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

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

NITMGH/AA/Notice-Student/2020-2021/356 Dated: 28-01-2021

NOTIFICATION

This is to inform to all concerned the ***Comprehensive Examination Spring 2021*** shall be held on ***10th Feb. 2021*** through online mode in pursuance of the Academic Calendar vide No-NITMGH/AA/Academic Calendar/2020-21/331, dated-15/01/2021.

Scholars listed in the ***Annexure-I*** are eligible to appear the ***Online Comprehensive Examination 2020*** to be held on 10th Feb 2021. The guidelines and syllabi for the same is given in ***Annexure-II and Annexure-III*** respectively.

In this connection, the concerned scholars are advised to remain in touch with the concerned supervisor(s) and HoD to obtain the relevant information. Further the concerned scholars are advised to ensure the network connectivity and other related equipment beforehand in order to avoid the unnecessary interruption during the Examination.

This issues with the approval of the Competent Authority.

Ambika Rai

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.

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Website: www.nitm.ac.in

ANNEXURE- 1

LIST OF THE ELIGIBLE SCHOLAR FOR THE COMPREHENSIVE EXAMINATION SPRING 2020

SL no	Dept	Roll No	Name of the scholar	Part/Full Time	Remarks
1	CS	P20CS003	Rakesh Kancharla	Part Time(Sponsored)	
2	CS	P20CS004	Manabendra Nath	Part Time(Sponsored)	
3	CS	P20CS005	Alok Choudhury	Part Time(Sponsored)	
4	CY	P19CH005	Ankita Agarwal	Full Time Project Fellow	
5	CY	P20CH001	Sona Lyndem	Part Time(Sponsored)	
6	EC	P20EC001	Deb Sunder Swami	Part Time(Sponsored)	
7	EC	P20EC002	Moupali Roy	Part Time(Sponsored)	
8	EC	P20EC003	J R K Kumar Dabbakuti	Part Time(Sponsored)	
9	HS	P20HS001	Amanda Bashisha Basaiawmoit	Part Time(Sponsored)	
10	MA	P19MA001	Suman Dowerah	Full Time	
11	MA	P20MA001	Jahnabi Chakravarty	Full Time Project Fellow	
12	PH	P20PH001	Sanchia Mae Kharphanbuh	Full Time Project Fellow	
13	PH	P20PH002	Onus Manner	Full Time Project Fellow	
14	EE	P19EE005	Satyavarta Kumar Prince	Full Time Project Fellow	
15	EE	P19EE013	Priya Darshini Kumari	Part Time(Sponsored)	Provisionally allowed

Ambika Rai

Asst.Registrar (AA)

ANNEXURE- II

GUIDELINES FOR PREPARATION OF ONLINE COMPREHENSIVE PH.D EXAMINATION

SPRING 2021

1. The Dept will take the responsibility to conduct the online examination as per schedule. In this regard HoD may choose coordinator(s) based on the research groups.
2. The question papers should be preferably **numerical/analytical type** as much as possible depending on the syllabus framed by Dept research groups. The question paper should be discussed at dept research group level before submission to the Academic Section.
3. All the Research groups need to submit questions papers to coordinators on or before 05/02/2021 and the HoD will submit the question papers to the Academic Section by 09/02/ 2021.
4. For conduction of exam a Google platform will be used.
5. The Question paper should consist of 2 parts. Part-A will consists of 30 objective type question s with duration of ½ hour and each question carries 1 mark. Part-B should consist of 10 questions (subjective type) with duration of 2 hours. A scholar need to attempt 7 out of 10 questions and each question carries 10 marks.
6. The Dept Research groups will finalize the distribution of marks on subject wise for common courses.
7. After submission of Part-A only Part-B will be shared to the scholars as per schedule.
8. The question papers should be set in such a way that the students can finish their writing within the prescribed time.
9. The coordinators/HOD will conduct the examination (as per the schedule) using Google Classroom platform (under assignment category). The students will upload the hand-written scan copy of the answer scripts in the interface.
10. Question paper template is attached for this purpose
11. Exam schedule as follows.

