8.6 Digital filter: Implementation of digital filter, Applications of FFT algorithms. (AExE0806)

9. Wireless and Telecommunication System (AExE09)

9.1 Telecommunication and its evolution: History of telecommunication. Generations and future trends. Telecommunication transmission media. (AExE0901)

9.2 Cellular network: Free space propagation model, Reflection, diffraction and scattering; small scale multipath propagation and fading model, Rayleigh fading model, cellular concept frequency reuse Strategies Channel assignment and handover process, coverage and capacity in cellular system, cell splitting and cell sectoring concept. (AExE0902)

9.3 Signal and system: Equalization and diversity techniques, Spread Spectrum modulation, Multiple Access techniques. (AExE0903)

9.4 Switching systems: Digital and analog switching, soft switching, Routing and Signaling. (AExE0904)

9.5 Traffic engineering: Tele traffic parameters (busy hour, grade of service, service levels, and traffic intensity). Traffic routing in wireless networks, common channel signaling, integrated services digital networks. Packet vs circuit switching for PCN, protocol for network access. (AExE0905)

9.6 Rules and regulations: International Telecommunication Union (ITU), Nepal Telecommunication Authority (NTA), Ministry of Communication and Information, National frequency allocation plan, Radio act. (AExE0906)

10. Project Planning, Design and Implementation (AALL10)

10.1 Engineering drawings and its concepts: Fundamentals of standard drawing sheets, dimensions, scale, line diagram, orthographic projection, isometric projection/view, pictorial views, and sectional drawing. (AALL1001)

10.2 Engineering Economics: understanding of project cash flow; discount rate, interest and time value of money; basic methodologies for engineering economics analysis (Discounted Payback Period, NPV, IRR & MARR); comparison of alternatives, depreciation system and taxation system in Nepal. (AALL1002)

10.3 Project planning and scheduling: project classifications; project life cycle phases; project planning process; project scheduling (bar chart, CPM, PERT); resources levelling and smoothing; monitoring/evaluation/controlling. (AALL1003)

10.4 Project management: Information system; project risk analysis and management; project financing, tender and its process, and contract management. (AALL1004)

10.5 Engineering professional practice: Environment and society; professional ethics; regulatory environment; contemporary issues/problems in engineering; occupational health and safety; roles/responsibilities of Nepal Engineers Association (NEA). (AALL1005)

10.6 Engineering Regulatory Body: Nepal Engineering Council (Acts & Regulations). (AALL1006)

Plane earth propagation. (AExE0606)

7. Communication System (AExE07)

7.1. Communications system: Basic building blocks of analog and digital communication systems, Signal and noise in communication system. (AExE0701)

7.2 Representation of signals and systems in communication: Low pass and Band pass signals and systems, bandwidth of a system, distortion less transmission, the Hilbert transform and its application. (AExE0702)

7.3 Modulation: Time domain expression, Frequency domain representation of AM, FM & PM signals. Types of AM & FM signals. Modulation, Demodulation and Bandwidth requirement of AM & FM signal. Digital Modulation & Demodulation of ASK, FSK & PSK signal. M-array data communication system. (AExE0703)

7.4 Digital communication systems: Process of Analog to Digital Communication system, Source Coding, Pulse Modulation Technique, Pulse Code Modulation, Types of Quantization, Quantization Noise. Shannon Hartly channel capacity theorem. Multiplexing. (AExE0704)

7.5 Baseband and band pass data communication systems: Introduction to information theory, Measure of information, line codes, pulse shaping, error control coding techniques. (AExE0705)

7.6 Random signals and noise in communication system: Random Signal and processes, White Noise, Thermal Noise, Bandlimited White Noise, the PSDF and AC function of White Noise. (AExE0706)

8.Signal System and Digital Signal Processing (AExE08)

8.1 Signal and system: Signal definition, Impulse response and convolution, Fourier series, Fourier Transform, Unit step, Delta, Sinc & Signum function, Hilbert transform, LTI system Continuous time Fourier series representation, Properties of continuous time Fourier Series. Discrete time Fourier series representation, Properties of discrete time Fourier series, Continuous time Fourier transform representation, Properties. Energy spectral densities, power spectral density, discrete time Fourier transform representation and Properties. (AExE0801)

