S.R.T MARATHWADA UNIVERSITY, VISHNUPURI, NANDED

SYLLABUS FOR PhD ENTRANCE TEST

ELECTRONICS, ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Syllabus for Paper-1 (section B)

1. Basic circuit theory: Network graphs, nodal and mesh analysis, Network theorems, Linear constant coefficient differential equations, Solution of network equations using Laplace transform: frequency domain analysis of RLC circuits, 2port network parameters, State equations for networks.

2. Analog Circuits: Simple diode circuits, clipping, clamping, rectifier, Amplifiers, Frequency response of amplifiers, Filters, oscillators, Function generators and wave shaping circuits, 555 Timers.

3. Digital circuits: Boolean algebra, logic gates, digital IC families, Combinational circuits, Sequential circuits, Sample and hold circuits, ADCs, DACs, Semiconductor memories.

4. Communications: Probability theory & Statistics Random signals and noise, Analog communication systems: amplitude and angle modulation and demodulation systems, super heterodyne receivers; SNR calculations for amplitude modulation (AM) and frequency modulation(FM), Sampling theorem, Digital communication systems: PCM, DPCM, digital modulation schemes, TDMA, FDMA and CDMA and GSM, Optical fiber communication.

5. Signals and Systems: Laplace transform, continuous time and discrete time Fourier series, continuous time and discrete time Fourier Transform, DFT and FFT, Z-transform, LTI Systems, Signal transmission through LTI systems, Convolution, FIR and IIR Filters, Open loop and closed loop systems, first order, second order, higher order systems.

6. Computer Networks: ISO/OSI stack, LAN technologies (Ethernet, Token ring, etc), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers. Network security, basic concepts of public key and private key cryptography, digital signature.

7. Microprocessor and Computer Organization: Microprocessor(8085): architecture, programming, memory and I/O interfacing, Machine instructions and addressing modes, ALU and data path, CPU control design, Memory interface, I/O interface, Instruction pipelining, Cache and main memory, Secondary storage, Microcontrollers.

Paper-2: Paper 2 will have eight groups, and the candidates will be required to answer two questions out of five from ***any one group*** only.
Descriptive Questions – two questions out of five from any one group;
Marks: 30(15 marks each);
Time: 60 minutes for Paper-2.

Group-I: COMMUNICATION NETWORKS

Internet Architecture

Architectural concepts in ISO's OSI layered model, layering in the Internet. TCP/IP protocol stack. Transport layer - TCP and UDP. Network layer - IP, routing, internetworking. Data link layer - ARQ schemes, multiple access, LANs.

Broadband services and QOS issues

Quality of Service issues in networks- Integrated service architecture- Queuing Disciplines- Weighted Fair Queuing- Random Early Detection- Differentiated Services- Protocols for QOS support- Resource reservation-RSVP- Multi protocol Label switching- Real Time transport protocol.

Introduction to Queuing theory

Markov chain- Discrete time and continuous time Markov chains- Poisson process- Queuing models for Data gram networks- Little's theorem- M/M/1 queuing systems- M/M/m/m queuing models- M/G/1 queue- Mean value analysis- Time reversibility- Closed queuing networks- Jackson's Networks.

Statistical Multiplexing in Communication Networks

Multiplexing: Network performance and source characterization; Stream sessions in packet networks - deterministic analysis, stochastic analysis, circuit multiplexed networks; Elastic transfers in packet networks - adaptive bandwidth sharing.

Text books and references:

1. James. F. Kurose and Keith.W. Ross, "Computer Networks, A top-down approach featuring the Internet", Addison Wesley, 2001.
2. D. Bertsekas and R. Gallager, "Data Networks", PHI, 2000.
3. S. Keshav, "An Engineering Approach to Computer Networking", Addison Wesley
4. Peterson L.L. & Davie B.S., "Computer Networks: A System Approach", Morgan Kaufman Publishers.
5. Anurag Kumar, D. Manjunath, and Joy Kuri, Communication Networking: An Analytical Approach, Morgan Kaufman Publ. 2004.

