राष्ट्रीय प्रौद्योगिकी संस्थान मेघालय
NATIONAL INSTITUTE OF TECHNOLOGY MEGHALAYA
(An Institute of National Importance under MHRD)

Bijni Complex, Laitumkhrah, Shillong – 793003 (India)
Website: www.nitm.ac.in

No. NITMGH/AA/Notice-Student/2020-2021/ 30 Dated: 22nd of July, 2020.

NOTIFICATION

This is to inform to all concerned the ***Comprehensive Examination Autumn 2020*** shall be held on ***10th Aug. 2020*** through online mode in pursuance of the Academic Calendar vide No-NITMGH/AA/Academic Calendar/2020-21/556, dated-28/05/2020. The Syllabi for the said Examination are enclosed herewith for ready reference.

In this connection, the concerned scholars are advised to remain in touch with the concerned supervisor(s) and HoD to obtain the relevant information.

This issues with the approval of the Competent Authority.

Asst.Registrar (AA)

Encl: As stated above.

Copy forwarded to:

1) AR (DR), for kind information of the Director.
3) All Deans, for kind information.
5) All HoDs , for information and needful
6) Dr P. Rangababu, PIC (AA-PG&R)
7) All Faculty Members, for information and needful.
8) E-Notice board.
9) Guard File, for record.

Syllabi for Comprehensive Examination of Eligible Ph. D Scholars

(Only for the Courses relating to Research Domains for Full Time & Sponsored Part Time)

Date of Comprehensive Exam: 10th Aug, 2020

Department: Computer Science and Engineering

1) Research/Specialization Group: 1

(Name of the Group) Computer Network & Security

Syllabus Content { should be an extract from the course syllabus (not the entire syllabus) which will be helpful for the research work of the scholar }:

(a) Course Code and Course Name : *CS 702: Selected Topics in Computer Networks Syllabus:* Computer Communication Network Architecture, OSI reference model, TCP/IP reference Model, Transmission Media, Switching Techniques, Medium Access Control: ALOHA, CSMA, CSMA/CD, token ring, token bus, Network Layer Addressing IP version 4 and 6, Intra- and Inter-domain Routing, Distance Vector Routing, Link State Routing Path Vector Routing, Multicast Routing Protocol.

Wireless communication, Fading, Cellular concept, Hands off, Channel allocation in cellular systems, CDMA, GPRS, channel structure, wireless LAN, IEEE 802.11, Wireless multiple access protocols, Ad-Hoc network, MAC protocols, Network Layer Protocols, TCP over wireless applications, Mobile IP.

(b) Course Code and Course Name : *CS 707: Selected Topics in Wireless Sensor Networks* Syllabus: Wireless Sensor Network, Coverage, Connectivity, longevity, scheduling, synchronization in WSNs, WSN Hardware, Internet of Things, WSN Deployment, Routing Protocols for WSNs, Fault Tolerance, network protocols, Data Storage.

(c) Course Code and Course Name: *CS 704 : Selected Topics in Network Security Syllabus:* Security Architectures and Protocols, Distributed Denial-of-Service (DDoS) attacks and defence, Worm defence, Botnets defence, Security of IEEE 802.11 WLANs, Mobile malware detection and defence, Social network security and privacy, Security of mobile ad hoc networks, Security of wireless sensor networks, Security of vehicular networks, Security in cloud computing.

(d) Course Code and Course Name: *CS 517 : Soft Computing Syllabus:*
Fuzzy Sets and Membership Function, Fuzzy If-Then Rules, Fuzzy Models, Fuzzy Logic Controller, Neural Networks- Backpropagation, Extended Backpropagation for Recurrent Networks, Genetic Algorithm, Particle Swarm Optimization, Ant Colony Optimization.

(e) Course Code and Course Name: *CS 521 : Number Theory and Cryptography Syllabus:* Mathematics of symmetric key and non-symmetric key cryptography, Encryption algorithms- DES, AES, hash functions-MD5, SHA, Signatures- RSA, ring signature, group signature, blind signature, aggregate signature, Elliptic curve Crytography.

(f) Course Code and Course Name: *CS 701 :Advanced Data Structures and Algorithms Syllabus:*
Array, Linked List, Stack, Queue, Double-Ended Queue, Search Trees, Height-Balanced Trees (or AVL Trees), Weight-Balanced Trees, Red-Black Trees, Splay Trees, Skip List, Balanced Search Trees as Heaps, Hash Tables and Collision Resolution, Hash Functions, Hash Trees, Selection Sort, Bubble Sort, Mergesort, Quicksort, Heapsort, Bucket and Radix Sort, Basic Algorithm Paradigms – Divide and Conquer, Greedy Algorithms, Dynamic Programming with examples, Minimum Spanning Trees.

***(g)* Course Code and Course Name** *: CS 514 : Cloud Computing Syllabus:*
Virtualization: Basic concept– Hypervisor- Types of virtualization- hardware, operating system, server, storage- Features of virtualization- Advantages and disadvantages of different types of virtualization. Cloud Architecture:Types of deployment models-Private, Public , Hybrid, Community, Types of service models-Iaas, PaaS, SaaS.

2) Research/Specialization Group: 2

(Name of the Group) Computer Vision and Computational Intelligence

Syllabus Content { should be an extract from the course syllabus (not the entire syllabus) which will be helpful for the research work of the scholar }

(a) Course Code and Course Name: *CS 511 : Image Processing Syllabus:*
Basics of Image processing:Visual Perception, Image Sampling and Quantization, Basic relationships between Pixels, Image File Format, Histogram Processing, Enhancement using Arithmetic/ Logic Operations, Smoothing and Sharpening Spatial Filters, Restoration in the presence of Noise only - Spatial Filtering, Inverse Filtering, Weiner Filtering.
Feature Selection and Feature Extraction - Probabilistic Separability based criterion functions, Interclass Distance based criterion functions, Branch and Bound algorithm, Sequential Forward/ Backward selection algorithms, (l, r) algorithm, Feature Extraction based on PCA, LDA.
Clustering - Different Distance functions and Similarity Measures, Criterion for Clustering, Minimum Within Cluster Distance criterion, Methods of Clustering - Partitional, Hierarchical, Graph theoretic, Density based, Clustering Validity.