Date	Question Type	Duration	Answer to be uploaded (allowable Time)
10/02/2021	Part-A	9am -9:30 am	9:50 am
	Part-B	10:30 am-12:30 pm	12:50 pm

National Institute of Technology, Meghalaya

Ph.D. Comprehensive Examination-(Spring 2021)

Group: Image *and Video Processing*

Dept.: ECE **Time: ½ hrs.** **Total marks: 30**

Part A

Answer all the questions 30x1=30

SI.no	**Choose the correct answer.**	Answer
1	DIT algorithm divides the sequence into a. Positive and negative values b. Even and odd samples c. Upper higher and lower spectrum d. Small and large samples	
2	The computational procedure for Decimation in frequency algorithm takes a. Log2 N stages b. 2Log2 N stages c. Log2 N2 stages d. Log2 N/2 stages	
3	The similarity between the Fourier transform and the z transform is that a. Both convert the frequency spectrum domain to the discrete-time domain b. Both convert the discrete-time domain to frequency spectrum domain c. Both convert analog signal to digital signal d. Both convert digital signal to analog signal	
4	Which mathematical notation specifies the condition of periodicity for a continuous time signal? a. $x(t) = x(t + T0)$ b. $x(n) = x(n+ N)$ c. $x(t) = e-\alpha t$ d. None of the above	
30		

	National Institute of Technology, Meghalaya **Ph.D. Comprehensive Examination-(Spring 2021)** **Group: Image *and Video Processing* Dept.: ECE** **Time: 2 hrs.** **Total marks: 70**

Part-B		
SI.no	*Answer any 7 out of 10 Questions*	
1		
2		
4		
5		

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: 10rd February , 2021

Department: ECE

1) Research/Specialization Groups:

(Name of the Group): Embedded systems

Course Code & Course Name:

Embedded Systems and Architectures (EC 501), Reconfigurable Computing (EC 528)

Embedded systems :

ARM Cortex-M3 processor: Applications, Programming model – Registers, Operation modes, Exceptions and Interrupts, Reset Sequence Instruction Set, Unified Assembler Language, Memory Maps, Memory Access Attributes, Permissions, Bit-Band Operations, Unaligned and Exclusive Transfers. Pipeline, Bus Interfaces Unit 2: Exceptions, Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor and Pendable Service Call, Nested Vectored Interrupt Controller, Basic Configuration, SYSTICK Timer, Interrupt Sequences, Exits, Tail Chaining, Interrupt Latency. Unit 3: LPC 17xx microcontroller- Internal memory, GPIOs, Timers, ADC, UART and other serial interfaces, PWM, RTC, WDT

System on Chip

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.

Emphasis on different embedded processors and multiprocessor and architectures. 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, Cache mapping techniques and impact on system performance. Co-simulation using different simulators, system level optimization, and System level design Trade-offs, Power, Energy, Performance and Area. Design for Test.

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, and advanced high-speed buses. Debugging methodologies

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}:

2) Research/Specialization Group: 2

(Name of the Group):

Course Code & Course Name: Estimation theory and Detection, Mobile Communication (EC 503)a

ANALOG COMMUNICATION

Need for modulation, Linear CW modulation –Amplitude modulation: DSB/SC, SSB/SC signals and spectra, Generation of AM, DSB-SC, SSB. Detection of AM: Envelope detector, synchronous detection of AM-SC, Relation between FM and PM, generation of FM and PM. Quantization, uniform and non-uniform quantization, quantization noise, binary encoding, A-Law and μ-Law commanding

DIGITAL COMMUNICATION

Digital Modulation, ASK, FSK, PSK, DPSK.
SOURCE CODING: Introductions, Shannon's theorem, Shannon-Fano coding, Huffman coding, efficiency calculations, channel capacity and efficiency of discrete and analog channels.

DIGITAL SIGNAL PROCESSING

Discrete Fourier Transforms: Properties of DFT, Linear Convolution of Sequences using DFT, Computation of DFT: Over-Lap Add Method, Over-Lap Save Method. Order of Digital filter, recursive and non-recursive digital filter, FIR Digital Filters.