Group-II: Embedded Systems

Unit 1: Introduction
Embedded system- definition, Types of processors used; Peculiarities and specialties; Requirement and Application
Unit 2: Processors and microcontrollers for embedded systems
Brief review of 8085, 8051, 8086, 80386, PIC processors and ARM based processor.
Unit 3: Operating systems for embedded systems: -
Need for an operating system; Different types like single user and tasking, multi user, multi tasking, time sharing, batch processing, real time; Micro kernel vs. monolithic; Major functions-Process management, Memory management, File system Management, I/O management and Network management.; Concept of process, threads, task switching, scheduling, critical sections, deadlock.
Unit 4: Real time operating systems Issues
I/O programming- Synchronization, transfer rate and latency. Polled I/O issues. Interrupt driven I / O; ISR; Response time- interrupt controller; Software interrupts and exceptions; Buffering of data and queuing of interrupt request; Concurrency control-Foreground / Background systems; Thread state and serialization, latency, prevention of interrupt overruns; Concurrent execution of threads, context switch, non-preemptive multitasking, preemptive multitasking; Critical sections:- disabling interrupts, disabling ask switch, spin lock, semaphore.
Unit 5: Scheduling in embedded systems
Conventional scheduling, deadline driven scheduling, rate monotonic scheduling, deadlock, watchdog timer; Memory management in embedded systems- Static allocation, dynamic allocation; Recursion and dynamic allocation; shared memory, re-entrant functions; Boot up and System initialization. 80x86 microprocessor with a C compiler (suited for RTOS) and uC / OS RTOS; Real time Embedded System applications as case study;

Text Books:

1. Fundamentals of Embedded Software- Daniel W Lewis, Pearson Education
2. An Embedded Software Primer- David E. Simon, Pearson Education
3. Embedded Systems Design- Ramani Kalpathi and Ganesh Raja,
4. Design with PIC microcontroller- Peatman, Pearson Education
5. Microcontrollers- Rajkamal, Pearson Education

Group-III: WIRELESS COMMUNICATION

Fading and Diversity

Wireless Channel Models- path loss and shadowing models- statistical fading models- Narrow band and wideband Fading models- Review of performance of digital modulation schemes over wireless channels- Diversity- Repetition coding and Time Diversity- Frequency and Space Diversity- Receive Diversity- Concept of diversity branches and signal paths- Combining methods- Selective diversity combining - Switched combining- maximal ratio combining- Equal gain combining- performance analysis for Rayleigh fading channels.

Cellular Communication

Cellular Networks- Multiple Access: FDM/TDM/FDMA/TDMA- Spatial reuse- Co-channel interference Analysis- Hand over Analysis- Erlang Capacity Analysis- Spectral efficiency and Grade of Service- Improving capacity - Cell splitting and sectorization.

Spread spectrum and CDMA

Motivation- Direct sequence spread spectrum- Frequency Hopping systems- Time Hopping.- Anti-jamming- Pseudo Random (PN) sequence- Maximal length sequences- Gold sequences- Generation of PN sequences.-Diversity in DS-SS systems- Rake Receiver- Performance analysis. Spread Spectrum Multiple Access- CDMA Systems- Interference Analysis for Broadcast and Multiple Access Channels- Capacity of cellular CDMA networks- Reverse link power control- Hard and Soft hand off strategies.

Fading Channel Capacity

Capacity of Wireless Channels- Capacity of flat and frequency selective fading channels- Multiple Input Multiple output (MIMO) systems- Narrow band multiple antenna system model- Parallel Decomposition of MIMO Channels- Capacity of MIMO Channels.

Cellular Wireless Communication Standards

Second generation cellular systems: GSM specifications and Air Interface - specifications, IS 95 CDMA- 3G systems: UMTS & CDMA 2000 standards and specifications

Text Books:

1. Andrea Goldsmith, “Wireless Communications”, Cambridge University press.
2. Simon Haykin and Michael Moher, “Modern Wireless Communications”, Person Education.

Reference Books:

1. T.S. Rappaport, “Wireless Communication, principles & practice”, PHI, 2001.
2. G.L Stuber, “Principles of Mobile Communications”, 2nd edition, Kluwer Academic Publishers.
3. Kamilo Feher, ‘Wireless digital communication’, PHI, 1995.
4. R.L Peterson, R.E. Ziemer and David E. Borth, “Introduction to Spread Spectrum Communication”, Pearson Education.
5. A.J.Viterbi, “CDMA- Principles of Spread Spectrum”, Addison Wesley, 1995.

Group-IV: Digital Speech & Image Processing

Review of Filter design. Linear phase FIR filters. Methods of FIR filter design. Methods of IIR filter design. Applications of FIR & IIR filters in speech, image, seismic, medical and other areas.

Speech Processing

Review of human speech and Acoustic theory, nature of sound, harmonics, resonance measurement, virtual display. Music theory, pitch, duration, intervals, rhythm. Human speech production, the vocal tract, the Larynx, the source filter. Speech signal processing the phasor mode, Fourier transfer, DFT, FFT. The hardware use of FIR & IIR filters. Software, Elements of speech Synthesis speech Recognition speech in the computer human interface.

