DETAILED SYLLABUS FOR THE POST OF ASSISTANT PROFESSOR IN ELECTRONICS AND COMMUNICATION ENGINEERING (TECHNICAL EDUCATION DEPARTMENT (ENGG. COLLEGES)

(Cat.No.: 725/2021)

(Total Marks – 100)

Topic	Mark
Module I : **Network Analysis** Steady-state AC analysis using Mesh and Node analysis, Supermesh and Supernode analysis. Network theorems: Superposition, Thevenin and Norton's, maximum power transfer (applied to both dc and ac circuits having dependent source). Transient analysis of RL, RC, and RLC networks with impulse, step and sinusoidal inputs (with and without initial conditions). Analysis of networks with transformed impedance and dependent sources. Network functions: driving point and transfer functions, Two-port network parameters: Reciprocal and Symmetrical two port network.	**8**
Module II : **Electronic Devices:** Energy bands in silicon, carrier transport in silicon, diffusion current, drift current, mobility and resistivity, generation and recombination of carriers. MOS capacitor, band diagrams at equilibrium, accumulation, depletion and inversion, threshold voltage, body effect, MOSFET-structure, types, Drain current equation - linear and saturation region, Drain characteristics, transfer characteristics. MOSFET scaling, Sub threshold conduction in MOS. Short channel effects- Channel length modulation, Drain Induced Barrier Lowering, Velocity , Saturation, Threshold Voltage Variations and Hot Carrier Effects. Non-Planar MOSFETs: Fin FET –Structure, operation and advantages. **VLSI Circuit Design** : VLSI Design Methodologies, Static CMOS Logic Design, Dynamic logic Design, Storage Cells, Arithmetic circuits, Fabrication techniques and MOSFET physical Design.	**10**
Module III :**Analog Circuits** Simple diode circuits: clipping & clamping, biasing and bias stability of BJTs and MOSFETs, small signal equivalent circuits of BJTs and MOSFETs. Amplifiers: single & multi stage, differential, feedback and power. DC & AC Analysis Frequency response of amplifiers. Linear Regulated power supplies. Op. amp circuits: Inverting, non-inverting, Integrator and Comparator. Op-amp applications. Active filters. Sinusoidal Oscillators, Multivibrators, Timer and VCO. Mixed Circuit Design: MOS Amplifiers, Cascoded stages, MOS Current Mirror, Differential	**8**

Amplifiers, CMOS OP AMPS & Comparator, Phase Locked Loop, Switched Capacitor Circuits, Data Converters - DAC & ADC Architecture.	
Module IV : Digital Circuits Boolean algebra, minimization of Boolean functions, logic gates, combinational Circuits: arithmetic circuits, code converters, multiplexers and decoders, sequential circuits: latches and flip-flops, counters and shift registers, CMOS - Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product, CMOS inverter. Programmable logic Devices, CPLDs, FPGA architecture, Placement and Routing, Commercial FPGAs. Digital System Design : Clocked Synchronous Networks, Asynchronous Sequential Circuits, Hazards, Faults.	**8**
Module V : **Computer Architecture *:*** Von Neumann and Harvard computer architectures, CISC and RISC architectures. Processor Architecture, Processor operation, 8051 Architecture and programming, Interfacing of 8051, Memory System. **Embedded Systems :** Complex Systems and Microprocessors, The Embedded System Design Process, Formalisms for System Design, Embedded product development cycle (EDLC), Embedded system interfacing and peripherals, ARM Processor fundamentals, ARM Programming, Real Time Operating Systems.	**7**
Module VI : **Signals and Systems** Linear Time-invariant (LTI) systems : definitions and properties, causality, stability, impulse response and convolution, continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform. Z-transform: definition, properties and inverse, stability analysis using pole-zero plot, difference equation solution using unilateral Z-transform, DFT and its properties, FFT: radix 2 and composite radix algorithm, sampling theorem, realization of IIR and FIR structures – parallel and cascade structure, frequency response, group delay and phase delay, signal transmission through LTI systems. Design of FIR & IIR Filters. Multi-rate Digital Signal Processing. Short Time Fourier transform, Continuous Wavelet Transform (CWT), Discrete Wavelet Transform, Multi resolution Analysis, Construction of wavelets, Wavelet Packet Transform, Wavelet Transform Applications in image and audio processing.	**10**
Module VII : Electromagnetics Derivation of capacitance and inductance of two wire transmission line and coaxial cable. Energy stored in Electric and Magnetic field. Displacement current density, continuity equation. Magnetic vector potential. Relation between scalar potential and vector potential. Maxwell's equation from	**8**

