .i.e. in a small room or over a large geographical area
State the types and how do they differ from each other

**[6marks]**

E. Design an interconnected network (including IP addressing using 192.168.1.0 and 192.168.2.0 as the main network-addresses for hosts (computers, switches, and internal interface on routers) and links, respectively). The following configurations exist for the three networks:

**Network A**: Six (6) computers, a Switch, and a Router.

**Network B**: Three (3) desktops, a switch, and a Router

**Network C**: Twenty-six (26) desktops, two (2) switches, and a router

**[4marks]**

## Question 5

1. Write a program that allows a user to enter their mark attained in each course and displays their grade. After all marks are entered the average mark is displayed.

| Mark | Grade |
|---|---|
| 0-49 | Fail |
| 50-59 | Pass |
| 60-69 | Credit |
| 70-79 | Distinction |
| 80-100 | High distinction |

**[40marks]**

# THE UNIVERSITY OF ZAMBIA

## SCHOOL OF ENGINEERING

## DEPARTMENT OF MECHANICAL ENGINEERING

## ME 6108 ADVANCED AUTOMOBILE ENGINEERING I FINAL EXAMINATION 2011

## OPEN BOOK

**TIME: 3 HOURS**

**ANSWER ALL QUESTIONS (100 Marks)**

Q1. (a) What is a Dynamic Certificate and its significance? (5 marks)

(b) Calculate and draw the Dynamic Certificate of a motor vehicle propelled by a four stroke carburetor engine developing a maximum effective power of 72 kW with a crankshaft angular velocity of 472 rad/s. The Dynamic Certificate in question takes account of dynamic characteristics with load monogram

The relationship between a given power and maximum effective power at given corresponding angular velocities is given by the following empirical formula describing the speed characteristics as follows:

$$Ne = Ne\,max\left(\left(\frac{We}{WN}\right) + \left(\frac{We}{WN}\right)^2 - \left(\frac{We}{WN}\right)^3\right)$$

Where: Ne – Power at a given angular velocity We

Ne max – maximum effective power at angular velocity $W_N$.

The motor vehicle with its own weight of 14,900 (N) includes that of the driver which is 750 N moves on an asphalt horizontal road in uniform motion and carrying an external load of 3,000 N. The weight taken by the driving wheel without load is given as 7, 000 N.

Additional information is given as follows:

*Rolling resistance coefficient – 0.018*

*Transmission efficiency – 90%*

*Radius of the driving wheels – 0.33 meters*

*Distance from the axis of the rear wheel to that of the centre of gravity – 1.34 metres*

*Wheel base – 2.8 metres*

*Air resistance coefficient – 0.20 N.S$^2$/m$^4$*

**Gear ratios**

1$^{st}$ gear – 3.51

2$^{nd}$ gear – 2.26

3$^{rd}$ gear – 1.45

4$^{th}$ gear – 1.0

Differential gear – 4.1

(30 Marks)

(c) Using the obtained Dynamic Certificate

i. Determine the road resistance coefficient if the motor vehicle moves with 50% load and a speed of 25 m/s.

ii. Determine the maximum possible speed if the load and road resistance coefficient are given as 70% and 0.16 respectively.

iii. Find the maximum load in a certain year with road resistance and speed given as 0.10 and 13 m/s respectively.

(5 Marks)

**Q1 Total 40 marks**

Q2. (i) Using the same information as in Q.1, determine the cost of fuel if the motor vehicle is used to transport goods of 5,000 N from Lusaka to Ndola a distance of 350 km. The motor vehicle moves at an average speed of 80 km/hr in uniform motion over an average gradient of 3.3 degrees

(ii) What will be the cost of fuel for the same distance if the carburetor engine is replaced with a diesel engine with a similar engine capacity?

(iii) If any saving is realised, what extra load will you take to improve on your profitability.

The following information is given.

