UNIVERSITY OF DELHI

CNC-II/093/1(23)/2022-23/458
Dated: 14.03.2023

N O T I F I C A T I O N

Sub: Amendment to Ordinance V

[E.C Resolution No. 38-1/ (38-1-10) dated 08.12.2022]

Following addition be made to Appendix-II-A to the Ordinance V (2-A) of the Ordinances of the University;

Add the following:

Syllabi of Semester-II of the B.Tech (Information Technology & Mathematical Innovations) under Cluster Innovation Centre based on Under Graduate Curriculum Framework -2022 to be implemented from the Academic Year 2022-23.

CLUSTER INNOVATION CENTRE

Category-I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

DISCIPLINE SPECIFIC CORE COURSE -4 (DSC-4): Engineering through Linear Algebra

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Engineering through Linear Algebra DSC-4	4	3	0	1	Class XII pass	Mathematics till XII

Learning Objectives

Almost, every area of modern science contains models where equations may be approximated by linear equations and linear algebra plays a vital role for finding their solution and interpreting them. This paper aims to enable the student to learn linear models for various physical problems such as traffic flow, electric-circuit flow etc. and to facilitate their solution using concepts of linear dependence, independence, rank, basis, eigenvalues, eigenvectors etc. This paper intends to provide geometrical interpretation of vectors, basis and vector operations

in 2 & 3 dimensions and lays the groundwork for a more abstract, pure-mathematical treatment of vector spaces. Also, the importance and application of eigenvalues, eigenvectors in computer graphics, face recognition and many other fields is taught. Students will also learn how to use MATLAB for some simple matrix operations, for finding eigenvalues & eigenvectors, rank etc.

Learning outcomes

After completing this course, student should be able to;

- Understand graphical representation of vector and their operations in 2 and 3 dimensions
- Solve linear matrix system AX=B
- Understand the concept of Eigen values and Eigen vectors and their applications in computer graphics, face recognition algorithms & many other fields
- Conceptualize vector spaces, subspaces and their basis functions
- Understand inner product spaces, orthogonal sets, projection and orthogonal diagonalisation
- Learn basic arithmetic operations of matrices in MATLAB
- Implement basic loops (for, while, if else etc) of programming in MATLAB
- Write their own programs for solving system of linear equations

SYLLABUS OF DSC-4

Unit I: (09 Hours)
Matrix Algebra
Algebra of matrices – Review of Determinants - Hermitian, Skew-Hermitian and Unitary matrices - Vectors and vector operations in 2 and 3 dimensions - Solution and application of linear matrix system AX = B

Unit II: (12 Hours)
Eigenvalues and Eigenvectors
Eigenvalues and eigenvectors, minimal polynomial, Cayley-Hamilton theorem and diagonalization

Unit III: (12 Hours)
Abstract vector spaces, subspaces
Finite dimensional vector spaces - Linear independence and dependence of vectors, bases, dimension of vector spaces - Finite dimensional inner product spaces

Unit IV: (12 Hours)
Orthogonality
Orthogonal sets and projections, Gram Schmidt process, orthogonal diagonalisation

Practical component – 30 Hours
Engineering Kitchen Activity (matrix based numerical mathematics software) [Laboratory]

- Basic arithmetic operations, hierarchy of arithmetic operations

- Declaration and assignment of variables
- Introduction to elementary mathematical functions
- Dealing with matrices and arrays
- Basic programming with loops (for, while, switch), if else statements
- Programs for solving system of linear equations, Orthogonalization
- Creating 2D, 3D plots
- Innovation project

Essential/recommended readings

1. *Linear Algebra and its Applications*, D. C. Lay, Addison Wesley, 2005.
2. *A Modern Introduction*, David Poole, *Linear Algebra,* Brooks Cole, 2011.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 5 (DSC-5): Data Structure and Design

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Data Structure and Design, DSC-5	**4**	**3**	**1**	**0**	**Class XII pass**	**DSC-3**

Learning Objectives

This course objective is to give an understanding of the real world data representation, organisation and structuring to the student while writing the programs and software. The course makes them familiar with the several types of data structures and their strengths and weaknesses, particularly in a real-world situation.