***(b)* Course Code and Course Name:** *CS 513 : Artificial Intelligence Syllabus:*
Basics of Artificial Intelligence: State Space Search, Uninformed Search - Breadth First Search, Depth First Search, Stochastic Search - Hill Climbing, Simulated Annealing, A*, AO*, Constraint Satisfaction Problems, First Order Predicate Logic, Planning - Goal Stack Planning, Overview of different forms of Learning: Unsupervised, Supervised, Semi-supervised
Pattern recognition basics: Classification - Bayesian Decision Rule, Minimum Distance Classifier, Mahalanobis distance, Maximum Likelihood Classification, kNN Classifier, Decision Tree, Artificial Neural Networks: Introduction to Expert Systems and Robotics
Expert systems - Architecture, Knowledge Representation, Basic forms of Inference - Abduction, Deduction, Induction, Knowledge Engineering, Robotics - Classification with respect to Geometrical Configuration (Anatomy), Sensors

(c) Course Code and Course Name : *CS 514 : Cloud Computing Syllabus:*

Virtualization: Basic concept– Hypervisor- Types of virtualization- hardware, operating system, server, storage- Features of virtualization- Advantages and disadvantages of different types of virtualization. Cloud Architecture: Types of deployment models-Private, Public , Hybrid, Community, Types of service models-Iaas, PaaS, SaaS.

(d) Course Code and Course Name: *CS 701 :Advanced Data Structures and Algorithms Syllabus:*

Array, Linked List, Stack, Queue, Double-Ended Queue, Search Trees, Height-Balanced Trees (or AVL Trees), Weight-Balanced Trees, Red-Black Trees, Splay Trees, Skip List, Balanced Search Trees as Heaps, Hash Tables and Collision Resolution, Hash Functions, Hash Trees, Selection Sort, Bubble Sort, Mergesort, Quicksort, Heapsort, Bucket and Radix Sort, Basic Algorithm Paradigms – Divide and Conquer, Greedy Algorithms, Dynamic Programming with examples, Minimum Spanning Trees.

3) Research/Specialization Group: 3

(Name of the Group) High Performance Computing

Syllabus Content { should be an extract from the course syllabus (not the entire syllabus) which will be helpful for the research work of the scholar }

***(a)* Course Code and Course Name** : *CS 204: Computer Organization & Architecture Syllabus:*

Performance: Definition, Nuances and Metrics for measuring performance; MIPS, CPI, Benchmarking, Amdahl's Law

Performance oriented design of ALU, Control Unit, Memory and I/O units

(b) Course Code and Course Name : *CS 301 : Operating Systems Syllabus:*

Performance oriented Aspects of Operating System Design: CPU Scheduling, Memory management (paging, segmentation, demand paging, fragmentation/ compaction etc., memory allocation algorithms)

(c) Course Code and Course Name : *CS 413: High Performance Architectures Syllabus*:

Parallelism on Uni-processor: Basic parallel processing techniques: instruction level, thread level and process level. Basic concepts of pipelining, Arithmetic pipelines, Instruction pipelines, Hazards in a pipeline: structural, data and control hazards, Overview of hazard resolution techniques, Dynamic instruction scheduling, Brach prediction techniques, Instruction-level parallelism using software approaches, Superscalar techniques, Speculative execution.

Parallelism in uniprocessor System, memory-interleaving, pipelining and vector processing.

Multi-Processors: Centralized vs. distributed shared memory, Interconnection topologies, Multiprocessor architecture, Symmetric multiprocessors, Cache coherence problem, memory consistency, Multicore architecture, Case study: multiprocessors, co-processors like GPU.

***(d)* Course Code and Course Name** : *CS 705: Parallel Processing: Architectures And Algorithms Syllabus:* Process Level Parallelism: Distributed Computers, Clusters, Grid. Middlewares for realizing distributed computing platforms. Virtualization: Characteristics & Taxonomy,

Parallel computer structures, architectural classifications, parallel computer models: PRAM and VLSI complexity models, program properties: conditions of parallelism, program partitioning and scheduling, granularity and scalability.

Systems interconnect architectures: Static interconnection networks array, tree, mesh, pyramid, hypercube, cubeconnected-cycles, butterfly; Dynamic interconnection networks crossbar, multistage interconnection networks, blocking, non-blocking and rearrangeable operations, properties and routing. Networked computers as a multi-computer platform, basics of message-passing, computing using workstation clusters, Software tools.

Parallel algorithms and their mapping on different architectures for: Arithmetic computations, Matrix operations, Numerical applications, Sorting, Graph algorithms, Computational Geometry applications among others.

Cloud Computing: High performance Vs. High Throughput computing, Data Intensive Computing in the Cloud, Hadoop, Map Reduce programming paradigm.

(e) Course Code and Course Name: *CS 701 :Advanced Data Structures and Algorithms Syllabus:*

Array, Linked List, Stack, Queue, Double-Ended Queue, Search Trees, Height-Balanced Trees (or AVL Trees), Weight-Balanced Trees, Red-Black Trees, Splay Trees, Skip List, Balanced Search Trees as Heaps, Hash Tables and Collision Resolution, Hash Functions, Hash Trees, Selection Sort, Bubble Sort, Mergesort, Quicksort, Heapsort, Bucket and Radix Sort, Basic Algorithm Paradigms – Divide and Conquer, Greedy Algorithms, Dynamic Programming with examples, Minimum Spanning Trees.