fundamental laws. Boundary condition of electric field and magnetic field from Maxwells equations. Solution of wave equation. Elements of vector calculus: divergence and curl, Gauss and Stokes theorems, Maxwell's equations, differential and integral forms, wave equation, Poynting vector, Plane waves: propagation through various media, reflection and refraction, phase and group velocity and skin depth, Transmission lines: characteristic impedance, impedance transformation. Waveguides: modes in rectangular waveguides, boundary conditions, cut-off frequencies and dispersion relations, basics of propagation in dielectric waveguide and optical fibres. Antennas: Dipole antennas, radiation pattern, antenna gain.	
Module VIII : Communication Digital communication systems: pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes, matched filter receivers, fundamentals of information theory and channel capacity theorem, random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral density. Microwaves : Microwave vacuum type amplifiers and sources, Reflex Klystron Oscillators, Magnetron oscillators, Travelling Wave Tube, Microwave measurements, Microwave hybrid circuits, Directional couplers, Solid state microwave devices, Tunnel diodes, Gunn Diode. Microwave Radio Communications. Optical Communication. Opto Electronic Devices. Advanced Communication Systems **:** Microwave Radio Communications, Diversity, protection switching arrangements, Satellite communication systems, Satellite sub systems, Evolution of mobile radio communications, Modern Wireless Communication Systems, wireless networks, Over view of WIMAX technologies, Cellular concept, Wireless propagation mechanism, Introduction to Multiple Access GSM system architecture, Introduction to new data services.	**10**
Module IX : Instrumentation Principles of measurements, Static and dynamic characteristics of Measurement systems: Measurement of displacement, velocity and acceleration, force, Indicating & Recording instruments, Waveform analyzing instruments, Transducers, biomedical instruments, EEG, ECG and EMG, Clinical measurements DC & AC bridges, ultrasonic transducers. Industrial Instrumentation : Temperature Measurement, Pressure Measurement, Electronic Pressure Sensors, Differential Pressure Transmitters, Flow Measurement, Mass Flowmeters, Anemometers, Measurement of Viscosity, Level Measurement, Electrical Methods.	**8**
Module X: Control Systems System modeling - Transfer function approach : Transfer function of electrical, mechanical and electromechanical system – Block diagram – Signal flow graph – Mason's gain formula. Time domain analysis: Response of systems to standard test signals – Step response of second order	**10**

systems – Time domain specifications – Steady state response – Steady state error- Static & Dynamic error coefficients. Stability of linear systems in time domain: Asymptotic and BIBO stability, Routh-Hurwitz criterion of stability. Root locus. Frequency domain analysis : Frequency domain specifications – Stability in the frequency domain- Nyquist stability criterion – Stability from polar and Bode plots - Relative stability – Gain margin and phase margin – M & N circles – Nichol's chart. State variable analysis: State space representation of Continuous Time systems. Transfer function from State Variable Representation, Solution of state equations, state transition matrix, Concepts of Controllability and Observability, Kalman's Test. Controller Design : Basic Control actions and Controller characteristics: Classification of Controllers, Two position control, proportional, integral and derivative controllers. Integral control action and derivative control action. Electronic Controllers- Design of PI, PD and PID controllers using op.amp.	
Module XI : Advanced Topics	
Nanoelectronics : Mesoscopic physics, trends in microelectronics and optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence, Schrodinger's Equation, wave function, Low dimensional structures Quantum wells, properties of two dimensional semiconductor nanostructures, Quantum wires and quantum dots, carbon nano tube, grapheme, methods of fabrication of nano-layers, characterization of nanostructures, Principle of operation of Scanning Tunnelling Microscope, X-Ray Diffraction analysis, MOSFET structures, Quantum wells, modulation doped quantum wells, multiple quantum wells, The concept of super lattices, Transport of charge in Nanostructures under Electric field, Transport of charge in magnetic field, Nanoelectonic devices, principle of NEMS	**2**
Computer Communication : Transmission modes, Networks, Interconnection of Networks: Internetwork, Network models: OSI model, TCP/IP protocol suite. Physical Layer, Data Link Layer, Media access control, Ethernet(802.3), Logical link control, Logical addressing: IPV4, IPV6, Subnetting, CIDR, ICMP, IGMP, DHCP, Routing, Transport Layer, Congestion Control & Quality of Service, Application Layer, Introduction to system and network security, security attacks, Firewalls, Intrusion detection systems.	**2**
Information Theory and Coding : Entropy, Sources and Source Coding, Channels and Channel Coding, Introduction to Linear Block Codes, Important Classes of Algebraic codes, Convolutional and LDPC Codes.	**2**
Power Electronics : Power Semiconductor Switches, Protection circuits and Rectifiers, DC – DC Switch-Mode Converter, DC – AC Switch-Mode Inverter, Applications of Power Electronics - DC Motor Drives, Induction Motor Drives, Residential and Industrial applications, Electric utility applications.	**2**

Digital Image Processing : Digital Image Fundamentals, Review of matrix theory, Image transforms, Image Compression, Image Enhancement, Image Restoration, Image segmentation	**1**
Computer Vision: Fundamentals of Image Formation, Feature Extraction, Depth estimation, Motion Analysis, Object detection, Neural Networks.	**1**
MEMS : MEMS and Microsystems, Actuation and Sensing techniques, Review of Mechanical concepts, Flexural beams, Scaling laws in miniaturization, Materials for MEMS, Micro System fabrication, Micro manufacturing, Micro system Packaging, RF MEMS, BioMEMS, MOEMS, NEMS	**1**
Optimization Techniques : Classical method , Linear programming problems, Game Theory, Network path models, Nonlinear unconstrained optimization, Modern methods of optimization - Introduction to Genetic algorithm, Basic GA framework, GA operators: Encoding, Crossover, Selection, Mutation, Introduction to Fuzzy logic. Fuzzy sets and membership functions. Operations on Fuzzy sets. Optimization of Fuzzy Systems.	**1**
Internet of Things : IOT hardware, IOT Communication and Connectivity, IOT Data Management, Internet of Things SMART Applications and protocols	**1**
Total Marks	**100**

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.