NETWORK PROTOCOL DEVELOPMENT

Advanced C:

Architecture Of Simple Computer:

- CPU
- Memory
- I/O controllers
- Executable Image contents
- Text/Code
- Data (Initialized and uninitialized)
- Heap
- Stack

Development tools and Environment:

Compiler:

1. Compilation Stages
2. Object file format

Linker:

- Function of Linker
- Executable file format
- Executable file vs Executable Image in memory

Archive or Libray utility

Make utility

Debugger

Source Code Control System (SCCS)

Project Environment development:

- Module concept
- Interface functions
- Unit testing of module
- Test Driver
- Test Stub

Functions:

- Definition, Declaration/prototype, Invocation
- Function type and return value
- Output parameters
- Pass by value and pass by reference
- Local variables

- Static variables
- Thread of execution(stack frames)
- Stdio functions
- Passing parameters to a C function from the assembly language
- Accessing the parameters from the C function from an assembly language

Pointers:

- Pointers Vs Integers
- Pointer type
- Pointer de-reference
- Pointers and arrays
- Pointer arithmetic
- Array of pointers
- Pointers and Dynamic memory
- Function pointers

Arrays:

- Valid Indexes to array
- Addresses of elements of array
- Initialization
- Using pointer as an array
- Strings
- Passing an array to a function
- Two-dimensional array initialization
- Two dimensional arrays and pointers

User Defined Datatypes:

- Structures
- Unions
- Typedef
- Enums

Structures:

- Compound type
- Packing of elements within a structure
- Alignment and hole in the structure
- Structure pointers
- Accessing elements of a structure using structure pointers
- Dynamic allocation of memory for structures
- Self referential structures
- Passing structure parameters to functions
- Returning a structure or struct pointer by a function

Unions:

- Differences between union and structure
- Uses of unions

Bit Operations:

- Binary, Decimal and Hex conversions
- Logical versus Bit wise operations
- Masking a bit
- Testing a bit
- Setting a bit
- Testing a set of bits
- Setting a set of bits

Miscellaneous:

- Big Endian and Little endian
- Ascii codes and file formats
- Interpreting the contents of a file
- As a text
- As a numbers (int, short, float or combination)
- As an image
- As a sound
- As CPU instructions

File Operations:

- Storing structures in binary format
- Storing structures in ascii format

Essential Data Structures:

Arrays:

- Operations on arrays
- Strings

Linked Lists:

- Single linked lists
- Operations on linked lists
- Double linked lists

Stacks:

Queues:

- Linear queues
- Circular queues

Search Techniques:

- Linear search
- Binary search
- Hash based search

Packets or Messages

- Framing of messages
- Parsing of messages

File Formats:

Mini Project in C:

LINUX SYSTEM PROGRAMMING

Introduction to Linux:

- Process Management
- File Management
- Memory Management
- I/O management

Unix File I/O System Calls:

- File descriptors
- File types
- Stdin, Stdout and Stderr File descriptors
- Link or Relationship between File Descriptor and File or device
- File descriptors of same file but from multiple processes
- Unix File I/O calls (unbuffered i/o)
- open, create, close, lseek, read, write, dup, dup2
- fcntl, ioctl
- File types, IDs and Access permissions

Standard I/0 Library Functions:

- fopen, fread, fwrite, fclose & fseek
- Relationship between file descriptor and FILE pointer
- Character at a time I/O
- Line at a time I/O
- Formatted I/O

Reading and Writing Structures to Files:

- In ascii format
- In Binary format
- Modifying a structure in the file

The Environment of a Unix Process:

- How C program starts and terminates as process
- Memory layout of a C Program
- Main function, Command line arguments, Environment variables
- exit(), _exit() and atexit() functions

Process System Calls:

- Process Identifiers
- fork, vfork, exit, wait, waitpid, execv

Initial Process Relationships:

- Terminal Logins

Signals:

- Signal Concepts
- Signal(), kill(), raise(), alarm() and pause()

Inter Process Communication:

- Pipes
- FIFO (Named pipes)
- Message Queues
- Semaphores
- Shared Memory

Threads:

- Multi-threaded programming
- Synchronization and Mutual exclusion for threads
- POSIX Semaphores

NETWORK PROGRAMMING

Introduction to Networking:

- Need/Uses of Networking
- Network topologies
- LAN, MAN, WAN
- Typical media used in each
- Typical protocols used in each
- LAN Standards
- Ethernet, Token Ring, Token Bus, FDDI
- Ethernet Media (Thick, Thin, Twisted pair)
- WAN Standards
- Dial-up, Leased Line
- ISDN, DSL
- ATM
- Wireless

Network Protocol Layers:

- Use of Layers
- OSI Protocol layers
- TCP/IP protocol layers

Socket Programming:

- Concept of socket / socket pair
- Concept of Client and Server
- Concept connectionless and connection oriented protocols (UDP/TCP)
- Socket calls for UDP server and client
- Socket calls for TCP server and client
- Algorithms and Issues in Client software design
- Algorithms and Issues in Server software design
- Iterative, Connectionless Servers
- Iterative Connection-Oriented servers
- Concurrent, Connection-Oriented servers
- Serving multiple clients with a single process
- Serving multiple clients with one thread per client

UDP/TCP Applications:

- TFTP
- SMTP
- HTTP
- Mixed techniques

TCP/IP Stack Internals:

Internet Addresses:

- IP Address
- Hardware Addresses
- Unicast, Broadcast, Multicast in IP and HW addresses
- Ethernet Frame format
- ARP

Internet Protocol:

- Packet format
- Fragmentation and Re-assembly
- Routing

UDP:

ICMP:

TCP:

- Timeout and Retransmission

- Flow control
- State machine
- Congestion control
- Silly window syndrome
- Socket API Interface

Software Engineering:

- Software Development Life Cycle
- Requirement Specification
- Design (High level and Detailed)
- Coding, Coding standards
- Unit testing, Unit test plan, Test drivers, test stubs
- Integration and System testing and their test plans
- Acceptance test plan

Major Project:

Finally, student will do a major project on network or wireless or telecom protocols using VxWorks or VxWorks like RTOS.