4) Research/Specialization Group: 4

(Name of the Group) Data Science and Machine Learning

Syllabus Content { should be an extract from the course syllabus (not the entire syllabus) which will be helpful for the research work of the scholar }

(a) **Course Code and Course Name** : *CS 510: Data Mining Syllabus:*

Data –Preprocessing: Data Quality Issues, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization

Mining Frequent Pattern Mining and Association Rules: Basic Concepts, Apriori Algorithm, Frequent Pattern growth (FP-growth) Algorithm, Mining Closed and Max Patterns, Pattern Evaluation Methods, Constraint-Based Frequent Pattern Mining

Classification Techniques: Basic Concepts, Decision Tree Classifier, Rule-Based Classifier, Nearest Neighbor Classifiers, Model Over fitting, Model Evaluation and Selection

Clustering Techniques: Overview, Types of Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Performance Parameters, Clustering with Constraints

Outlier Detection: Basic Concepts, Outlier Detection Methods, Statistical Approaches, Proximity-Based Approaches, Clustering-Based Approaches, Classification-Based Approaches

(b) **Course Code and Course Name:** *CS 519 : Pattern Recognition Syllabus:*

Linear Algebra, vector spaces, probability theory, estimation techniques.

Bayesian decision rule, Error probability, Minimum distance classifier, Mahalanobis distance, Discriminant functions and decision boundaries; Maximum likelihood classification, K-NN Classifier, Linear and nonlinear Classifier, Branch and bound algorithm, Feature selection and feature extraction, PCA algorithm. Parameter estimation, Density estimation.

(c) **Course Code and Course Name:** *CS 708 : Computational Geometry Syllabus:*

Quick hull, Plane-sweep algorithm, Triangulating monotone polygons, Guarding art gallery – problem, 1-D range searching, Farthest point Voronoi diagram, Fortune's plane sweep algorithm, Line arrangements, Visibility graphs, Motion planning and shortest paths for a point robot

(d) **Course Code and Course Name:** *CS 517 : Soft Computing Syllabus:*

Fuzzy Sets and Membership Function, Fuzzy If-Then Rules, Fuzzy Models, Fuzzy Logic Controller, Neural Networks- Backpropagation, Extended Backpropagation for Recurrent Networks, Genetic Algorithm, Particle Swarm Optimization, Ant Colony Optimization.

(e) **Course Code and Course Name:** *CS 701 :Advanced Data Structures and Algorithms Syllabus:*

Array, Linked List, Stack, Queue, Double-Ended Queue, Search Trees, Height-Balanced Trees (or AVL Trees), Weight-Balanced Trees, Red-Black Trees, Splay Trees, Skip List, Balanced Search Trees as Heaps, Hash Tables and Collision Resolution, Hash Functions, Hash Trees, Selection Sort, Bubble Sort, Mergesort, Quicksort, Heapsort, Bucket and Radix Sort, Basic Algorithm Paradigms – Divide and Conquer, Greedy Algorithms, Dynamic Programming with examples, Minimum Spanning Trees.

Signatures and Names of DRC Members:

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
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8. _____ _____

Signature of DRC Chairman

Syllabi for Comprehensive Examination of Eligible Ph. D Scholars

(Only for the Courses relating to Research Domains for both Full Time & Sponsored Part Time)

Date of Comprehensive Exam: 10thAug, 2020

Department: Electronics and Communication Engineering

Research/Specialization Group: 1

Research Group: VLSI Signal Processing

EC 528 (Reconfigurable Computing)

Introduction to Reconfigurable Computing, Coarse-grained reconfigurable devices, Fine-grained reconfigurable devices. FPGA architecture, FPGA design cycle, Multi FPGA systems, Embedded computer organization and methodology of System on chip (SoC) system in FPGA devices, Design challenges and Differences GPP, DSP, ASIC and FPGA based System On Chip platforms, Application profiling and partitioning, FPGAs vs. Multi-core processor architectures,

High level compilation Hardware software co-design of Embedded Systems, Simple & Autonomous I/O Controllers, Custom Intellectual-Property (IP) and Coprocessor creation, hardware design for System-On-a-Chip; Concepts & types of Memory interfacing. Architecture exploration of IP, Design of Master and Slave Bus protocols based IPs, Bus protocols AXI. Design Metrics, General purpose peripherals (interrupt, timer, clock, DMA etc.) and special purpose peripherals Serial Transmission protocols & Standards.

EC 526 (Computer Arithmetic) :

Binary Parallel Adder, BCD Adder, Encoder, Decoder, Multiplexer and Demultiplexer Circuits, Basic Concepts of Counters and Register, Design of Counter using State Diagrams and Tables, Sequence Generators, Register Using Different Types of Flip flops and ASM realization, RTL design,.

Numbers and their encodings, Fixed-radix positional number systems, Number radix conversion, Classes of number representations, Signed-magnitude representation, Biased representations, Complement representations.

Shift/add multiplication algorithms, Programmed multiplication, Basic hardware multipliers, Multiplication of signed numbers, Multiplication by constants, and Preview of fast multipliers

EC 503 (Advanced Digital Signal Processing) : Introduction of DFT, Z transform with Applications. FFT (Radix 2, Radix 3, and Composite Radix) Algorithm.Short term Fourier Transform.

Time Frequency Atoms, Windowed Fourier Transform, Completeness and Stability, Choice of Window, Discrete Windowed Fourier Transform, Wavelet Transforms, Real Wavelets, Analytic Wavelets, Discrete Wavelets, Instantaneous Frequency, Windowed Fourier Ridges, Wavelet Ridges, Wavelet Bases, Orthogonal Wavelet Bases, Multiresolution Approximations, Scaling Function, Conjugate Mirror Filters, In Which Orthogonal Wavelets Finally Arrive, Classes of Wavelet Bases, Choosing a Wavelet, Wavelets and Filter Banks, Fast Orthogonal Wavelet Transform, Perfect Reconstruction Filter Banks.

Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for sampling rate Conversion.Multistage Implementation of Sampling Rate Conversion, Applications of Multirate Signal Processing, Sampling Rate Conversion of Bandpass Signals.

Text Books:

1. The Zynq Book: Embedded Processing with the Arm Cortex-A9 on the Xilinx Zynq-7000 All Programmable SoC, Strathclyde Academic Media , UK ,2014
2. B. Parhami, Computer Arithmetic: Algorithms and Hardware Designs, Oxford University Press, 2nd Edition, 2010.
3. I. Koren, Computer Arithmetic Algorithms, Prentice Hall Publications, 2nd Edition, 2003
4. Proakis, J. G. &Manolakis, D. G., "Digital Signal Processing", 4th Edition, Pearson 2007..

Research/Specialization Group: 2

Research Group : Speech and Signal Processing

EC 701 (Concepts of Electronics and Communication) : Classification of signals, operation on continuous signals and discrete signals, properties of signals, classification of systems and properties of systems.

EC 535 (Speech Signal Processing And Coding (3-0-0:3) : Introduction Speech production and perception, information sources in speech, linguistic aspect of speech, acoustic and articulatory phonetics, nature of speech, models for speech analysis and perception; Short-term processing: need, approach, time, frequency and time-frequency analysis; Short-term Fourier transform (STFT) Overview of Fourier representation, non-stationary signals, development of STFT, transform and filter-bank views of STFT. Cesptrum analysis Basis and development, delta, delta-delta and mel-cepstrum, homomorphic signal processing, real and complex cepstrum.Linear Prediction (LP) analysis Basis and development, Levinson-Durbin's method, normalized error, LP spectrum, LP cepstrum, LP residual. Sinusoidal analysis Basis and development, phase unwrapping, sinusoidal analysis and synthesis of speech.

EC 503 (Advanced Digital Signal Processing) : Introduction of DFT, Z transform with Applications. FFT (Radix 2, Radix 3, and Composite Radix) Algorithm.Short term Fourier Transform.

Time Frequency Atoms, Windowed Fourier Transform, Completeness and Stability, Choice of Window, Discrete Windowed Fourier Transform, Wavelet Transforms, Real Wavelets, Analytic Wavelets, Discrete Wavelets, Instantaneous Frequency, Windowed Fourier Ridges, Wavelet Ridges, Wavelet Bases, Orthogonal Wavelet Bases, Multiresolution Approximations, Scaling Function, Conjugate Mirror Filters, In Which Orthogonal Wavelets Finally Arrive, Classes of Wavelet Bases, Choosing a Wavelet, Wavelets and Filter Banks, Fast Orthogonal Wavelet Transform, Perfect Reconstruction Filter Banks.

Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for sampling rate Conversion.Multistage Implementation of Sampling Rate Conversion, Applications of Multirate Signal Processing, Sampling Rate Conversion of Bandpass Signals.

Text Books:

1. L.R. Rabiner and R.W. Schafer, "Digital Processing of Speech Signals", Pearson Education, 1993.

2. T. F. Quatieri, "Discrete time processing of speech signals", Wiley India 2000.

3. Proakis, J. G. &Manolakis, D. G., "Digital Signal Processing", 4th Edition, Pearson 2007.

4. Mallat, S., "A Wavelet Tour of Signal Processing: The Sparse Way", 3rd Edition,Elsevier 2009.

Research/Specialization Group: 3

(Name of the Group) RF & Microwave Engineering

Course Code & Course Name:

EC 519: RF and Microwave Engineering

Microwave Frequency bands, Applications of Microwaves: Civil and Military, Medical, EMI/ EMC. Rectangular waveguide, Concept of Mode, Characteristics of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission, Field analysis of transmission line, Coaxial Line, Circular waveguide, Stripline, Microstrip Line, CPW Line, Equivalent Voltages and currents for non-TEM lines, Network parameters for microwave Circuits, Scattering Parameters.

EC 532: Antenna Theory and Propagation

Review of Maxwell's Equation; Condition of radiation of electromagnetic waves and introduction to Antenna; Vector Potential and Retarded Vector Potential; Radiation fields of a Hertzian dipole(electric); Duality Principle, Radiation fields due to short magnetic dipole. Antenna Characteristics: Radiation Pattern, Beam Width; Radiation Resistance and efficiency; Directivity and Gain, Impedance, VSWR, Polarization; Effective height and Receive Aperture; Noise Temperature of Antenna. Radiation fields and Characteristics of $\lambda/2$ dipole; discussion on $\lambda/4$ monopole antenna; Current distribution and Radiation patterns of center-fed dipoles of length λ, $3\lambda/2$ and $2\ \lambda$. Horizontal and Vertical antennas over a plane ground, design and analysis of Microstrip Patch Antenna.

EC 533: Advanced Engineering Electromagnetics

Introduction Maxwell equations, boundary conditions, polarization, scattering at an interface, scattering at multiple interfaces, Electromagnetic Properties of Materials Lorentz and Drude models, non linear materials, anisotropic materials, Kramers-Kronig relations, Analysis of wave propagation under different boundary condition

Research/Specialization Group: 4

(Name of the Group) Image Processing

Course Code & Course Name:

EC 536: Digital Image Processing

Origin of digital image processing, human visual system and image perception, image acquisition, display, storage, colour image fundamentals - RGB, HSI models, image sampling, quantization: scalar and vector, Dither, two-dimensional signal and system preliminaries, 2D transforms - DFT, DCT, KLT, SVD, DWT. Histogram equalization, spatial-domain filtering, frequency-domain filtering, colour image enhancement. Edge detection, edge linking via Hough transform, thresholding, and region based segmentation – region growing, region splitting and merging, dam construction – watershed segmentation algorithm.

