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: 02/03/2022

Department: CIVIL ENGINEERING

1) Research/Specialization Group: 1

(Name of the Group): Structural Engineering

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}**:**

Sl No	Name of the Scholar	Course Code for Comprehensive exam
1	DONKUPAR FRANCIS MARBANIANG	CE 559 & CE 502
2	RICHARD BADONBOK LYNGKHOI	CE 559, CE 502 & CE 556
3	ANJALI KUMARI PRAVIN KUMAR PANDEY	CE 501, CE 503 & CE 556
4	MOSTAFA DADA	CE 501, CE 503 & CE 556
5	ATHUL NATH M K	CE 504 & CE 555

a. Course Code & Course Name: CE 559 (Advance Concrete Technology):

- Strength and durability of concrete: Factors affecting the strength, curing of concrete, strength in tension, failure in compression, aggregate cement paste interface, effect of age on strength of concrete, relationship between compressive and tensile strength, bond strength. Causes of inadequate durability, transportation mechanism in concrete, diffusion, absorption, water permeability of concrete, air and vapour permeability, carbonation, acid attack on concrete, sulphate attack on concrete, chloride attack, and test for penetrability of concrete to chloride.
- Microstructure analysis techniques: Working principle of Scanning Electron Microscope (SEM), Energy Dispersive X-ray Spectrometry (EDS), X-ray Powder Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR) analysis techniques, TGA (Thermo Gravimetric analysis) and DTA (Differential Thermal Analysis).

b. Course Code & Course Name: CE 502 (Advance Structural Design):

- Basic load calculation and design concept: Dead load, live load, wind and seismic load calculation for different types of structures according to IS code. Basic design philosophy of RCC structures (working stress and limit state method of design).
- Ductile Detailing Concept of Ductility: Detailing for ductility – Design of beams, columns for ductility - Design of cast-in-situ joints in frames

c. Course Code & Course Name: CE 501 (Advance Solid Mechanics):

- Kinematics: Motion field, Displacement field, Deformation gradient, Transformation of curves, surfaces and volumes, strain measures, linearized strain measures, Principal strains and principal directions, Transformation of strain components with changes in coordinate basis, Compatibility conditions for linearized strain.
- Traction and stresses: Concept of traction, Cauchy's stress theorem, Postulate of Cauchy stress tensor, Traction on arbitrary planes, Extreme normal and shear traction, Octahedral shear stress, Other stress measure – Engineering stress

d. Course Code & Course Name: CE 503 (Matrix Method of Structural Analysis):

- Plane Trusses: Global and Local coordinate systems; Degrees of Freedom; Member Stiffness relations in the Local coordinate system; Calculation of member forces; Finite Element formulation using virtual work; Coordinate transformations; Member stiffness relations in the

Global coordinate system; Structure Stiffness relations, Three dimensional framed structures Space Trusses; Grids; Space frames.

e. **Course Code & Course Name: CE 556 (Advance Steel and Concrete Composite Structure):**
   - Composite columns: Design of encased columns, design of in-filled columns under axial, uni-axial and bi-axially loaded columns. Behaviour of Composite Beams to Temperature, shrinkage and creep, vibration of composite beams.

f. **Course Code & Course Name: CE 504 (Finite Element Method):**
   - Element Properties: Natural Coordinates; Triangular Elements; Rectangular Elements; Lagrange and Serendipity Elements; Isoparametric Formulation; Stiffness Matrix of Isoparametric Elements; Numerical Integration: One Dimensional; Numerical Integration: Two and Three Dimensional
   - Analysis of Frame Structures: Stiffness of Truss Members; Analysis of Truss; Stiffness of Beam Members; Finite Element Analysis of Continuous Beam; Plane Frame Analysis

g. **Course Code & Course Name: CE 555 (Dynamic of Structures):**
   - Dynamics of Single Degree-of-Freedom Structures: Dynamic equation of equilibrium; Free vibration of single degree of freedom systems; Forced vibration: harmonic and periodic loadings; Dynamic response functions, force transmission and vibration isolation; SDOF response to arbitrary functions.
   - Earthquake Response of SDOF Systems: Earthquake excitation, response history and construction of response spectra; Response spectrum characteristics and design spectrum.