8.2 Linear time invariant system: Ideal sampling, linear time invariant (LTI) system, properties of LTI system, frequency response of LTI system, Ideal low pass filter, impulse response and step response of ideal low pass filter. Frequency response of LTI system, Stability of LTI systems, Implementation of LTI system. (AExE0802)

8.3 Z-Transform and discrete Fourier transform: Definition of the z-transform, Region of convergence, Relationship to causality. Inverse z-transform, Convolution, Parseval's theorem's-transform function H (z)-transient and steady state sinusoidal response, pole-zero relationship stability. Frequency domain sampling and reconstruction, Relationship of the DFT to other transforms. Properties of the Discrete Fourier Transform, Multiplication of two DFTs and Circular Convolution. (AExE0803)

8.4 Implementation of discrete-time system: Structures for FIR and IIR, Conversion between direct form and lattice and vice versa, Lattice and lattice-ladder for IIR. Digital filters, finite precision implementations of discrete filters, Representation of Numbers; fixed point and floating binary point, Effect of Rounding and truncation, Quantization of filter coefficients and effects on location of poles, and zeros. (AExE0804)

8.5 IIR filter design and FIR filter design: IIR filter design by classical filter design. IIR filter design by Impulse-invariant method, IIR low pass discrete filter design. FIR filter design by Fourier approximation. FIR filters using window function, Design of linear phase FIR filter by the frequency sampling method, FIR filter design using the Remez exchange algorithm. Design of optimum equi-ripple linear-phase FIR filters. (AExE0805)

representation using VHDL. Design of combinational and sequential logic using VHDL. Pipelining using VHDL. (ACtE0406)

5. Concept of Computer Network and Network Security System (ACtE05)

5.1 Introduction to computer networks and physical layer: Networking model, Protocols and Standards, OSI model and TCP/IP model, Networking Devices (Hubs, Bridges, Switches, and Routers) and Transmission media. (ACtE0501)

5.2 Data link layer: Services, Error Detection and Corrections, Flow Control, Data Link Protocol, Multiple access protocols, LAN addressing and ARP (Address Resolution Protocol), Ethernet, IEEE 802.3(Ethernet), 802.4(Token Bus), 802.5(Token Ring), CSMA/CD, Wireless LANs, PPP (Point to Point Protocol), Wide area protocols. (ACtE0502)

5.3 Network layer: Addressing (Internet address, classful address), Subnetting, Routing Protocols (RIP, OSPF, BGP, Unicast and multicast routing protocols), Routing algorithms (shortest path algorithm, flooding, distance vector routing, link state routing) Routing Protocols (ARP, RARP, IP, ICMP), and IPv6 (Packet formats, Extension headers, Transition from IPv4 to IPv6, and Multicasting). (ACtE0503)

5.4 Transport layer: The transport service, Transport protocols, Port and Socket, Connection establishment & Connection release, Flow control & buffering, Multiplexing & de-multiplexing, Congestion control algorithm (ACtE0504)

5.5 Application layer: Web (HTTP & HTTPS), File Transfer (FTP, PuTTY, Win SCP), Electronic Mail, DNS, P2P Applications, Socket Programming, Application server concept, and Concept of traffic analyzer (MRTG, PRTG, SNMP, Packet tracer, Wireshark). (ACtE0505)

5.6 Network security: Types of Computer Security, Types of Security Attacks, Principles of cryptography, RSA Algorithm, Digital Signatures, securing e-mail (PGP), Securing TCP connections (SSL), Network layer security (IPsec, VPN), Securing wireless LANs (WEP), Firewalls. (ACtE0506)

6. Electromagnetic Waves and Propagation (AExE06)

6.1 Electric field: Electric field and flux density. Significance of divergence, Divergence theorem. Electric potential, potential gradient, Energy density in electrostatic field, Free and bound charges, polarization, relative permittivity, electric dipole, Electric Boundary conditions. Current, current density, conservation of charge, continuity equation, relaxation time. Boundary value problems, Laplace and Poisson equations and their solutions, uniqueness theorem. (AExE0601)