CS 519: Pattern Recognition

Bayesian decision rule, Error probability, Minimum distance classifier, Mahalanobis distance, Discriminant functions and decision boundaries; Maximum likelihood classification, K-NN Classifier, Linear and nonlinear Classifier, Parameter estimation, Density estimation. Different distance functions and similarity measures, Criterion for clustering Minimum within cluster distance criterion, Methods of clustering - partitional, hierarchical, graph theoretic, Problem statement and uses, Probabilistic separability based criterion functions, interclass distance based criterion functions, Branch and bound algorithm, sequential forward/backward selection algorithms, (l,r) algorithm, Feature extraction based on PCA, Kernel PCA, LDA.

EC 528: Reconfigurable Computing

Introduction to Reconfigurable Computing, Coarse-grained reconfigurable devices, Fine-grained reconfigurable devices. FPGA architecture, FPGA design cycle, Multi FPGA systems, Embedded computer organization and methodology of System

on chip (SoC) system in FPGA devices, Design challenges and Differences GPP, DSP, ASIC and FPGA based System On Chip platforms, Application profiling and partitioning, FPGAs vs. Multi-core processor architectures,

High level compilation Hardware software co-design of Embedded Systems, Simple & Autonomous I/O Controllers, Custom Intellectual-Property (IP) and Coprocessor creation, hardware design for System-On-a-Chip; Concepts & types of Memory interfacing. Architecture exploration of IP, Design of Master and Slave Bus protocols based IPs, Bus protocols AXI. Design Metrics, General purpose peripherals (interrupt, timer, clock, DMA etc.) and special purpose peripherals Serial Transmission protocols & Standards.

Text Books:

1. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Second Edition, Pearson Education/PHI.
2. R. O. Duda, P. E. Hart and D. G. Stork, "Pattern Classification and Scene Analysis", Wiley.
3. The Zynq Book: Embedded Processing with the Arm Cortex-A9 on the Xilinx Zynq-7000 All Programmable SoC, Strathclyde Academic Media , UK ,2014

Research Group: **Research/Specialization Group: 5**

(Name of the Group) : Microelectronics Device & Circuit

Course Code & Course Name:

EC 515 - MIXED SIGNAL DESIGN

Analog and discrete-time signal processing, introduction to sampling theory, Analog continuous-time filters: passive and active filters, Basics of analog discrete-time filters and Z-transform, Switched-capacitor filters. Basic CMOS Comparator Design, Adaptive Biasing, Analog Multipliers. Basics of data converters, Successive approximation ADCs, Dual slope ADCs, High-speed ADCs (flash ADC, pipeline ADC and related architectures), High-resolution ADCs (delta-sigma converters) DAC specifications, DAC Architectures, Mixed-signal layout issues. Voltage-mode signaling and data transmission, Current-mode signaling and data transmission, Introduction to frequency synthesizers and synchronization, Basics of PLL, AnalogPLL, Digital PLL, Delay locked loops (DLL)

EC 520: RFIC DESIGN

Review of RF Theory: RF range, skin effect, behavior of various passive components like R, L, C, at high RF, their equivalent circuits at high RF. Transmission line theory, reflection coefficient, Smith chart calculation, impedance matching, S-parameter, Basic concepts in RF design: RF design, nonlinearity, harmonics, gain compression, desensitization, cross modulation, inter modulation distortion (IMD), input intercept point (IIP3 & IIP2), inter symbol interference. Noise, types of noise, noise analysis of active devices.TRF receivers, heterodyne receivers, Homodyne receivers, their comparison, type RF receiver architecture and its design. Design concepts-1: Low noise amplifiers, various topologies, comparison and design. Mixers, various topologies, comparison and design, Oscillators (emphasis to PLL and VCO) design. Design concepts-2: Power Amplifiers, various topologies, comparison and design. Difference between Linear and Non-Linear Power Amplifiers.

EC 502: ANALOG SYSTEM DESIGN

Single Stage and Differential Amplifiers,Frequency Response of Amplifiers, Current Mirrors, Current and Voltage Reference, Feedback, Stability and Frequency Compensation, Operational Amplifiers

Reference:

1. R. Ludwig and P. Bretcheko, RF circuit design, PHI., 1 st Edition, 2000.

2. B. Razavi, RF Microelectronics, PHI., Edition 1, 1998.

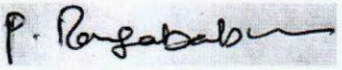
3. S. C. Cripps, RF Power Amplifiers for Wireless Communications ,Artech House, Inc. Publication, 1 st Edition, 1999

4. B. Razavi, Design of Analog CMOS Integrated Circuits, Tata McGraw Hill, 1st Edition, 2002

Syllabus Content {should be an extract from the course syllabus (not the entire syllabus) which will be helpful for the research work of the scholar}:

Signatures and Names of DRC Members:

1. **D.Anupdandapat**
2. **Dr.Ch.VRamaRao**
3. **Dr.PradeepRathore**
4. **Dr.PrabirSahaDr.P.Rangababu**
5. **Dr.AbhishekSarkhelDr.B.Puhspadevi**
6. **Dr.ShubankarMajumdar**



Signature of DRC Chairman

Syllabi for Comprehensive Examination of Eligible Ph. D Scholars

(Full Time & Sponsored Part Time)

Department: Electrical Engineering

Exam Date: 10/08/2020 (Autumn 2020)

Research/Specialization Group: 1

Name of the Group: Power & Energy System

- **EE 501: Power System Interconnection & Control**

Syllabus Content: Basic introduction, Concepts of stability, control of voltage, frequency and tie-line power flows, Q-v and P-f control loops, mechanism of real and reactive power control, net interchange tie-line bias control, Turbine and governing system, Emergency Control, Preventive control, system wide optimization, SCADA, Demand side management, Smart grid.