2) Research/Specialization Group: 2

(Name of the Group): Environmental Engineering

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

Sl No	Name of the Scholar	Course Code for Comprehensive exam
1	KRISHNA DAS	CE 516, CE 515 & CE 580

a. **Course Code and Course Name: CE 513 (Solid and Hazardous Waste Management):**
Evolution of Solid Waste Management: Sources/Types and Characteristics; Generation; Handling, Separation, storage, and Processing at source, Biological treatment (Composting, Anaerobic digestion), Bio-medical waste management, Rules and legislation. Collection, processing, and treatment: on-site storage, collect and transportation; Physical, Chemical, Thermal and Biological treatment processes of Hazardous Waste Management.

b. **Course Code and Course Name: CE 515 (Physico-Chemical Processes in Environmental Engineering):**
Physical, Chemical and Biological quality Parameters of surface and sub-surface waters and wastewater, Potable Water Standards, Wastewater Effluent Standards, Unit Processes, theory and design of physicochemical unit operations, screening, grit chamber, equalization, sedimentation, floatation, coagulation, flocculation, filtration, disinfection, water softening, adsorption, ion exchange, aeration and gas transfer, Unit operation & Design water treatment Plant.

c. **Course Code and Course Name: CE 580 (Environmental Management):**
Ecological and remedial actions; future strategies; multidisciplinary environmental strategies, environmental impact assessment (EIA), environmental impact factors and areas of consideration, measurement of environmental impact, scope and methodologies of EIA, status of EIA in India. Environmental audit versus accounts audit

3) Research/Specialization Group: 3

(Name of the Group): Water Resources Engineering

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

Sl No	Name of the Scholar	Course Code for Comprehensive exam
1	AVISHEK GOSWAMI	CE 510, CE 572 &CE 576

a. **Course Code and Course Name: CE 510 (Advanced Hydraulic Engineering):**
River mechanics and river management; River erosion; River training works; Uniform flow, Critical flow and GVF with special reference to compound channel; Rapidly varied flow in prismatic and non-prismatic channel

b. **Course Code and Course Name: CE 572 (Optimization Methods):**
Optimization problem formulation; types of optimization problems; objective function; design variables; constraints and variable bounds; single variable optimization methods, optimality criteria, necessary and sufficient conditions; multivariable optimization methods, optimality criteria, necessary and sufficient conditions; introduction to genetic algorithms, working principles of genetic algorithms, encoding of variables, selection, cross over and mutation, applications

c. **Course Code and Course Name: CE 576 (Computational Methods in Water Resources Engineering):**
Polynomial Approximation and Interpolation; Newton's forward and backward interpolation; Numerical Solution of Transcendental Equation; Regula Falsi method, Newton-Raphson method; Numerical Differentiation and Difference Formulas; Simpson's rule, Numerical Solution to Ordinary Differential Equation; Euler's method; Finite Difference Method; Introduction to Finite Difference, Difference equation, initial and boundary conditions, forward difference, backward difference, central difference, explicit and implicit approach

Signatures and Names of DRC Members:

(Dr. C. Marthong)
Member

16/02/2022
(Dr. B. K. Debnath)
Member

S. Sahoo 16/02/2022
(Dr. S. Sahoo)
Member

16/2/2022
(Dr. S. Sharma)
Member

(Dr. P.K. Gautam)
Member

16/02/2022
(Dr. H. M. Kalita)
DRC Chairman

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: 2nd March, 2022

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 sy

Syllabus (not the entire syllabus) which will be helpful for the research work of the scholar }:

(a) **Course Code and Course Name** : *CS 305: 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.