*Cost of diesel - K 7600 per litre*

*Cost of petrol - K 8000 per litre*

*Density of petrol - 0.76 kg/litre*

*Density of Diesel - 0.80 kg/litre*

*Specific effective fuel consumption for carburetor engines – 350 g/kW.hr*

*Specific effective fuel consumption for diesel engines - 290 g/kW.hr*

**(20 Marks)**

Q3. A motor vehicle is moving on a horizontal asphalt road with a road resistance coefficient of 0.08 at a speed of 90 km/hr. In the process of travelling, the driver observes an obstruction on the road, and the driver brakes with a shut off engine from the travelling speed to stopping down on the same road texture with a grip road coefficient of 0.6.

Determine the braking time, stopping distance and deceleration.

**(20 Marks)**

Q4. (a) What is lateral stability and what are the causes of lateral instability.

(b) Discuss how lateral stability of a motor vehicle is assessed.

(c) Describe the forces acting on the motor vehicle during uniform motion on the arc of constant radius.

(d) Describe the equations for determining critical speeds under toppling and skidding conditions.

**(20 Marks)**

# THE UNIVERSITY OF ZAMBIA
## SCHOOL OF ENGINEERING
## DEPARTMENT OF MECHANICAL ENGINEERING

**UNIVERSITY EXAMINATIONS** **NOVEMBER 2011**

**MEC 6041: COMBUSTION ENGINEERING**

**ANSWER: FIVE QUESTIONS** **CLOSED BOOK**

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**Q1.** (i) What is Combustion?
(ii) What role do fuels play in combustion and give a physical categorization of the various types of fuels that are available with emphasis on spheres of application.

**Q2.** Discuss in detail the following:
(i) Combustion stoichiometry
(ii) Heat of Reaction
(iii) Heat of Formation
(iv) Absolute Enthalpy

**Q3.** (i) Discuss in detail and differentiate the types of idealized flames that can be found in various applications.
(ii) What is the explosion limit?

**Q4.** (i) Discuss in detail the various stages of spray formation in the combustion of liquid fuels.
(ii) Describe in detail the operation of at least two types of fuel injectors.

**Q5.** (i) Sketch a simple diagram of an open cycle gas turbine system
(ii) Sketch a gas turbine combustor showing all the main components
(iii) Describe in detail the operation of such a gas turbine combustor.

**Q6.** (i) Discuss in detail any two types of burners that are used in gas-fired furnaces.
(ii) Discuss the differences between a compressor and a turbine

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**END OF EXAMINATION** **Dr. C K Wamukwamba** **November 2011**

# The University of Zambia
# School of Engineering
# Department of Mechanical Engineering
# MEC 6061 Advanced Fluid Mechanics Part I
# Final Examination Semester I, 2011

**Time:** Three (3) Hours Closed Book

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**Instructions**

1. Answer three questions, question two (2) is compulsory;
2. State all assumptions, and comment as much as possible on the fluid mechanics implications of the answers obtained;
3. Draw neat graphs and sketches were necessary;
4. Work with algebraic expressions as far as possible before final computations;
5. Use metric units, where possible, for all your computations;
6. Tie or staple the answer scripts in the left-hand corner; and
7. Each question carries twenty (20) marks.

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**Question 1**

a) Efficiency of a hydrodynamic pump is generally lower than that of a hydraulic turbine. Comment upon the truth of this statement.

b) A centrifugal pump, having impeller diameter of 1 m, has backward curved vanes which make an angle of 25° with the wheel tangent at the blade tip. At the operational speed of 1440 rpm, the radial velocity of flow at the tip is 10 m/s and the slip coefficient is 0.85. Determine:

(i) Actual work input/kg of water flow,
(ii) Absolute velocity of fluid at the impeller tip, and
(iii) Hydraulic efficiency, considering that kinetic energy at the outlet is wasted. How the hydraulic efficiency would change if the pump is fitted with a diffusion chamber of 75% efficiency so that exit velocity is reduced to 12 m/s?

