Course Brief and Outline – <2020>

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1 Course Background

Networks constitute an integral component of our daily lives. Whether, it is the internet (World Wide Web) for web-browsing, the local LAN network at our offices, schools and homes or the cellular network that we use to make mobile-calls, we make use of different type of networks all the time and thus is an important field of study/work especially for electrical and computer engineers/scientists/programmers. Networking is also playing a crucial role in emerging areas of research e.g. High Performance Computing, Cloud Computing, Internet of Things etc.

Each network is built by making use of certain principles and methodologies and the aim of this course is to introduce to students the basic of networking principles. This will involve learning about the basics of networking technology, types of networks, network protocol layers, specific algorithms at each protocol layer and the use of tools to monitor networks and basics of how to use programming to create networking applications e.g. email, web-browser, chatting and social- networking applications etc.

2 Course Objectives

- Each telecoms/computer network is built by making use of certain principles and methodologies and the aim of this course is to introduce to students the basic of networking principles underlying all of these networks.
- Make the students learn about the basics of networking technology, types of networks and OSI protocol stack.
- Show to the students how to model and solve important networking parameters by exploiting the relationship amongst those parameters.
- Enable the students to develop an understanding of specific algorithms used at different protocol layers which are most relevant to networking i.e. Application Layer, Transport Layer, Network Layer and Data-link layer.
- Expose the students to hands-on experience with tools used for monitoring networks and help them develop software programs to create networking applications e.g. email, web-browser, chatting and social- networking applications etc.

3 Course Outcomes

On successful completion of this course, the student is able to:

Knowledge

- Describe the important components of a network and differentiate between different types of networks.
- Describe ISO protocol stack, the need for different protocol layers and explain services provided by Transport Layer.
- Demonstrate the structure and working of important protocols at different layers e.g. HTTP, FTP, DNS, TCP, IP etc.
- Understand the working of two important types of packet networks i.e. 1) Virtual Circuits and 2) Datagram networks and explain the associated pros and cons
- Describe how a router works.
- Understand working of important routing protocols for Internet.

Skills

After completion of this course, the student will have developed the following skills:

- Ability to model and solve different parameters of networks for a given network specification.
- Do socket programming with TCP and/or UDP
- Create and Perform different Reliable Data Transfer Protocols with respect to different set of requirements.
- Perform and analyze pipelined reliable data transfer protocols.
- Perform IP addressing/subnetting with respect to a particular set of network addressing requirements.
- Perform 2 important types of routing protocols i.e. 1) Link-State Routing and 2) Distance Vector Routing and describe their pros and cons.
- Mathematical modelling and analysis of the performance of different medium access protocols in the Data-link layer.

4 Course Content

The contents of this course are as per Rules & Syllabuses: Faculty of Engineering and the Built Environment. It states:
This course will explore the concepts, principles and architecture of communication networks, making reference to appropriate examples from the internet and public telephony networks (PSTN).
The ISO reference model will be used to discuss each of the layers and the functionality it performs. Application layer discussions will focus on standardized protocols that support many application types. Transport layer discussions will focus on achieving reliable transfer over an unreliable channel, flow and congestion control. Network layer discussions will cover global hierarchical addressing and the operation of routing. The data link layer will cover local area networks and their operation.

5 Prior Knowledge Assumed

The following prior knowledge is assumed on the part of students starting this course:

All third year courses, ELEN3024 mandatory.

The prerequisites and co-requisites to register for this course are defined in the current *Rules & Syllabuses: Faculty of Engineering and the Built Environment*.

6 Assessment

The student will have reached the outcomes if he/she can:

- Describe the important components of a network, differentiate between different types of networks and is able to identify and explain the purpose and working of protocols residing in different layers in the protocol stack.
- Show the different components of a router and explain their purpose.
- Model a networking problem in terms of important parameters of the network and solve for the unknown parameters making use of the available information and by making reasonable assumptions.
- Perform coding in any software language for the task of socket programming and use this skill in the project to develop a prototype networking application.
- Design a reliable data transfer protocol based on a given set of errors present in a network.
- Perform IP addressing/subnetting with respect to a particular set of network addressing requirements.
- Demonstrate the working of the Link-state and the distance-vector network routing algorithms for a given network topology.
- Model the performance of important protocols at the data-link layer using the relevant mathematical tools.