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 322 : 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 516 : 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 516 : 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 202: 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 304 : 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 419: 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 512: 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 312 : 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. 14-2-2022 [D. Kumar]
2. 14/2/22 (DS Roy)
3. 14/2/22 (A P. Singh)
4. (Dr. Yogita)
5. 14/02/2022 (S. Mukherjee)
6. _____
7. _____
8. _____

14/02/2022

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:

Department: Electronics and Communication Engineering

1) Research/Specialization Group: 1

(Name of the Group): Semiconductor & MEMS Devices

Course Code & Course Name:

(1) EC511 - Physics of Semiconductors: Syllabus Content { **Introduction to Semiconductor Physics:** Basics of semiconductors, energy band diagrams, electrons & holes carrier concentrations, carrier transport in semiconductor; **Semiconductor Junctions:** Basics of PN junction and its IV characteristics, Schottky & Ohmic semiconductor-metal junctions; **MOS Structures:** Basics of MOS capacitor, Energy band diagrams of MOS structure, Work function difference, flatband voltage and threshold voltage and CV characteristics of MOS structures}:

(2) EC517 - Device Fabrication & Characterization Technology: Syllabus Content {**Environment for VLSI Technology** :Clean room and safety requirements. Water cleaning processes and wet chemical etching techniques; **Impurity incorporation** : Thermal diffusion & Ion Implantation Techniques; **Oxidation:** Oxide growth both for thick, thin and ultrathin films. Oxidation technologies; **Lithography** Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI; Mask generation; **Thin film deposition techniques:** Chemical & Physical Vapour Deposition (CVD & PVD) Techniques**; Etching techniques:** Wet & Dry etching processes; **Fabrication of Semiconductor devices:** integration for Semiconductor Diode, BJT transistor, MOSFET transistor & CMOS}

2) Research/Specialization Group: 2

(Name of the Group) VLSI architectures for Bio-medical Machine learning

EC 533- Medical Image Processing

Introduction to Medical Imaging: Various Medical images : X-ray and Computed Tomography (CT) imaging, Magnetic Resonance Imaging (MRI) Ultrasonic Imaging, Microscopic Imaging, Objectives of biomedical image analysis, Difficulties in biomedical image acquisition and analysis **Image Enhancement** :Gray scale thresholding, Contrast manipulation, histogram equalization, Laplacian derivatives, rank operators –textural analysis, Homomorphic filtering **Detection of Region of Interest** : Edge Detection, Optimal thresholding, Region based segmentation (splitting and merging), K-means clustering based segmentation, Fuzzy based segmentation **Pattern Classification and Diagnosis detection:** Supervised pattern classification (SVM, Naive Bayes, k-NN, Decision trees), Neural Networks, Unsupervised pattern classification (k-Means and FCM).

CS510: ARTIFICIAL INTELLIGENCE (3-0-0: 3):

Problem Analysis and Representation, Basic Problem-Solving Methods, Structured Representation of Knowledge State Space Search, Uninformed and Informed Search Probabilistic Inference, Bayes Networks, Reasoning of Uncertain Information Fuzzy Logic and Reasoning Planning algorithms, Rule based Systems,

Machine Learning, preliminary understanding of unsupervised learning Artificial Intelligence applications: Decision Tree, Artificial Neural Networks.

EC 521: **Electronic System Design**

MSI and LSI Circuits And Their Applications Arithmetic Circuits, Comparators, Multiplexers, Code Converters, XOR And AND-OR INVERTER Gates, Wired Logic, Bus Oriented Structures, Tri-State Bus System, Propagation Delays , The Concept Of Memory, The Binary Cell, The Cell And The Bouncing Switch, Set I Reset, D, Clocked T, Clocked JK Flip Flop, Design Of Clock FIF, Conversion, Clocking Aspects, Clock Skew, State Diagram Synchronous Analysis Process, Design Steps For Traditional Synchronous Sequential Circuits, Programmable System Controllers, ROM, PLA And PAL Based Design. Introduction to the CPLD &FPGA

Signatures and Names of DRC Members:

1. _____ (P. Rangababu)
2. _____ (Dr. Ch. V Rama Rao)
3. _____ (Dr. Pradeep Kumar)
4. _____ (Dr. Anup Kadpa
5. _____ (Dr. Abhisk Sarki
6. _____ (Dr. Prabirsan
7. _____ (Dr. Vipinpal

Signature of DRC Chairman

Syllabi for Comprehensive Examination of Eligible Ph. D Scholars

(Full Time & Sponsored Part Time)

Date of Comprehensive Exam: 02 March 2022

Department: Electrical Engineering

1) 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).