## Question 2

An axial flow compressor is to deliver helium and has six stages equally loaded, with stage temperature rise of 25 K. Id the overall efficiency is to be 87%, determine the overall pressure ratio, and the stage pressure ratio for the last and the first stages if $T_{O1}$ and $p_{O1}$ are 288K and is 155 $N/m^2$ respectively. Calculate the blade height at entry to the last stage and the rotational speed if $V_1$ is 165 m/sec and makes an angle of 20° to the axial direction, the mass flow is 13kg/sec and the D mean is 680 mm. The Howell work done factor is 0.83 and the mean section has been designed t be 50% reaction. What is the maximum Mach number in the last stage?

## Question 3

Discuss in detail how CFD does works in terms of preprocessor, solver and post processor?

## Question 4

Define the following:

a) Convergence,
b) Consistent, Numerical Schemes, and
c) Stability.

## Question 5

Discuss in detail distinguishable and indistinguishable thermodynamic microstates

## Question 6

Discuss in detail partial and complete equilibrium thermodynamic states.

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**End of MEC 6061-Advance Fluid Mechanics Semester I, 2011 Final Examinations**
**Prepared by Dr. P. C. Chisale © Department of Mechanical Engineering**

# THE UNIVERSITY OF ZAMBIA

**School of Engineering**
**Department of Mechanical Engineering**
**MEC 6061 Advanced Fluid Mechanics I**
**Final Examination Semester I , 2011**
**Part 2 – Numerical Experiment**

**Time: Three (3) Hours** **Use Intel PHOENICS 2009 CFD Software**

## Instructions

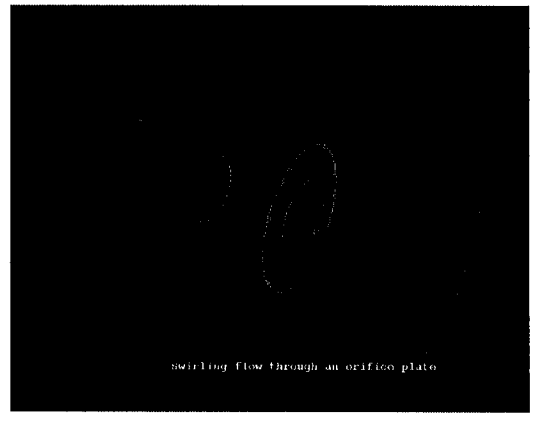
1. Answer All **CASE 1** and **CASE 2**
2. Comment as much as possible on the implications of the plots obtained.
3. Save the input programmes Q1's and all the result plots in one folder.
4. Each CASE carries marks as indicated.

# CASE 1:3D Swirling Flow through an Orifice Plate

**[60 marks]**

You are supposed to set up and run the simulation of a swirling flow through an orifice plate using cylindrical-polar coordinates and cyclic boundary conditions.

The flow is 3-D and its geometry is shown below. Velocity and pressure are to be solved. Cyclic boundary conditions are used to allow the flow to swirl.




At the inlet, the flow velocity is 1 m/s axially, swirling at 20 radians/s.

In the second case, a flow-straightener is introduced down-stream of the orifice in order to remove the swirl component.

**Set the domain size, and activate solution of variables:**

Set 'Swirling flow through an Orifice plate' as the Title.

NB: In Cylindrical-polar co-ordinates, X is always the angle measured in radians, Y is always the radius in metres, and Z is always the axis, also in metres.

The domain size is as follows:

X = 6.28319 radians ($2\pi$).
Y = 0.2 m.
Z = 1.0 m.

The numbers of cells are as follows:

20 cells in the X-direction,

15 cells in the Y-direction,

15 cells in the Z-direction

In 'Sources' set 'Velocity' next to 'U values are' as 'Angular Velocity'.
All references to U velocity inlet and initial values are interpreted as radians per second.

Set 'All slabs off' next to 'Cyclic boundaries', as 'All slabs on' to allow fluid to pass freely through the boundaries at X=0 and $X=X_{max}$.