6.2 Magnetic field: Biot-Savart's law, Magnetic field intensity and flux density Ampere's circuital law and its application, Physical significance of curl, Stoke's theorem. Magnetic force, magnetic torque, magnetic moment, magnetic dipole, magnetization. Magnetic boundary condition. (AExE0602)

6.3 Wave equation and wave propagation: Displacement current, Maxwell's equations in integral and point forms. Wave propagation in lossless and lossy dielectric, Plane waves in free space, lossless dielectric, good conductor. Reflection of plane wave at normal and oblique incidence. (AExE0603)

6.4 Wave-guides and antenna: Rectangular wave guide. Transverse electric mode, transverse magnetic mode. Antenna Radiation, Theorem and Parameters. (AExE0604)

6.5 Antenna's classification: Isotropic antenna, Omni directional antenna; Dipole, Directional antennas, Travelling wave antennas – single wire, V and Rhombus Reflector antennas – large plane sheet, small plane sheet, linear, corner, parabolic, elliptical, hyperbolic and circular reflector. Aperture antenna horn Array antennas – Yagi Uda, Log Periodic Other antennas – Monopole, Loop, Helical, Micro strip. (AExE0605)

6.6 Propagation and radio frequency spectrum: Ground or surface wave, Space wave, duct propagation, Ionospheric or sky wave. Critical frequency, Troposphere wave. Free space propagation,

3. Programming Language and Its Applications (ACtE03)

3.1 Introduction to C programming: C Tokens, Operators, Formatted/Unformatted Input/output, Control Statements, Looping, User-defined functions, Recursive functions, Array (1-D, 2-D, Multi-dimensional), and String manipulations. (ACtE0301)

3.2 Pointers, structure and data files in C programming: Pointer Arithmetic, Pointer and array, passing pointer to function, Structure vs Union, array of structure, passing structure to function, structure and pointer, Input/output operations on files, and Sequential and Random Access to File. (ACtE0302)

3.3 C++ language constructs with objects and classes: Namespace, Function Overloading, Inline functions, Default Argument, Pass/Return by reference, introduction to Class and object, Access Specifiers, Objects and the Member Access, Defining Member Function, Constructor and its type, and Destructor, Dynamic memory allocation for objects and object array, this Pointer, static Data Member and static Function, Constant Member Functions and Constant Objects, Friend Function and Friend Classes. (ACtE0303)

3.4 Features of object-oriented programming: Operator overloading (unary, binary), data conversion, Inheritance (single, multiple, multilevel, hybrid, multipath), constructor/destructor in single/multilevel inheritances. (ACtE0304)

3.5 Pure virtual function and file handling: Virtual function, dynamic binding, defining opening and closing a file, Input / Output operations on files, Error handling during input/output operations, Stream Class Hierarchy for Console Input /Output, Unformatted Input /Output Formatted Input /Output with ios Member functions and Flags, Formatting with Manipulators. (ACtE0305)

3.6 Generic programming and exception handling: Function Template, Overloading Function Template, Class Template, Function Definition of Class Template, Standard Template Library (Containers, Algorithms, Iterators), Exception Handling Constructs (try, catch, throw), Multiple Exception Handling, Rethrowing Exception, Catching All Exceptions, Exception with Arguments, Exceptions Specification for Function, Handling Uncaught and Unexpected Exceptions. (ACtE0306)

4. Computer Organization and Embedded System (ACtE04)

4.1 Control and central processing units: Control Memory, addressing sequencing, Computer configuration, Microinstruction Format, Design of control unit, CPU Structure and Function, Arithmetic and logic Unit, Instruction formats, addressing modes, Data transfer and manipulation, RISC and CISC Pipelining parallel processing. (ACtE0401)

4.2 Computer arithmetic and memory system: Arithmetic and Logical operation, The Memory Hierarchy, Internal and External memory, Cache memory principles, Elements of Cache design - Cache size, Mapping function, Replacement algorithm, write policy, Number of caches, Memory Write Ability and Storage Permanence, Composing Memory. (ACtE0402)