Image Processing

Characterization of images as two-dimensional discrete fields, unitary transforms— DFT. Handmaid, slant and cosine transforms, compression schemes Karhunen Loeve compression predictive coding schemes. Image enhancement gray scale modification, edge enhancement, restoration Wiener filtering, constrained deconvolution, recursive filtering. Segmentation, edge detection, thresholding, textural properties, geometry and shape description.

Text Books:

1. Digital Signal Processing by Proakis & Manolakis
2. Speech and Audio Processing for multimedia PC's by Iain Murray
3. Digital Image Processing by Keenneth R Castleman, Pearson Education Society.
4. Digital Image Processing by Rafact Gonzalez and Richard E. Woods, Pearson Education Society.

Group-V: VLSI DESIGN

1. Overview

Overview of combinational and sequential circuits, timing analysis of combinational and sequential circuits, metastability, methods to eliminate metastability single synchronizer and double synchronizer, MTBF Clocking strategies.

2. Sequential Machine Design

State diagram, state minimization, state assignments, design of mealy and Moore machines, design of RAM, SDR, SRAM, DRAM, ROM. Charge Coupled Devices (CCD's).

3. Programmable logic Devices

Basic concepts, programmable logic array (PLA), Programmable Array Logic (PAL), Structure of standard PLD's Complex (PLD's), Complex PLD's (CPLD), Xilinx Xc9500. Introduction to field programmable gate arrays types of FPGA's, Configurable logic Block (CLB) Input/ Output Block (IOB). Introduction to Xilinx series. FPGA, XC4000 family, Implementation of Design in PLD's.

4. VHDL

Need for HDL's, Design flow, overview of VHDL, data types, Logic Operators, Data flow Modeling, Structural Modeling, Behavioral Modeling, Mixed Modeling, Modeling of combinational and sequential circuits.

5. Verilog

Verilog as HDL, HDL model abstraction behavioral, RTL, structural, switch model, verification, Modeling of combinational logic, sequential logic, tasks and functions, Advanced Modeling concepts, User defined primitives.

Text Books

1. Fundamentals of Digital Design by Charles. H. Roth, Jr., Jaico Publishing House
2. Digital Design Principle & Practice – by John. F. Wakerly, PHI
3. VHDL Analysis & Modeling of Digital Systems – by Z Navabi, Mc. Graw Hill
4. An Engg. Approach to Digital Design by William. I. Fletcher
5. Verilog HDL: Digital Design & Synthesis – by Samir Palnitker
6. Documents of Xilinx

Group-VI: Neural Networks & Fuzzy Logics

1. Neural networks characteristics, History of development in neural networks principles, Artificial neural net terminology, Model of a neuron, Topology, Learning, types of learning, Supervised, Unsupervised, Reinforcement learning. Knowledge representation and acquisition.

2. Basic Hop field model, Basic learning laws, Unsupervised learning, Competitive learning, Kmeans clustering algorithm, Kohonen`s feature maps.

3. Radial basis function neural networks, Basic learning laws in RBF nets, Recurrent back propagation, Introduction to counter propagation networks, CMAC network, and ART networks.

4. Applications of neural nets such as pattern recognition, Optimization, Associative memories, speech and decision-making. VLSI implementation of neural networks.

5. Fuzzy Logic: Basic concepts of fuzzy logic, Fuzzy vs. Crisp set, Linguistic variables, Membership functions, Operations of fuzzy sets, Fuzzy IFTHEN rules, Variable inference techniques, DeFuzzification, Basic fuzzy inference algorithm, Fuzzy system design, FKBC & PID control, Antilock Breaking system (ABS), Industrial applications.

Text Books:

1. Neural Networks by Simon Haykin
2. Fuzzy logic with engineering application by ROSS J.T (Tata Mc)
3. Neural Networks & Fuzzy Logic by Bart Kosko
4. Neural computing theory & practice by P.D. wasserman (ANZA PUB).
5. Introduction to applied Fuzzy ElectronicsAhmad M.Ibrahim (PHI)
6. Introduction to artificial neural systems by J.M. Zurada.(Jaico Pub)
7. An introduction to Fuzzy control by D. Driankor, H. Hellendorn, M. Reinfrank (Narosa Pub.)
8. Fuzzy Neural Control by Junhong NIE & DEREK LINKERS (PHI)
9. Related IEEE/IEE publications
10. Fuzzy System Design Principles, Building Fuzzy IFTHEN Rule Bases – by Riza C.Berkiu & Trubatch, IEEE Press 7

Group-VII: Power Electronics and Control System

A: Power Electronics

Unit 1: Introduction to power electronics: Basic terminologies, definitions, comparison of conventional and power electronics, calculation of power, power factor, single/three phase, star and delta connections, power measurement techniques and equipment, heating effect, noise factors, shielding, protections, circuit breakers, ground leakage detection, MCBs ELCBs, etc. Single phasing preventors.