- **EE 502: Computer Aided Power System Analysis**

Syllabus Content: Network modeling, Y-bus & Z-bus formation, power flow techniques, symmetrical domain components, unsymmetrical & symmetrical fault analysis, rotor angle stability, multi-machine swing equations, state estimation techniques, contingency analysis methods.

- **EE 503: Advance Power Converter**

Syllabus Content: Single-phase and three-phase controlled rectifiers, Buck, Boost, Buck-boost and Cuk converters – topology, current and voltage waveforms, voltage and current ripple. DC-AC converters: Single phase and three phase bridge inverters, PWM switching scheme, space vector modulation (SVPWM), Reduction of harmonics, output voltage control. Resonant Converters, concept of zero current switching (ZCS) and zero voltage switching (ZVS).

Research/Specialization Group: 2

Name of the Group: Power Electronics & Drives

- **EE 503: Advance Power Converter**

Syllabus Content: Single-phase and three-phase controlled rectifiers, Buck, Boost, Buck-boost and Cuk converters – topology, current and voltage waveforms, voltage and current ripple. DC-AC converters: Single phase and three phase bridge inverters, PWM switching scheme, space vector modulation (SVPWM), Reduction of harmonics, output voltage control. Resonant Converters, concept of zero current switching (ZCS) and zero voltage switching (ZVS).

- **EE 529: Special Electrical Machines**

Syllabus Content: Control of PM Motor Drives Control strategies, modeling, vector control, flux-weakening operation, design of controllers, sensor-less control & rotor position estimation. Brushless DC Motor & Permanent Magnet Synchronous Motor Drives: Construction, operation, sensing and switching logic scheme, Drive and power circuit, Theoretical analysis and performance prediction, transient analysis.

- **EE 510: Advanced Control Systems**

Continuous Time Systems in State-Space: Introduction of State-Space, modelling of dynamic systems. Concepts of Controllability, Observability, Stabilizability & Detectability. Design of state variable feedback, Regulator design via pole placement method, determination of full state feedback gain using Direct-comparison method, controllable canonical form method and Ackermann's formula, state observers, Design of Full order state observers, reduced order State observers.

Non-Linear Control System: Introduction, Phase-Plane analysis: singular points, Phase portrait, Limit Cycle, Qualitative behaviour near equilibrium points, Jacobian linearization, Construction of phase trajectories using different method, Stability of non-linear system by Phase-Plane method. Lyapunov's Stability Analysis: Stability definitions, Lyapunov's stability criterion, Lyapunov function, sign definiteness of scalar functions, Sylvester's criterion, Lyapunov's Direct and In-direct methods for linear and nonlinear systems, Construction of Lyapunov function, Lyapunov based control design. Control design for some application like power systems, smart grid and renewable energy systems.

Research/Specialization Group: 3

Name of the Group: Instrumentation, Control and Signal Processing

- **EE 521: Instrumentation and Control in Energy System**

Measurement Systems: Elements of generalized measurement system, input-output configuration of instruments and measurement systems, methods of correction for interfering and modifying inputs, static performance characteristics of measurement system, noise, signal to noise ratio, errors in measurement.

Sensors and Transducers: Classification of transducers, passive transducers: resistive, inductive and capacitive transducers, active transducers: RTD, Thermistor, thermocouple, piezoelectric transducer, photoelectric, transducer, taco-generator, basic signal conditioning circuits for transducers.

- **EE 510: Advanced Control Systems**

Continuous Time Systems in State-Space: Introduction of State-Space, modelling of dynamic systems. Concepts of Controllability, Observability, Stabilizability & Detectability. Design of state variable feedback, Regulator design via pole placement method, determination of full state feedback gain using Direct-comparison method, controllable canonical form method and Ackermann's formula, state observers, Design of Full order state observers, reduced order State observers.

Non-Linear Control System: Introduction, Phase-Plane analysis: singular points, Phase portrait, Limit Cycle, Qualitative behaviour near equilibrium points, Jacobian linearization, Construction of phase trajectories using different method, Stability of non-linear system by Phase-Plane method. Lyapunov's Stability Analysis: Stability definitions, Lyapunov's stability criterion, Lyapunov function, sign definiteness of scalar functions, Sylvester's criterion, Lyapunov's Direct and In-direct methods for linear and nonlinear systems, Construction of Lyapunov function, Lyapunov based control design. Control design for some application like power systems, smart grid and renewable energy systems.

- **EE 522: Advanced Digital Signal Processing**

Fourier Transform, Digital Filter Design and Realization: Direct Evolution of DFT, Properties of DFT, Computational complexity analysis of DFT, Fast Fourier Transform, Radix-2 Decimation-In-Time FFT algorithm, Radix-2 Decimation-In-Frequency FFT algorithm, Computation complexity analysis of FFT algorithm, Basic concepts of FIR and IIR filters, design of linear phase FIR filters, FIR filter design using windows, Sampling method of filter design, Design of Butterworth and Chebyshev IIR analog filters, Analog-to-digital filter transformation methods; Impulse invariant, Approximation of derivatives, and Bilinear transform, Match z-transform, design of linear phase FIR filters, transformation of digital filters.

Introduction to multirate DSP, decimation and interpolation, polyphase decomposition, uniform DFT filter banks, quadrature mirror filters and perfect reconstruction. Realization of FIR and IIR Filters, Transposed Structure, Transversal Structure, Cascade Structure, Linear Phase Realization, Lattice Structure, Polyphase Realization of FIR Filter, Direct Form-I Realization, Direct Form-II Realization, Parallel Form Structure.