4.3 Input-Output organization and multiprocessor: Peripheral devices, I/O modules Input-output interface, Modes of transfer Direct Memory access, Characteristics of multiprocessors, Interconnection Structure, Inter-processor Communication and synchronization. (ACtE0403)

4.4 Hardware-Software design issues on embedded system: Embedded Systems overview, Classification of Embedded Systems. Custom Single-Purpose Processor Design, Optimizing Custom Single-Purpose Processors, Basic Architecture, Operation and Programmer's View, Development Environment. Application-Specific Instruction-Set Processors. (ACtE0404)

4.5 Real-Time operating and control system: Operating System Basics, Task, Process, and Threads, Multiprocessing and Multitasking, Task Scheduling, Task Synchronization, Device Drivers, Open-loop and Close-Loop control System overview, Control. (ACtE0405)

4.6 Hardware descripts language and IC technology: VHDL Overview, Overflow and data

Nepal Engineering Council Registration Examination

Electronics and Communication Engineering

Electronics and Telecommunication Engineering

Information Technology and Telecommunication Engineering

(Code: AExE)

Chapters 1-4 are fundamentals/principles of concepts in Electronics and Communication engineering and Information Technology; chapters 5-9 are related to application of engineering principles in practice; and the last (10^{th}) chapter is related to project planning, design and implementation.

1. Concept of Basic Electrical and Electronics Engineering (AExE01)

1.1 Basic concept: Ohm´s law, electric voltage current, power and energy, conducting and insulating materials. Series and parallel electric circuits, start-delta and delta-star conversion, Kirchhoff's law, linear and non-linear circuit, bilateral and unilateral circuits, active and passive circuits. (AExE0101)

1.2 Network theorems: concept of superposition theorem, Thevenin`s theorem, Norton`s theorem, maximum power transfer theorem. R-L, R-C, R-L-C circuits, resonance in AC series and parallel circuit, active and reactive power. (AExE0102)

1.3 Alternating current fundamentals: Principle of generation of alternating voltages and currents and their equations and waveforms, average, peak and rms values, three phase system. (AExE0103)

1.4 Semiconductor devices: Semiconductor diode and its characteristics, BJT Configuration and biasing, small and large signal model, working principle and application of MOSFET and CMOS. (AExE0104)

1.5 Signal generator: Basic Principles of Oscillator, RC, LC and Crystal Oscillators Circuits. Waveform generators. (AExE0105)

1.6 Amplifiers: Classification of Output Stages, Class A Output Stage, Class B Output Stage, Class AB Output Stage, Biasing the Class AB Stage, Power BJTs, Transformer-Coupled Push-Pull Stages, and Tuned Amplifiers, op-amps. (AExE0106)

2. Digital Logic and Microprocessor (AExE02)

2.1 Digital logic: Number Systems, Logic Levels, Logic Gates, Boolean algebra, Sum-of-Products Method, Product-of-Sums Method, Truth Table to Karnaugh Map. (AExE0201)

2.2 Combinational and arithmetic circuits: Multiplexetures, Demultiplexetures, Decoder, Encoder, Binary Addition, Binary Subtraction, operation on Unsigned and Signed Binary Numbers. (AExE0202)

2.3 Sequential logic circuit: RS Flip-Flops, Gated Flip-Flops, Edge Triggered Flip-Flops, Mater- Slave Flip-Flops. Types of Registers, Applications of Shift Registers, Asynchronous Counters, Synchronous Counters. (AExE0203)

2.4 Microprocessor: Internal Architecture and Features of microprocessor, Assembly Language Programming. (AExE0204)

2.5 Microprocessor system: Memory Device Classification and Hierarchy, Interfacing I/O and Memory Parallel Interface. Introduction to Programmable Peripheral Interface (PPI), Serial Interface, Synchronous and Asynchronous Transmission, Serial Interface Standards. Introduction to Direct Memory Access (DMA) and DMA Controllers. (AExE0205)

2.6 Interrupt operations: Interrupt, Interrupt Service Routine, and Interrupt Processing. (AExE0206)