- **EE 504: Renewable & Distributed Energy Systems**

Syllabus Content: Renewables Resources, Microgrid, DERs, Grid connected DERs, Hydrogen Energy, Wave Technologies, Distributed Generations and associated Technologies.

- **EE 523: FACTS Controller**

Syllabus Content: Need for FACTS controllers- types of FACTS controllers. Concept of different FACT devices, Single phase three phase full wave bridge converters transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters, Power system oscillations

2) 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.

3) 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.

16/2/22

Dr. Sanjoy Debbarma

HOD

Electrical Engineering Department

DRC Members

(1) 16/2/22

(2) 16/02/2022

(3) 16/2/2022

(4) 14/02/22

(5) 14/02/22

(6)

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: 02/03/2022

Department: Mechanical Engineering

1) Research/Specialization Group: 1

(Fluids & Thermal Engineering) For Mr. Pratit Sundar Devroy (P21ME004)

Course Code & Course Name:

ME 501: Advanced Fluid Mechanics;

ME 511: Conduction and Radiation;

ME 701: Measurement systems in Mechanical Engineering

Syllabus Content [Please Refer to the Attachment]

(Fluids & Thermal Engineering) For Mr. Ashish B. Khelkar (P21ME006)

Course Code & Course Name:

ME 701: Measurement systems in Mechanical Engineering

Syllabus Content [Please Refer to the Attachment]

(Fluids & Thermal Engineering) For Mr. Nikhil Singh (P21ME005)

Course Code & Course Name:

ME 511: Conduction and Radiation;

ME 701: Measurement systems in Mechanical Engineering

Syllabus Content [Please Refer to the Attachment]

2) Research/Specialization Group: 2

(Name of the Group)_____

_____

Course Code & Course Name: _____

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)_____

_____

Course Code & Course Name: _____

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. Dr. Mahapatra
2. 18/2/2022
3. 02/8/02/22
4.
5.
6. _____

Dr. Mahapatra

Signature of DRC Chairman

Syllabus for Comprehensive Test
Full Marks: 30 marks

Pratit S. Devroy
P21ME004

ME 501: Advanced Fluid Mechanics

Basic concepts of Fluid Mechanics

Basic concept and Governing Equations of Fluid Motion: Definition and Properties of Fluids, Langragian and Eulerian description, Velocity and stress field, Fluid statics, Fluid Kinematics, Reynolds transport theorem, Integral and differential forms of governing equations: mass, momentum and energy conservation equations, Navier-Stokes equations, Euler's equation, Bernoulli's Equation

Laminar Boundary Layers

Boundary layer equations, Boundary layer parameters, Boundary layer on a flat plate, Integral form of boundary layer equations, Approximate Methods, Flow separation and control, Hagen Poiseuille Flow, Plane Poiseuille Flow, and Couette Flow

Potential Flows

Stream and Velocity Potential Function, Circulation, Irrotational Vortex, Source and Sink, Vortex Flow, Doublet, Flow Past a Circular Cylinder, Magnus Effect; Kutta-Joukowski Lift Theorem; Concept of Lift and Drag.