Unit 2: Power electronics circuits: Controlled rectifiers and filters: Single phase half wave and full wave-Semiconverter and full converter, Dual converter, Three phase half wave, semi and full wave converter, three phase dual converter, simple LC and cascaded LC filters, Power factor improvement. Inverters: Principle of operation, voltage driven inverters, current driven inverters; Choppers: Basic principles, Type A, B and C choppers Series and parallel turn-off choppers, Morgan choppers and Jones choppers. Triggering and protection circuit: Thyristor firing, circuit-using transistor, UJT, PUT etc. thyristor gate protection circuit, di/dt and dv/dt protection for thyristors.

Unit 3: AC power supply systems: CVTs, Stabilizers, tap changers, UPS types (on-line and off line) etc.

Unit 4: Special application DC power supplies: CVCC, voltage mode and current mode SMPS, Tracking and foldback systems, Low voltage, low current, high voltage and high current power supplies, SMPS for computers

B: Control System

Unit 1: Concepts of closed-loop and open-loop systems: Importance and Application of Control System; Conceptual Block diagram of a control system and types- open loop and closed loop, Continuous and discrete data systems, Feedback theory;

Unit 2: Representation of feedback control system: Block diagram, signal flow graphs, Mason's gain formula; Transfer function concept- Time and frequency domain analysis of first and second order systems to step, ramp and other inputs; error analysis, Types of systems;

Unit 3: Stability: Routh Hurwitz stability criteria, Root locus, Nyquist criteria, Relative and absolute stability; Polar and Bode Plot, Gain and phase margins;

Unit 4: Discrete Control Systems & Control System Design: Z-transform, Simulation diagram and flow graphs. Effects of proportional, integral and derivative control, Discrete Vs Continuous control systems.

Unit 5: State Variable Analysis: Importance of state variable analysis; Definition of state, state space, state vector; SV representation of physical systems and electrical networks; Eigen value and eigen vector; Determination of transfer function using SVA; Resolvent Matrix and State transition matrix; Solution of homogeneous and non-homogeneous systems using SVA;

Text Books:

A: Power Electronics

1. Power Electronics – Rashid, PHI
2. Power Electronics- P.C. Sen, TMH Ltd.
3. Thyristor engineering- M.S. Berdi, Khanna publications.
4. Thyristors and their applications-N.Rammurthy

B: Control System:

1. Control Systems Engineering - I.G. Nagrath, M. Gopal; Wiley Eastern Ltd.
2. Automatic Control Systems- B.C. Kuo, Prentice-Hall of India.
3. Modern Control Engineering- K. Ogata, Prenticd-Hall of India.
4. Control System – S. Ghosh, Pearson Education
5. Control System Engineering- Bhattacharjya- Pearson Education;

Group- VIII: Bio Electronics

Unit 1: Introduction

Nature of Biomedical signals; Bio Electronic potentials; Necessity of Bio Electronics; Components; Scope and Application; Basics of cell biology; Structure of the cell, the nervous system and the neuron; function of enzymes; nucleus and role of DNA and RNA, adhesion of cell to surfaces.

Unit 2: Electrical Circuit treatment of biological environments

Behavior of cells on semiconductor materials; Ionic conduction, the metal-electrolyte double layer, models of the cell membrane; Cell culture and biocompatibility testing; Mathematical modeling of the nervous system. Use of model neurons for associative computer memory; Bio-inspired systems;

Unit 3: Electrical signal detection in biological systems

Silicon, glass and metal electrodes, amplifier design; Fundamentals of electron transfer and its application in bio electronic systems;

Unit 4: Bioelectronics device production

Microelectronic fabrication methods as adapted to Bioelectronics, hard and soft lithography, bio-compatibility of materials.

Unit 5: Biosensors:

Importance, working, types; Miniaturization and Microsystems including sensing using optical techniques, field effect transistors, ion-selective and enzymatic sensitive electrodes, as well as impedance monitoring.

Text Books:

1. Biosensors- E A Hall, Wiley;
2. Electrodes and Membranes- J Koryta Ions, Wiley;
3. Bioelectronics- S Bone & B Zabba, Wiley;