1.	**Name of Course/Module:** Introduction to Network Programming and Design
2.	**Course Code:** CNP308
3.	**Rationale for the inclusion of the course/module in the programme:** Network programming is an essential task to ensure proper functionality of network applications. It covers specialized skills including to understand the underlying network principles and to carry out programming. This course provides both theoretical knowledge and practical skills that are essential to designing and implementing a network.
4.	**Faculty, Semester and Year offered: BICT,** Semester 5 Year 2
5.	**Credit Value: 3**
6.	**Prerequisite (if any):** None
7.	**Objectives:** The objectives of this course are to: ▪ Explain a range of underlying principles and techniques in developing, designing and marketing network applications; ▪ Describe the underlying principles of computer networks; ▪ Prepare and write programs for developing Internet applications; ▪ Evaluate different network design strategies; ▪ Compose digital design, design for the market, and design in a global environment.
8.	**Learning outcomes:** Upon completion, the students should be able to: ▪ Identify the key elements of a computer network and how networks can be interconnected. ▪ Explain the basics of network operating system functionality. ▪ Discuss the underlying algorithms of networking protocols, and the underlying principles of Internet protocols, as well as the application of layering models in the design of networks. ▪ Use C programs in the UNIX environment. ▪ Complete projects that require one to communicate the problem-solving techniques and technical solutions through writing and verbal presentation.
9.	**Transferable Skills:** ▪ Programming – Students will be taught network programming, specifically, writing C programs in UNIX environment. ▪ Design – Student will be taught how to compose and develop digital design, or how various components of networking can be interconnected, based on the requirement, which could be derived from the local or global markets. ▪ Analytical – Students will be taught how to evaluate various kinds of network design strategies and algorithms. This enables the students to make the right choice of decision on network design as well as in their project. ▪ Hands-on and Troubleshooting – Students will be taught how to configure basic functionality of switches, and how to implement Virtxfal LANs, VTP, and Inter-VLAN routing in networks, as well as to sort out the source of the problem in these tasks, and subsequently to solve the problem. ▪ Project and Communication - Students will be given exposure working on a project which can be on an individual or team basis, and to present their work.
10.	**Teaching-learning and assessment strategy:** **Teaching-learning** ▪ Lectures - lectures are conducted weekly that cover every topic stated in the course outline. Lecturers also promote interactive learning with the students where mutual participation in question and answer and short discussion are expected. ▪ Practical Laboratories - the lab session is used to teach network programming to the student. It is conducted in the computer laboratory. **Assessment** ▪ Exam – it is a written form of summative assessment which is conducted in the final exam. ▪ Quiz - It is a written form of formative assessment that may be conducted during the lecture period. ▪ Assignment - It is a take home task that student has to complete outside of the classroom. It can be in the form of practical or theoretical report. ▪ Project - It is a take home task that student has to complete outside of the classroom. It may be assigned to an individual or group where marks are given based on the fulfillment to the assessment criteria of the project. ▪ Presentation - Student is assessed on the communication skills.
11.	**Synopsis:** This course provides a comprehensive, theoretical, and practical approach to learning the technologies and protocols needed to design and implement a converged switched network. Students learn about the hierarchical network design model and how to select devices for each layer. The course explains how to configure a switch for basic functionality and how to implement Virtxfal LANs, VTP, and Inter-VLAN routing in a converged network. The different implementations of Spanning Tree Protocol in a converged network are presented, and students develop the knowledge and skills necessary to implement a WLAN in a small-to-medium network.

12. **Mode of Delivery**
Lectures and Practical Laboratories

13. **Assessment Methods and Types**
Continuous assessment: 60%
Final exam: 40%

14. **Mapping of the course/module to the Programme Aims**
- Competent information and communication technology practitioner with solid theoretical and practical knowledge in the area of information technology.
- IT professional who is a proficient in communicating the state-of-the-art in information technology.
- IT professional who has the abilities in leading the specific task in a team with qualities in decision making and entrepreneurial attributes.