References:

1. F. P. Incropera & D.P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Willey & Sons
2. A. Bejan,"Convective Heat Transfer", John Wiley and Sons
3. K. Muralidhar and G. Biswas, "Advanced Engineering Fluid Mechanics", Narosa

Syllabus for Comprehensive Test | **Pratit S. Devroy**
Full Marks: 40 marks | **P21ME004**

ME 511: Conduction and Radiation

Governing Equations
Basic modes of heat transfer, Heat transfer mechanisms, Governing laws, Reynolds Transport Theorem (RTT), Derivation of Energy Equation, Fourier's Law

Conductive Heat Transfer systems
Heat conduction equations in isotropic and anisotropic materials, Initial and boundary conditions, 1-D conduction problems without and with heat generation, Plane wall, hollow cylinder, composite tube, hollow sphere, Steady 2-D heat conduction problem, Problems in cylindrical and spherical coordinate system, Bounded 1-D domain, Slab with heat generation, Principle of superposition, Thermal Resistance, Transient Response, Semi-infinite solid, Polar co-ordinate (2-D), Time dependent BCs

Radiative Heat Transfer
Mechanism of energy transport in thermal radiation Divergence of radiative heat flux, Laws of radiation, View factor and solid angle, Radiation in presence of participating medium, Radiation transport equations (RTE), Radiative equilibrium

References:

1. F. P. Incropera & D.P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Willey & Sons
2. A. Bejan,"Convective Heat Transfer", John Wiley and Sons
3. K. Muralidhar and G. Biswas, "Advanced Engineering Fluid Mechanics", Narosa

Syllabus for Comprehensive Test
Full Marks: 30 marks

Pratit S. Devroy
P21ME004

ME 701: Measurement Systems in Mechanical Engineering

Experimental Objectives
Monitoring, Control and Research, Systems and Variables Identifications for Mechanical Systems, Planning of Instrumentations

Measurement Systems
Generalized Description of the Measurement System, Operational Description of the General Measurement System and Elimination Method of Interfering Inputs to the Desired Inputs, Null and Deflection Methods of Measurements, Analog and Digital Measurements, Order of Instruments and Calibration, Performance Characteristics, Frequency Response

Analysis of Experimental Data
Causes and Types of Experimental Errors, Error Analysis on a Common-Sense Bias, Uncertainty Analysis and Propagation of Uncertainty, Evaluation of Uncertainties for Complicated Data Reduction, Statistical Analysis of Experimental Data, Probability Distributions, The Gaussian or Normal Error Distribution, Method of Least Squares, the Correlation Coefficient, Multivariable Regression, Standard Deviation of the Mean, Graphical Analysis and Curve Fitting, Design of Experiments, Aliasing, Constructing Fractional Design, Taguchi's Design

Sensors and Transducers
Data Sampling, Signal Conditioning and Computer Data Acquisition. Error Response Characteristic of Sensors, Measurement Error

Measurement of Process Variables
Pressure Measurement: Dynamic Response, Dead Weight Pressure Tester, Bourdon Gauge; Low Pressure Measurement Techniques-the McLeod Gauge, Pirani Thermal Conductivity Gauge, Knudsen Gauge

Flow Measurement: Positive Displacement Methods, Flow Obstruction Methods, the Sonic Nozzle, Hot Wire and Hot Film Anemometer, Magnetic Flow Meter, Flow Visualization Method, LDA

Temperature Measurement: Temperature Scales, the Ideal Gas Thermometer, Temperature Measurement by Mechanical Effect, Electrical Effect, Radiation, Effect of Heat Transfer on Radiation, Transient Response of Thermal Systems, Thermocouples, and Temperature Measurement in High-Speed Flow

Measurement of Force, Torque and Power
Force Measurement: Platform Balance, Force to Displacement Conversion, Conversion of Force to Hydraulic Pressure, Piezoelectric Force Transducer

Measurement of torque and power: Torque Measurement: Electric Generator as a Dynamometer, Measurement of Rotational Speed

References

1. J. P. Holman, "Experimental methods for Engineers",McGraw-Hill.
2. R. S. Sirohi and H. C. Radha Krishna, "Mechanical Measurements", Wiley.

