Syllabi for Comprehensive Examination of Eligible Ph. D Scholars

Department: Mechanical Engineering

1) Research/Specialization Group: 1

(Name of the Group): Thermal and Fluids Engineering

Syllabi for: P23ME001

ME 701- Measurement Systems in Mechanical Engineering [100 Marks]

Basic Measurement Systems
To study the generalized and operational description of the general description of the measurement system, elimination method of Interfering inputs to the desired inputs, null and deflection methods of measurements, analog and digital measurements, calibration, performance characteristics, and frequency response.

Analysis of Experimental Data
Measurements error and uncertainty analysis, design of experiments, order of instruments and calibration, performance characteristics, frequency response.

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, temperature measurement in high-speed flow.

Measurement of force, Torque and Power.
To study the Measurement of force, Torque and Power using techniques like platform balance, force to displacement conversion, conversion of force to hydraulic pressure, piezoelectric force transducer. Electric generator as a dynamometer, Measurement of rotational speed,

Displacement Measurement:
To study the displacement measurement methods using Electric/electronic and optical techniques of displacement measurement.

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

Department: Mechanical Engineering

1) Research/Specialization Group: 1

(Name of the Group): Thermal and Fluids Engineering

Syllabi for: P23ME002

ME502 - Convective Heat Transfer and Mass Transfer [25 Marks]

Introduction to Convection
Derivation of governing equations of momentum, energy and species transport, Order of magnitude analysis, Reynolds analogy.

Convective Heat Transfer in External and Internal Flows
Derivation of hydrodynamic and thermal boundary layer equations, Similarity solution techniques, Momentum and energy integral methods and their applications in flow over flat plates with low and high Prandtl number approximations. Introduction to turbulence, Reynolds averaging, Eddy viscosity and eddy thermal diffusivity. Concept of developing and fully developed flows.

Thermally Developing Flows
Graetz problem, Concept of thermally fully developed flow and its consequences under constant wall flux and constant wall temperature conditions, Steady forced convection in Hagen Poiseuille flow, Plane Poiseuille flow, and Couette flow and analytical evaluation of Nusselt numbers in limiting cases.

Free Convection
Free convection boundary layer equations: order of magnitude analysis, similarity solutions.

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. Y. Cengel& A. Ghajar, "Heat and Mass Transfer", McGraw Hill (India) Pvt. Ltd

ME511 - Conduction and Radiation [25 Marks]

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

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

ME 701- Measurement Systems in Mechanical Engineering [50 Marks]

Analysis of Experimental Data
Measurements error and uncertainty analysis, design of experiments, order of instruments and calibration, performance characteristics, frequency response.

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, 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)

Department: _Chemistry_

1) Research/Specialization Group: 1

(Name of the Group): Computational Chemistry

Course Code: CH 701 [Analytical Methods in Chemistry] [Marks 30]

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.

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

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.

Course Code: HS 710 [Research Methodology] [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

Research Methods and Approaches - Orientation to Basic Research Methods and Approaches; Research Methods; Research Approaches; Qualitative and Quantitative Research; Which Methods and Approaches to Choose? Current Trends in Research

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

Course Code: CY 531 & CY 536 [Chemical Kinetics & Computational Chemistry] [Marks 40]

Chemical Kinetics: Rate of reactions, kinetics and mechanism, rate laws, elementary reactions, consecutive reactions, steady state approximation, kinetic isotope effect, chain reactions, kinetics of gas phase reactions

Reaction Dynamics: Arrhenius theory; collision theory, activated complex theory, Concept of molecular dynamics: Phase space, number of states, density of states. Force field: bonded and non bonded interactions

Introduction to Programming Language in Scientific Computing: Elements of computational programming, basic program structure, data types, logical and arithmetic expressions, loops and control statements, arrays, input/output statements, format specifications, file processing, functions, subroutines and applications.

Numerical Methods: Curve fitting: least square fit algorithm. Newton-Raphson method, Bisection method. Numerical integration: Trapezoidal and Simpson's rules. Numerical differentiation: forward, backward and centred differencing. Gauss-Jordan elimination. Numerical solutions of ordinary differential equations using Euler, modified Euler and fourth order Runge-Kutta method.

Signatures and Names of DRC Members:

1. _____ **4.** _____

2. _____ **5.** _____

3. _____ **6.** _____

Signature of DRC Chairman

Date

Syllabi for Comprehensive Examination of Eligible Ph. D Scholars

Department: Mathematics

1) Research/Specialization Group: 1

(Name of the Group) Applied Mathematics

Course Code & Course Name: MA410: Fluid Mechanics

Syllabus Content: Description of flow fields, steady and unsteady flows, uniform and non-uniform flows, laminar and turbulent flows, Newtonian and non-Newtonian fluids; Lagrangian and Eulerian methods of description; streamlines, streak lines and path lines; velocity, acceleration and circulation; stream function, velocity potential and vorticity. Equation of continuity, Euler's equation of motion, Bernoulli's equation, momentum equation, integrals of Euler's equations of motion. Viscous Flows: Stress analysis in fluid motion, relations between stress and rate of strain, Couette flow, Hagen-Poiseuille flow, Navier-Stokes equations, diffusion of vorticity, dissipation of energy, steady motion of a viscous fluid between two parallel plates, steady flow through cylindrical pipes, Nondimensionalization of Navier-Stokes equation, Reynold's number, Concept of boundary layer.

Course Code & Course Name: MA406: Partial Differential Equations

Syllabus Content: Classification of second order equations, hyperbolic, parabolic and elliptic equations, linear second order equations with constant coefficients, reduction of second order liner PDEs into canonical forms. Parabolic differential equations, one dimensional diffusion equation, method of separation of variables. Hyperbolic differential equations, one dimensional wave equation, D'Alembert's Solution, solution of one-dimensional wave equation, initial boundary value problem of two-dimensional wave equation. Elliptic differential equations, two-dimensional Laplace's equation in rectangular coordinates.