Dr. Sanjoy Debbarma

HOD

Electrical Engineering Department

Syllabi for Comprehensive Examination of Eligible Ph. D Scholars

(Full Time & Sponsored Part Time)

Date of Comprehensive Exam: 10th August., 2020

Department: Mechanical Engineering

1) Research/Specialization Group: 1

(Thermal Engineering)

Syllabus Content {Only from the domain subjects offered to the students }:

- **Power Production Engineering (ME512)**
  Syllabus:
  1. **Vapour power cycle**
  2. **Steam generator**
  3. **Steam turbine**
  4. **Steam condenser and cooling tower**
  5. **Gas turbine power plant**
- **Measurement Systems in Mechanical Engineering(ME701)**
  Syllabus:
  1. **Introduction**
  2. **Experiment Objectives**
  3. **Basic Measurement Systems**
  4. **Sensors and Transducers**
  5. **Measurement of Process Variables**
- **Convective Heat Transfer(ME502)**
  Syllabus:
  1. **Introduction to Convection**
  2. **Convective Heat Transfer in External and Internal Flows**
  3. **Thermally Developing Flows**
  4. **Free Convection**
- **Operations Management (ME 516)**
  1. **Operations Management and Capacity Planning:**
  2. **Facility Location and Layout**
  3. **Quality Management**
- **Computational Fluid Dynamics (ME504)**
  1. **Definition and Importance of CFD, Fundamental conservation laws of fluid motion and heat transfer**
  2. **Mathematical classification of PDEs, role of characteristics, types of and role of boundary conditions**
  3. **Overview of finite difference method and finite volume method**
  4. **Discretization**
  5. **Conservativeness, boundedness and transportiveness properties**
  6. **Discretization Schemes - FTCS, FTFS, FTBS, Upwind , etc schemes and stability criterion of such schemes**
  7. **Concept of collocated and staggered grids; SIMPLE, SIMPLER algorithms**

2) Research/Specialization Group: 2(Production Engineering & Management)

Syllabus Content {Only from the domain subjects offered to the students }:

- **Measurement Systems in Mechanical Engineering(ME701)**
  Syllabus:
  1. **Introduction**
  2. **Experiment Objectives**
  3. **Basic Measurement Systems**
  4. **Sensors and Transducers**
  5. **Measurement of Process Variables**
  6. **Flow Measurement:**
  7. **Temperature Measurement**

- **Manufacturing Science(ME702)**

  Syllabus:
  1. **Casting**
  2. **Forming**
  3. **Machining**
  4. **Joining**
  5. **Advanced Manufacturing & Regenerative Machining Process**

- **Operations Management (ME 516)**
  1. **Operations Management and Capacity Planning:**
  2. **Facility Location and Layout**
  3. **Quality Management**
- **Supply Chain Management (ME 518)**
  1. **Scope of Supply Chain Management**
  2. **Decision Support Systems**
  3. **Logistics and SRM**

3) Research/Specialization Group: 3

(Machine Design)

Syllabus Content {Only from the domain subjects offered to the students}:

- **Measurement Systems in Mechanical Engineering (ME701)**
  Syllabus:

  1. **Introduction**
  2. **Experiment Objectives**
  3. **Basic Measurement Systems**
  4. **Sensors and Transducers**
  5. **Measurement of Process Variables**
  6. **Flow Measurement:**
  7. **Temperature Measurement:**

- **Engineering Fracture Mechanics(ME706)**
  Syllabus:
  1. **Introduction**
  2. **Linear Elastic Fracture Mechanics (LEFM)**
  3. **Fatigue Crack Growth Model**
  4. **Fracture Toughness Testing**
  5. **Crack Arrest and Repair**

- **Mechanical Vibration (ME 433)**

  Syllabus:
  1. **Introduction**
  2. **Un-Damped and Damped Free Vibration of single degree of freedom systems.**
  3. **Harmonic Vibration Analysis of Mechanical Systems**
  4. **Rotating Unbalance, Whirling of Shaft, Vibration Isolation, Sharpness of Resonance, Impulse and step response.**
  5. **Newton's Method (D'Alembert's Principle), Energy Methods, Virtual work Principle for obtaining the equation of motion and Natural frequency.**
  6. **Vibration of Single, multi degree of freedom and Continuous systems.**
  7. **Normal modes, vibration of bar, rod and beams.**
  8. **Vibration measuring instruments: Principle of operation and Applications.**

Signature of DRC Members:

Rd. Malapelwa

Signature of DRC Chairman

Syllabi for Comprehensive Examination of Eligible PHD Scholars

(Full Time)

Date of Comprehensive Examination:10.08.2020

Department: Physics

1. **Research/Specialization Group:1**
   (Advances in Physics)

   (a) PH 701 : Basic Characterization Technique

   Syllabus-Vacuum Techniques, Cryogenics, Need for Characterization, X-ray Diffraction,Scanning Electron Microscopy, Tunneling Electron Microscopy.

   (b) PH 541 : Science and Technology of Thin Films

   Syllabus-Thermodynamics of Evaporation Kinetic theory of gases, effusion, Hertz Knudsen equation; mass evaporation rate; Knudsen cell, directional distribution of evaporating species, evaporation of elements, compounds, alloys, Raoult's law.Elastic scattering, sticking coefficient, mechanism of thin film formation, 2D & 3D growth, rate of nucleation.

   (c) PH 554 : Phase Transitions

   Syllabus-Order of Phase transition, Ehrenfest criterion, examples of First and Second order phase transitions, critical points and exponents, the spin - ½ Ising model, spin-1 Ising model, q state Potts model, X-Y model, Heisenberg model, Weiss mean field theory, Landau theory of phase transition, Importance sampling, Metropolis algorithm, error analysis.