Syllabus for Comprehensive Test **Ashish B. Khelkar**
Full Marks: 100 marks **P21ME006**

ME 701: Measurement Systems in Mechanical Engineering

Experimental Objectives
Monitoring, Control and Research, Systems and Variables Identifications for Mechanical Systems, Planning of Instrumentations

Measurement Systems
Generalized Description of the Measurement System, Operational Description of the General Measurement System and Elimination Method of Interfering Inputs to the Desired Inputs, Null and Deflection Methods of Measurements, Analog and Digital Measurements, Order of Instruments and Calibration, Performance Characteristics, Frequency Response

Analysis of Experimental Data
Causes and Types of Experimental Errors, Error Analysis on a Common-Sense Bias, Uncertainty Analysis and Propagation of Uncertainty, Evaluation of Uncertainties for Complicated Data Reduction, Statistical Analysis of Experimental Data, Probability Distributions, The Gaussian or Normal Error Distribution, Method of Least Squares, the Correlation Coefficient, Multivariable Regression, Standard Deviation of the Mean, Graphical Analysis and Curve Fitting, Design of Experiments, Aliasing, Constructing Fractional Design, Taguchi's Design

Sensors and Transducers
Data Sampling, Signal Conditioning and Computer Data Acquisition. Error Response Characteristic of Sensors, Measurement Error

Measurement of Process Variables
Pressure Measurement: Dynamic Response, Dead Weight Pressure Tester, Bourdon Gauge; Low Pressure Measurement Techniques-the McLeod Gauge, Pirani Thermal Conductivity Gauge, Knudsen Gauge

Flow Measurement: Positive Displacement Methods, Flow Obstruction Methods, the Sonic Nozzle, Hot Wire and Hot Film Anemometer, Magnetic Flow Meter, Flow Visualization Method, LDA

Temperature Measurement: Temperature Scales, the Ideal Gas Thermometer, Temperature Measurement by Mechanical Effect, Electrical Effect, Radiation, Effect of Heat Transfer on Radiation, Transient Response of Thermal Systems, Thermocouples, and Temperature Measurement in High-Speed Flow

Measurement of Force, Torque and Power
Force Measurement: Platform Balance, Force to Displacement Conversion, Conversion of Force to Hydraulic Pressure, Piezoelectric Force Transducer

Measurement of torque and power: Torque Measurement: Electric Generator as a Dynamometer, Measurement of Rotational Speed

References

1. J. P. Holman, "Experimental methods for Engineers",McGraw-Hill.
2. R. S. Sirohi and H. C. Radha Krishna, "Mechanical Measurements", Wiley.

Syllabus for Comprehensive Test **Nikhil Singh**
Full Marks: 50 marks **P21ME005**

ME 511: Conduction and Radiation

Governing Equations

Basic modes of heat transfer, Heat transfer mechanisms, Governing laws, Reynolds Transport Theorem (RTT), Derivation of Energy Equation, Fourier's Law

Conductive Heat Transfer systems

Heat conduction equations in isotropic and anisotropic materials, Initial and boundary conditions, 1-D conduction problems without and with heat generation, Plane wall, hollow cylinder, composite tube, hollow sphere, Steady 2-D heat conduction problem, Problems in cylindrical and spherical coordinate system, Bounded 1-D domain, Slab with heat generation, Principle of superposition, Thermal Resistance, Transient Response, Semi-infinite solid, Polar co-ordinate (2-D), Time dependent BCs

Radiative Heat Transfer

Mechanism of energy transport in thermal radiation Divergence of radiative heat flux, Laws of radiation, View factor and solid angle, Radiation in presence of participating medium, Radiation transport equations (RTE), Radiative equilibrium

References:

1. F. P. Incropera & D.P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Willey & Sons
2. A. Bejan,"Convective Heat Transfer", John Wiley and Sons
3. K. Muralidhar and G. Biswas, "Advanced Engineering Fluid Mechanics", Narosa