**The fluid inlet:**

The INLET has the following size:

X = 6.28319 radians
Y = 0.1 m
Z = 0.0 m

And the position of the inlet is:

X = 0.0
Y = 0.1 m
Z = 0.0 m

The velocities are:

Z-direction = 1.0 m/s.
X-direction = 20 radians/s.

**The fluid outlet:**

The OUTLET has the following sizes:

X = 6.28319 radiansType equation here.
Y = 0.2 m
Z = 0.0 m

And the position of the outlet is:

X = 0.0
Y = 0.0 m
Z = 1.0 m

**The central blockage:**

The central blockage CENTRE has sizes as follows:

X = 6.28319 radians
Y = 0.1 m
Z = 0.3 m

**The orifice plate:**

The ORIFICE has following size:

X = 6.28319 radians
Y = 0.1 m
Z = 0.0 m

And ORIFICE position as:

X = 0.0 m
Y = 0.1 m
Z = 0.6 m

**The control parameters:**

Under 'Output' change the monitoring point by setting

IXMON to 1,
IYMON to 12,
IZMON to 2

Under 'Numerics' set the number of iterations to 300.

## Solving the problem.

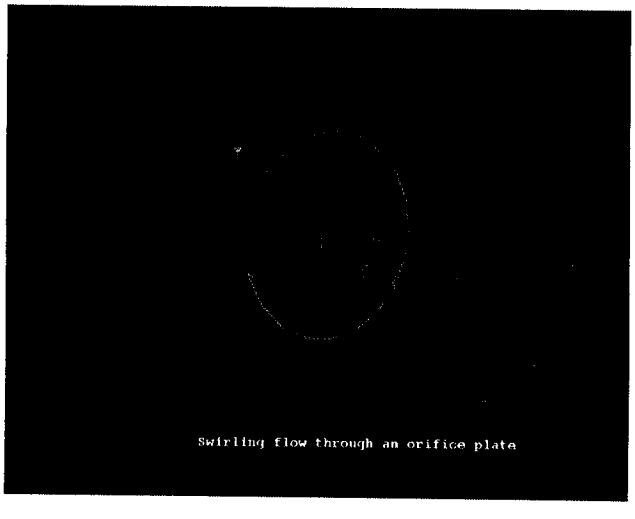
Use the appropriate tools to solve the Finite Volume Equations for this problem of case 1

## The results

Plot the relevant variables contours and vectors results for this case and "save as case" in folders named say NkambaCase1TEMPERATURE, NkambaCase1PRESSURE etc.

# CASE 2: Adding the Flow-Straightener [40 marks]

Now you are supposed to straighten the flow by adding five plates as shown below.




**Create the plates:**

The PLATE1 has size as:

X = 0.0 m

Y = 0.1 m
Z = 0.1 m

Plate position is:

X = 0.314
Y = 0.0 m
Z = 0.6 m

**Create three more plates:**

Duplicate using array' by setting Dimension to 4, and Pitch to 1.5708 ($2\pi/4$) in X.

**Create the outer plate:**

The outer plate named PLATE5 has size as:

X = 6.28319 radians
Y = 0.0 m
Z = 0.1 m

And PLATE5 position as:

X = 0.0 m
Y = 0.1 m
Z = 0.6 m

## Solving case 2

Use the appropriate tools to solve the Finite Volume Equations for this case 2 problem.

## The results.

Plot the relevant variables contours and vectors results for this case and "save as case" in folders named say NkambaCase2TEMPERATURE, NkambaCase2PRESSURE etc.

**NB**

Answer the following questions in the Answer booklet provided.

(i) Comment on the swirl at the exit after adding the five plates.
(ii) As an experiment, what do you see happening if the outer plate is removed?

Finally create a new folder named after you e.g. nkambaSWIRL or dakaSWIRL or chisalaSWIRL and transfer all the results plots above into this folder including.

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