WIRELESS COMMUNICATIONS

The Cellular concept, System design, Capacity improvement in cellular systems, Co channel interference reduction. Adjacent Channel interference, Power Control for Reducing interference Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring, Handover Strategies, Types of Handoff.

SIGNAL DETECTION &ESTIMATION
Bayesian, minimax, and Neyman-Pearson decision rules, likelihood ratio test (LRT), composite hypothesis testing, locally optimum tests, generalized LRT, detector comparison techniques, Matched filter detector, Minimum variance unbiased estimation, Fisher information matrix, Cramer-Rao bound.

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}:

3) Research/Specialization Group: 3

(Name of the Group) VLSI

Course Code & Course Name: EC 513 VLSI Signal Processing & EC 526 Digital Arithmetic Circuits

Architectural issues in DSP:

Linear system theory, DFT, FFT, realization of digital filters. Data flow graph representation of DSP algorithm. Binary Adders, Binary multipliers, Multiply Accumulator (MAC) and Sum of Product (SOP). Pipelining and Parallel Processing, Retiming, Unfolding, Folding , Systolic, Distributed arithmetic, Cordic architecture design.

Fast Convolution:

Cook-Toom algorithm and modified Cook-Toom algorithm, Winograd algorithm, modified Winograd algorithm, Algorithmic strength reduction in filters and transforms, DCT and inverse DCT, parallel FIR filters and analysis of finite word length effects

Redundant Number Systems:

Coping with the carry problem, Redundancy in computer arithmetic, Digit sets and digit-set conversions, Generalized signed-digit numbers, Carry-free addition algorithms, Conversions and support functions. Introduction to Residue Number systems.

Multiplication:

Shift/add multiplication algorithms, Programmed multiplication, Basic hardware multipliers, Multiplication of signed numbers, Multiplication by constants, and Preview of fast multipliers. Radix-4 multiplication, Modified Booth's recoding, Radix-8 and radix-16 multipliers, Multi-bit multipliers, VLSI complexity issues. Full-tree multipliers, Alternative reduction trees, Tree multipliers for signed numbers, Partial-tree and truncated multipliers, Array multipliers, Pipelined tree and array multipliers.

Division:

Shift/subtract division algorithms, Programmed division, Restoring hardware dividers, Nonrestoring and signed division, Division by constants, Radix-2 SRT division. Basics of high-radix division, Using carry-save adders, Radix-4 SRT division, General high-radix dividers, Quotient digit selection, Using p-d plots in practice.

Signatures and Name s of DRC Members:

P. Rangarao

1. _____ 4. Gulamare

2. _____ 5. _____

3. _____ 6. _____

P. Rangarao

Signature of DRC Chairman

Syllabi for Comprehensive Examination of Eligible Ph. D Scholars

(Full Time & Sponsored Part Time)

Department: Electrical Engineering

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

EE512: 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

DRC Members

27/01/2021

Dr. P. P. Singh

28/1/2021

Kishore Debnath

28/1/21

28.01.2020

28/01/21 (A. BANERJEE)

28/01/21

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 Feb, 2021

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. _____ _____ 5. _____

2. _____ _____ 6. _____

3. _____ _____ 7. _____

4. _____ _____ 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: 10rd February , 2021

Department: PHYSICS

1) Research/Specialization Group: 1

(Condensed Matter Physics)

Course Code & Course Name: PH701 , Basic Characterisation Techniques & Non Equilibrium Thermodynamics

Syllabus Content :

Kinetic Theory of Gases: Behaviour of gases, pressure of gases, Maxwell's law, gas transport phenomenon; viscous, molecular and transition flow regimes. Vacuum Generation: Measurement of pressure, residual gas analyses; production of vacuum - mechanical pumps, rotary vane pumps, diffusion pump, cryopumps, turbo-molecular pumps, getter and ion pumps, choice of pumping process. Vacuum Measurement: Fundamentals of low-pressure measurement, vacuum gauges, McLeod gauge, pirani gauge, penning gauge, thermal conductivity gauges - cold cathode and hot cathode ionisation gauges, materials in vacuum; high vacuum, and ultra high vacuum systems, leak detection. **Characterization Techniques** : X-ray Diffraction, X-ray fluorescence, X-ray photoelectron spectroscopy UV-Visible- IR spectroscopy, FTIR spectroscopy, Raman spectroscopy, Photoluminescence spectroscopy, Scanning Electron Microscopy, Tunneling Electron Microscopy, Atomic Force Microscopy, Impedance spectroscopy, Electronic (resistivity, Hall effect), Thermal (DTA, TGA, DSC). **Non-Equilibrium Thermodynamics**: Introduction review of statistical mechanics, phase transitions, critical phenomena, Landau Approach. Non-equilibrium phenomena, simple discussion of Brownian motion fluctuations, random walk and Brownian motion, the Langevin equation, Fokker-Planck equation.