Syllabus for Comprehensive Test
Full Marks: 50 marks

Nikhil Singh
P21ME005

ME 701: Measurement Systems in Mechanical Engineering

Experimental Objectives
Monitoring, Control and Research, Systems and Variables Identifications for Mechanical Systems, Planning of Instrumentations

Measurement Systems
Generalized Description of the Measurement System, Operational Description of the General Measurement System and Elimination Method of Interfering Inputs to the Desired Inputs, Null and Deflection Methods of Measurements, Analog and Digital Measurements, Order of Instruments and Calibration, Performance Characteristics, Frequency Response

Analysis of Experimental Data
Causes and Types of Experimental Errors, Error Analysis on a Common-Sense Bias, Uncertainty Analysis and Propagation of Uncertainty, Evaluation of Uncertainties for Complicated Data Reduction, Statistical Analysis of Experimental Data, Probability Distributions, The Gaussian or Normal Error Distribution, Method of Least Squares, the Correlation Coefficient, Multivariable Regression, Standard Deviation of the Mean, Graphical Analysis and Curve Fitting, Design of Experiments, Aliasing, Constructing Fractional Design, Taguchi's Design

Sensors and Transducers
Data Sampling, Signal Conditioning and Computer Data Acquisition. Error Response Characteristic of Sensors, Measurement Error

Measurement of Process Variables
Pressure Measurement: Dynamic Response, Dead Weight Pressure Tester, Bourdon Gauge; Low Pressure Measurement Techniques-the McLeod Gauge, Pirani Thermal Conductivity Gauge, Knudsen Gauge

Flow Measurement: Positive Displacement Methods, Flow Obstruction Methods, the Sonic Nozzle, Hot Wire and Hot Film Anemometer, Magnetic Flow Meter, Flow Visualization Method, LDA

Temperature Measurement: Temperature Scales, the Ideal Gas Thermometer, Temperature Measurement by Mechanical Effect, Electrical Effect, Radiation, Effect of Heat Transfer on Radiation, Transient Response of Thermal Systems, Thermocouples, and Temperature Measurement in High-Speed Flow

References

1. J. P. Holman, "Experimental methods for Engineers",McGraw-Hill.
2. R. S. Sirohi and H. C. Radha Krishna, "Mechanical Measurements", Wiley.

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: 02-03-2022

Department: Chemistry

1) Research/Specialization Group: 1

(Name of the Group: Stimuli-Responsive material)

Course Code & Course Name: CH 701, Analytical Methods in Chemistry

Syllabus Content

Separation Methods (Marks 40)

An introduction to chromatographic separations; gas chromatography: gas chromatographic columns and stationary phases, principles, and applications of gas-liquid chromatography; high performance liquid chromatography (HPLC); thin layer and column chromatography; ion-exchange chromatography; size-exclusion chromatography.

Thermal Methods (Marks 30)

Theory, instrumentation, and applications of thermogravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC), thermometric titrations.

Structure Elucidation (Marks 30)

Principles of UV-vis, IR, NMR and mass spectroscopy, structure elucidation of inorganic and organic molecules using spectroscopic methods

2) Research/Specialization Group: 2

Name of the Group: Organic Synthesis

Course Code & Course Name: CH 701, Analytical Methods in Chemistry

Syllabus Content

Separation Methods (Marks 40)

An introduction to chromatographic separations; gas chromatography: gas chromatographic columns and stationary phases, principles, and applications of gas-liquid chromatography; high performance liquid chromatography (HPLC); thin layer and column chromatography; ion-exchange chromatography; size-exclusion chromatography.

Thermal Methods (Marks 30)

Theory, instrumentation, and applications of thermogravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC), thermometric titrations.

Structure Elucidation (Marks 30)

Principles of UV-vis, IR, NMR and mass spectroscopy, structure elucidation of inorganic and organic molecules using spectroscopic methods

Signatures and Names of DRC Members:

1. _____ 16/2/2022
2. _____ 16/2/2022
3. _____ 15/2/22
4. _____ 15/2/22
5. _____
6. _____

14/2/2022

Signature of DRC Chairman