Course Code & Course Name: MA534: Numerical Solutions to PDEs

Syllabus Content: Well posed PDE. Classification of second order PDE's, finite difference representation of derivatives. Solution of one-dimensional heat equation, forward time central space (FTCS), backward time central space (BTCS), Schmidt explicit method and Crank-Nicolson implicit method, convergence and von-Neumann stability analysis. Laplace equation and Poisson equation, five-point formula, successive over relaxation (SOR) method and the alternating direction implicit (ADI) scheme.

Course Code & Course Name: MA701: Advanced Engineering Mathematics

Syllabus Content: Vector Space over C, linear independence and basis, linear Transform and matrices, eigenvalues, orthogonality; Linear systems of algebraic equations, Gauss elimination, LU factorization, Pivoting. 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 for BVPs. Solution of PDEs: finite difference method.

Signatures and Names of DRC Members:

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

Signature of DRC Chairman

Date

Syllabi for Comprehensive Examination of Eligible Ph. D Scholars

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

Department: Physics

1) Research/Specialization Group: I

(Name of the Group) **Energy Harvesting and Devices**

Course Code & Course Name: **PH 701** Characterization Techniques and Non-equilibrium Thermodynamics, **PH 542** Science and Technology of Thin Film, **PH 505** Nuclaer and Particle Physics

Syllabus Content

Unit 1: 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). [50%]

Unit 2: 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. Physical Vapor Deposition Thermal, e-beam, pulsed laser and ion beam evaporation, glow discharge and plasma, sputtering - mechanisms and yield, dc and rf sputtering, bias sputtering, magnetically enhanced sputtering systems, reactive sputtering. [25%]

Unit 3: Deuteron, proton-proton and neutron-neutron interaction, properties of the nuclear force, exchange force model, shell model, even–Z, even-N nuclei and collective structure, realistic nuclear models. Yukawa's hypothesis, properties of mesons, symmetries and conservation laws, Standard model, particle classification, quark model, colored quarks, gluons and strong interaction. [25%]

2) Research/Specialization Group: II

(Name of the Group) **Smart Materials**

Course Code & Course Name: **PH 701** Characterization Techniques and Non-equilibrium Thermodynamics, **PH 503** Condensed Matter Physics

Syllabus Content

Unit 1: 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.

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). [75%]

Unit 2: Quantum theory of paramagnetism. Curie law, Hund's rules, Paramagnetism in rare earth and iron group ions, Ferromagnetism Curie-Weiss law, Antiferromagnetism, Ferrimagnetism, Basic of dielectrics, Mechanisms of electric polarization, Microscopic approach, Determination of local field, Analytical treatment of Polarizability, Effect of alternative field in dielectric materials, Frequency dependence of dielectric properties, Dipolar relaxation, Circuit models in dielectric and impedance analysis, Impedance spectroscopy, Dielectric Breakdown, and its basic mechanisms, Application of dielectric materials. Nonlinear Dielectric Property: Classification, Ferroelectric, Piezoelectric and Pyroelctric ceramics.[25%]

Signatures and Names of DRC Members:

1. _____ **4.** _____

2. _____ **5.** _____

3. _____ **6.** _____

Signature of DRC Chairman
Date

Syllabi for Comprehensive Examination of Eligible Ph. D Scholars

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

Department: Computer Science and Engineering

Date of Comprehensive Exam: 21st Feb, 2024

1) Research/Specialization Group: 1

(Name of the Group) : Computer Network & Security

1. **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.
2. **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.
3. **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.
4. **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.
5. **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
6. **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.

Signatures and Names of DRC Members:

1. _____ 29/1/2024
2. _____ 29/1/2024
3. _____ 29/01/24.
4. _____ 29/01/24.
5. _____
6. _____

Signature of DRC Chairman

Date 29/01/24

Syllabus for Comprehensive Examination of Eligible Ph.D. Scholar

(Only for the Courses relating to Research Domains)

Department: HS – Humanities and Social Sciences

1) Research/Specialization Group: 1 (All Areas of Humanities and Social Sciences)

Course Code & Course Name: HS701 – Interdisciplinarity in Humanities and Social Sciences

Syllabus Content:

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. Terms and Themes of Interdisciplinarity: Class, Ethics, Eurocentrism, Culture, Cyberculture, Gender, Identity, Representation, Ideology, Knowledge, Discourse, Language, Ontology, Paradigms, Power, Globalisation, Ethnicity, Race, Nation, Social Justice etc.

Course Code & Course Name: HS503 – Critical Literary Theories

Syllabus Content:

Intellectual Background, Importance of Literary Theory, Humanism, Structuralism, Post-structuralism, Postmodernism, Postcolonialism, Psychoanalysis, Feminism, Sexuality, Gender Studies, Queer Theory, Marxism, Stylistics, Narratology, Ecocriticism, Culture Studies etc.

Course Code & Course Name: HS504 – Approaches to Literary Research

Syllabus Content:

Importance of Approaches, Literary Criticism, Kinds of Approaches, Appreciating Literature, Interpreting Literature. Kinds of Approaches: Reader Based, Text Based, Context-Based, Interdisciplinary Approaches. Critical Approaches to Literature: Formalist, Biographical, Historical, Psychological, Mythological and Archetypal, Sociological, Gender, Reader-Response, Deconstructionist, Cultural Studies.

Signatures and Names of DRC Members:

1. _____ 25/1/24
   Dr. M. L. Patton

2. _____ 25/01/24
   Dr. S. Maity

Signature of DRC Chairman

Date: 25.01.2024