Signatures and Names of DRC Members:

1. _____
2. _____
3. _____
4. Alekha Chandra Nayak
5. V. Senthilkumar
6. _____

V. Senthilkumar

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: 10rd February, 2021
Department: Chemistry

1) Research/Specialization Group: 1

(Name of the Group): Physical Chemistry

Course Code & Course Name: CH 701 [Analytical Methods in Chemistry] (Marks 70)

Syllabus Content

Statistical Analysis: Evaluating Data Significant figures, types of error, sources of errors and their effect upon the analytical results, precision, accuracy, mean deviations and standard deviation, statistical treatment of analytical data, method of least squares and methods for reporting analytical data.
Optical Methods: Atomic absorption spectroscopy, steady state and time resolved fluorescence spectrometry, linear and circular dichroism, X-ray methods: X-ray absorption and X-ray diffraction, photoelectron spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM) and Raman spectroscopy.
Thermal Methods
Theory, instrumentation and applications of thermogravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC), thermometric titrations.

Course Code & Course Name: HS 711 (Marks 30)

Syllabus Content

Fundamentals of Research: Meaning and Concepts of Research; Characteristics and Objectives of Research; Criteria of Good Research; Languages of Research; Types of Research; Psychological Tips; Motivation in Research; The Scholar and the Mentor; Institute Rules and Guidelines
The Research Process: Review of Literature; Identifying the Research Problem; Research Hypotheses; Sampling and Data Analysis; Interpretation of Results and Claims
Scholarly Writing: Characteristics of Scholarly Writing; Standard Guidelines; Critical Reviews; Research Proposals; Research Reports; Thesis/Dissertations; Research Papers; Impact Factor of Journals; Citation and Acknowledgement; Plagiarism and Self-Plagiarism; Reproducibility and Accountability.

Signatures and Names of DRC Members:

1. _____ 4. _____
2. _____ 5. _____
3. _____ 6. _____

Signature of DRC Chairman

Syllabus for Comprehensive Examination of Eligible Ph. D Scholars
(Full Time & Sponsored Part Time)
Date of Examination: February 10, 2021
Department: MATHEMATICS

Name of Research Group: Pure Mathematics
No. of Students: 02
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. *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.
(c)	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.
(d)	Course Name and Code	:	Topology (MA 536)
	Syllabus	:	Definition and examples of topological space, basis and sub-basis, order topology, closure, limit point, boundary, interior; Continuity and related concepts, product topology, metric topology, quotient topology; Connected spaces and Connected sets; Compact spaces and compact sets; limit point compact and sequentially compact.

Signatures and Names of DRC members:

1. _____ (Dr. S. Mukherjee, MA)
2. _____ (Dr. T. Subedi, MA)
3. _____ (Dr. M. Saha, MA)
4. _____ (Dr. A. K. Jena, MA)
5. _____ (Dr. B. K. Sarkar, ME)
6. _____ 25/01/2021 (Dr. B. Kumbhakar, MA)

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

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

Date of Comprehensive Examination: 10th February 2021

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, Culture, Gender, Identity, Representation, Ideology, Knowledge, Discourse, Ethnicity, Race, Nation

b) 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?"

c) 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

Signatures and Names of DRC Members:

1. **Dr. T. Bora**

2. **Dr. A. P. Singh**

3. **Dr. N. K. Nath**

4. **Dr. T. Subedi**

25/01/21

Signature of DRC Chairman