   (d) PH 555 : Quantum Information and Computation

   Syllabus-The Bloch sphere, Qubit projections. Single qubit logic gates, multiple qubits, two qubit system and logic gates. The Bell state and EPR paradox. Testing Bell's inequality. Three qubit system, quantum adder. Quantum Gate: controlled-U gate, controlled-V gate and Toffolic gate. Qubits error: Qubit-flips and phase-flips. Qubit error correction. Parallelism: computing and superposition. Entanglement and its measures, No-Cloning theorem, dense coding and quantum teleportation.

Syllabus for Comprehensive Examination of Eligible Ph. D Scholars
(Full Time & Sponsored Part Time)
Date of Examination: 10th August, 2020
Department: MATHEMATICS

Name of Research Group: Pure Mathematics
No. of Students: 01
Syllabus Content:

(a) Course Name and Code : Advanced Engineering (MA 701)

Syllabus : *Linear Algebra*: Vector Space over C, linear independence and basis, linear Transform and matrices, eigenvalues, orthogonality; Linear systems of algebraic equations, Gauss elimination, LU factorization, Pivoting, Cholesky decomposition.
Numerical Methods: Numerical solution of ODEs: Basic Principles of Numerical Approximation of ODEs, Euler, improved Euler, Runge-Kutta method; Solution of stiff equations; Linear Multistep Methods, Accuracy, Stability; Difference Methods for BVPs, accuracy; Linear Two-Point BVPs; Nonlinear Two-Point BVPs; The Shooting Method, Ansatz Methods for BVPs. Solution of PDEs: finite difference method.
Probability Theory: Probability, Bayes Theorem, random variables, moment generating function, expectation and its properties, Markov's inequality, Chebyshev's inequality, geometric and binomial distributions.

(b) Course Name and Code : Analysis (MA 702)

Syllabus : *Norms and metrics*: Metric spaces, convergence of sequences, completeness, connectedness and sequential compactness; Continuity and uniform continuity; sequences and series of functions, uniform convergence, equicontinuity, Ascoli's theorem, Weierstrass approximation theorem.
Calculus of functions of several real variables: Partial and directional derivatives, differentiability, Chain Rule, Taylor's theorem, Maxima and Minima, Lagrange multipliers, Inverse function theorem, Implicit function theorem;
Multiple Integration: Fubini's Theorem, Line integrals, Surface integrals, Green, Gauss and Stokes theorems.

(c) Course Name and Code : Measure Theory (MA 501)

Syllabus : Measure space and probability space: σ-algebra, events, measures, probability measures, examples, Borel σ-algebras, outer measure, Lebesgue measure, limit inferior and limit superior of a sequence of events, measurability and measurable functions, Lebesgue integration of measurable functions, Lebesgue monotone convergence theorem, Fatous lemma, Lebesgue dominated convergence theorem.

(d) Course Name and Code : Functional Analysis (MA 502)

Syllabus : Fundamentals of normed linear spaces, Banach spaces; Bounded linear maps on normed linear spaces: examples, linear map on finite dimensional spaces, finite dimensional spaces are isomorphic, operator norm. Hahn-Banach theorems. Dual spaces, weak and weak* convergence. Hilbert spaces: inner product spaces, orthonormal set, Gram-Schmidt ortho-normalization, Bessel's inequality, orthonormal basis, separable Hilbert spaces. Orthonormal complements, orthogonal projections, projection theorem, Riesz representation theorem; Bounded operators on Hilbert spaces: adjoint, normal, unitary, self-adjoint operators.

Signatures of DRC members:

Member Member Member Member

Chairman

Syllabus for Comprehensive Examination of the Eligible Ph.D. Scholar

(Only for the Courses relating to Research Domains for the Full Time Scholar)

Date of Comprehensive Examination: 10th August 2020

Department: Humanities and Social Sciences

Research/Specialization Group: **1**

Name of the Group: **Humanities and Social Sciences**

Syllabus Content {should be an extract from the course syllabus (not the entire syllabus) which will be helpful for the research work of the scholar}:

a) Course Code and Course Name: **HS701** – Interdisciplinarity in Humanities and Social Sciences
Contents: What is Interdisciplinarity? Nature and Scope of Interdisciplinarity, Nature and Scope of the Humanities, Nature and Scope of the Social Sciences, Interdisciplinary Nature of the Humanities and the Social Sciences, Class, Ethics, Eurocentrism, Culture, Gender, Identity, Representation, Ideology, Knowledge, Discourse, Ethnicity, Race, Nation

b) Course Code and Course Name: **HS502** – The Myths and the Classics
Contents: Classics, Folklore, Legend, Myth, Mythology, Epic, Greek Mythology, Roman Mythology, Relevance of Mythology in the Study of Literature

c) Course Code and Course Name: **HS503** – Critical Literary Theories
Contents: Importance of Literary Theory, Humanism, Modernism, Psychoanalysis, Feminism, Sexuality, Gender Studies, Queer Theory, Marxism, Stylistics, Narratology, Ecocriticism, Culture Studies, Richard Johnson: "What is Cultural Studies Anyway?", Elaine Showalter: "Feminist Literary Criticism in the Wilderness", Ernest Renan: "What is a Nation?"

d) Course Code and Course Name: **HS504** – Approaches to Literary Research
Contents: Importance of Approaches, Literary Criticism, Kinds of Approaches, Appreciating Literature, Interpreting Literature, Reader Based, Text Based, Context-Based, Interdisciplinary Approaches, Formalist, Biographical, Historical, Psychological, Mythological and Archetypal, Sociological, Gender, Reader-Response, Deconstructionist, Cultural Studies

15/07/2020

(Dr. P. S. Mangang)
Chairman, DRC, HS