15. **Mapping of the course/module to the Programme Learning Outcomes**
- Able to apply knowledge and skills in the field of information and communication technology management.
- Able to solve real world problem using information and communication technology approach and techniques.
- Able to express ideas and opinions effectively in various communication style, tools and media.
- Able to recognize and formulate new approach or method in providing IT technical solutions.
- Able to be participate in a project-based assignment at individual or team level.

16. **Content outline of the course/module and the SLT per topic**

1. Networking Topics
1.1. Describing the principles of layered communications protocols
1.2. Describing the ISO seven-layer model for open systems interconnection
1.3. Describing the Client-Server model for distributed applications
1.4. Describing the basic features provided by the TCP/IP protocol suit
1.5. Discussing some of the network facilities in the UNIX computing environment
1.6. Networking Software Architecture in UNIX
1.7. Describing the overall structure of the networking software in UNIX
1.8. Describing the basic features of the STREAMS I/O system
1.9. Describing the sockets interface implementation in UNIX

2. Transporting Selections and Name to Address Mapping
2.1. Describing the part played by the network selection and name to address mapping functions in the construction of transport protocol independent software
2.2. Performing run-time transport selection from within an application using the netconfig file and NETPATH environment variable.
2.3. Using the name to address mapping functions to translate host and service names to transport addresses in a transport independent way

3. Introduction to Transport Layer Interface (TLI) Programming
3.1. Describing the basic features of TLI
3.2. Describing the concepts of Transport User and Transport Provider
3.3. Accessing the TCP/IP protocols using TLI
3.4. Building simple applications using both connection mode and connectionless mode operation of TLI

4. More Advanced Use of TLI
4.1. Retrieving attributes of a transport provider through a transport endpoint
4.2. Describing how TLI functions can operate in non-blocking mode
4.3. Setting and examining protocol options through a transport endpoint
4.4. Describing the relationship between TLI and STREAMS
4.5. Writing applications which use a read()/write() interface to a transport endpoint
4.6. Performing asynchronous I/O using TLI
4.7. Managing multiple transport endpoints using the polling interface
4.8. Processing Out of Band (Expedited) data on a transport endpoint
4.9. Building a server which can monitor multiple transport endpoints

5. Accessing Network Information

5.1. Listing the configuration files, or Name Service maps and tables, that contain information about the network facilities used by sockets based applications

5.2. Using the standard library routines to access this information

5.3. Using the various macros and library routines used in building network-based applications

6. Sockets

6.1. Describing the basics of sockets

6.2. Describing the concepts of communications domains and socket types

6.3. Explaining how the different types of sockets give access to the different underlying protocols

6.4. Writing simple applications which use TCP and UDP as transport protocol

7. More Advanced Use of Sockets

7.1. Describing the characteristics of I/O using sockets

7.2. Describing the main socket options that can be interrogated and set

7.3. Accessing a network interface through a socket

7.4. Broadcasting through a socket

7.5. Describing how sockets operate in communications domains other than

7.6. UNIX and Internet

8. Introduction to Remote Procedure Call (RPC)

8.1. Describing the basic concepts of Remote Procedure Call Listing the main features of the Open Network Computing (ONC[TM]) RPC protocol

8.2. Describing the function of program, version and procedure numbers Explaining how RPC bind works Using the RPC service library routines

9. The Programmer's Interface to RPC

9.1. Describing the structure of RPC applications

9.2. Describing the simplified and standard programming interfaces to the

9.3. RPC facilities

9.4. Writing a small application using the simplified and standard interfaces

9.5. Building Applications with rpcgen

9.6. Specifying a RPC based application protocol using the RPC language

9.7. Using rpcgen to translate a protocol specification into code

9.8. Describing the various options available when using rpcgen

17. **Main references supporting the course:**

Goralski, W. (2009). *The illustrated network: How TCP/IP works in a modern network*. Morgan Kaufmann.

Additional references supporting the course

Dhotre, I. A., & Bagad, V. S. (2009). *Computer networks*. Technical Publications.

Stevens, W. R., Fenner, B., & Rudoff, A. M. (2004). *UNIX network programming: the socket networking API*. Addison-Wesley.