6.1 Formative Assessments Elements

All submissions must be in strict accordance with the guidelines contained in the School's Blue Book and the rules contained in the School's Red Book. No exceptions will be considered.

6.2 Summative Assessment

Table 1: Summative assessment contributions

Summative Assessment Contributor	Duration h	Component Yes/No	Method & Weight %	Calculator Type 0/1/2/3	Permitted Supporting Material
Project	N/A	No	30	N/A	N/A
Lab	13h45	No	20	N/A	N/A
Exam	3h00	No	50	2	A4 handwritten information sheet (no examples or fully worked solutions allowed)

6.3 Assessment Methods

As per the rule G-13 as posted on the student notice board as well.

The course knowledge area will be assessed by means of one (1) project, four (4) laboratories and one (1) exam.

7 Satisfactory Performance (SP) Requirements

For the purpose of Rule G.13 *satisfactory performance in the work of the class* means attendance and completion of prescribed laboratory activities, attendance at tutorials designated as compulsory in this CB&O, submission of assignments, writing of scheduled tests unless excused in terms of due procedure.

8 Teaching and Learning Process

8.1 Teaching and Learning Approach

- **ELO 1:** The students would be required to mathematically model and solve a number of problems related to networking in terms of different network parameters, and eventually analyse and interpret the obtained solution.
- **ELO 2:** Application of knowledge of basic mathematics and basic communication engineering learned in 3rd year to model and solve problems related to network design and/or analysis for a given set of specifications.
- **ELO 4:** Lab work a involving use of tools to analyse the captured packets over a network and analyse and interpret their contents.
- **ELO 5:** The use of a programming language to develop a basic network application, using the socket programming skills, in the course project
- **ELO 6:** Technical report about the project would be submitted by the students and assessed.
- **ELO 8:** Project will be conducted by a team of 2 students.
- **ELO 11**: The project will require management of the complete project lifecycle, involving the precise specification of the project, features to be implemented, division of tasks, creation of timeline and allocation of resources and then eventual execution of the project and its submission by the deadline.

8.2 Information to Support the Course

Course Textbook:

James F. Kurose, and Keith W. Ross, "Computer Networking: A Top-Down Approach" 7th Edition, Pearson, 2016.

8.3 Learning Activities and Arrangements

Lectures:

There are two (2) 45-minute lectures scheduled per week as shown on the fourth year first semester timetable. Lectures will be used to cover some material not included in course notes. The final examination will assume that students are familiar with all material covered in the notes, in the laboratories, in the project and during lecture periods.

Tutorials:

There are six (6) 45-minute tutorial sessions as shown on the timetable provided by the course coordinator. The venue information will be found on the same timetable.

Project/Assignment:

Details on the course project, including deliverables required and deadline, will be provided during lectures in the form of handouts as well as being made available on the course home page.

All submissions must be in strict accordance with the guidelines contained in the School's Blue Book and the rules contained in the School's Red Book. No exceptions will be considered.

Laboratory:

There are five (5) laboratory sessions as shown on the timetable provided by the course coordinator. The venue information will be found on the same timetable.

Consultation:

All questions arising from the laboratories must be directed to the demonstrator responsible. Questions relating to the use of the laboratory and its equipment must be directed to the lecturer. Questions relating to lectures and course material must be directed to the lecturer either during lectures or during formal consultation periods. Formal consultation periods will be scheduled at students' request. Students must, however, try to resolve any problems amongst themselves first.

9 Course Home Page

Further information and announcements regarding the course are posted on the course home page: http://dept.ee.wits.ac.za/~cheng/ELEN4017/

All students are expected to consult the course home page at regular intervals.