Learning outcomes

- Introduction to Data structure and their significance.
- Practical and theoretical understanding of Dynamic optimization
- Basics of Memory Hierarchy and implementation
- Understanding and implementation of Hashing, Networks and Graphs
- Understanding basics and practical aspects of Searching algorithms in the real world through implementation.
- Introduction and implementation of Heaps and Priority Queues and their comparison with other data structure

SYLLABUS OF DSC-5

Unit I: (12 Hours)
Program and data analysis
Introduction to Data structure, Basic concepts of Correctness, Efficiency and Application, Dynamic optimization Concept, Search Algorithms

Unit II: (12 Hours)
Data items arrangements and processing
Sorting Algorithms, Introduction to Linear Data Structures: Linked List, Stack and Queues

Unit III: (12 Hours)
Hierarchical arrangements and processing
Introduction to Hierarchical Data structure: Tree, Introduction to Heap, Priority Queues and Hashing

Unit IV: (09 Hours)
Network arrangements and analysis
Networks arrangements, Complex systems and real-world studies, Computational analysis

Practical component: 30 Hours
Engineering Kitchen Activity [Laboratory]:

- Implementation of Linked list in C/C++
- Implementation of Trees in C/C++
- Implementation of variant of Trees in C/C++
- Implementation of Heaps in C/C++
- Implementation of Hashing in C/C++
- Implementation of Priority Queues in C/C++
- Implementation of Graph and Network based approaches in C/C++
- Innovation Project

Essential/recommended readings

1. *Algorithms and Data Structures*, N. Wirth, Prentice-Hall of India, 2009
2. *Data Structures and Algorithms in C++,* A. Drozdek, Course Technology, 2013

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE– 6 (DSC-6): Object Oriented Programming

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Object Oriented Programming, DSC-6	4	3	0	1	Class XII pass	DSC-3

Learning Objectives

The objective is to implement real-world entities like inheritance, hiding, polymorphism etc. in programming. To learn how to bind together the data and the functions that operate on them so that no other part of the code can access this data except that function.

Learning outcomes

Upon Completion of this course the students will be able to:

- Recognise features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
- Use NetBeans, Eclipse, BlueJ as an Integrated Development Environment. Test a program and, if necessary, find mistakes in the program and correct them.
- Take a problem and develop the structures to represent objects and the algorithms to perform operations.
- Name and apply some object-oriented design patterns and give examples of their use.
- Apply standards and principles to write truly readable code.
- Design a class that serves as a program module or package.
- Design applications with an event-driven graphical user interface using java applets.
- Design different android applications such as web apps for the real-world problems.

SYLLABUS OF DSC-6

Unit I: (12 Hours)
Introduction to Java
Introduction to byte code, security and portability, Data Types, variables, operators, arrays, type conversion and casting, type promotion, Control statements, standard input-output, Designing Classes, constructors, methods. access specifiers - public, private, protected

Unit II: (12 Hours)
Classes and Objects
Introduction, Class revisited, constant objects and constructor, static data members with constructors and destructors, constructor overloading, nested classes, objects as arguments, returning objects, constant parameters and member functions, static data and member functions

Unit III: (12 Hours)
Inheritance, packages and interfaces and Exception Handling
Math, String, polymorphism - function overloading, function overriding, abstract classes, Dynamic objects - Introduction, array of objects, Exception types, nested try-catch, throw, throws and finally statements

Unit IV: (09 Hours)
Multi Thread Programming
Thread creation, synchronization and priorities

Practical component – 30 Hours
Engineering Kitchen Activities [Laboratory]

- Programs implying the use of Arrays, Linked Lists, Strings, Loops
- Programs on Object & Classes from Realistic Environment and Systems
- Programs demonstrating Constructors, Destructors, Methods & other concepts
- Programs Showcasing Inheritance, Polymorphism, Encapsulation & other OOPS features
- Programs on Exception Handling, Packages and Threading
- Reverse Engineering a Java Source/ project/Mobile Application and understanding the concepts
- Mapping the programs with Real life Systems and showcasing the implementation
- Innovation project

Essential/recommended readings

1. *Java: The Complete Reference*, 10th Edition. Herbert Schildt. McGraw-Hill, 2017.
2. *C++: The Complete Reference*, 4th Edition. Herbert Schildt. McGraw-Hill, 2012.
3. *Object Oriented Programming with C++,* 6th Edition. E Balagurusamy. Tata McGraw-Hill, 2001.
4. *C++ For Artists: The Art, Philosophy, and Science Of Object-Oriented Programming*. Rick Miller, Pulp Free Press, 2008
5. *Java For Artists: The Art, Philosophy, and Science Of Object-Oriented Programming*. Rick Miller , Pulp Free Press, 2008

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES

NOTE: The core papers offered in the B.Tech. Course at CIC are Mathematics and Information Technology. Therefore, the students will choose GE offered by Physics and Chemistry faculty members of CIC.

GENERIC ELECTIVES (GE-3): Engineering Physics II

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Engineering Physics II, GE-3	4	2	0	2	Class XII pass	Engineering Physics I, GE-1	Physics Faculty of CIC

Learning Objectives

This module intends to provide an understanding of the basics of electrostatics and electrodynamics. It emphasizes on learning of concepts of electric circuits, electromagnets and induction mechanism. Further it gives a day-to-day knowledge of transformers, motors and generators. Also, it provides learning of solar energy usage and its technology. The lab activities provide a hand on experiments on electricity and solar energy. It provides understanding of working of utility devices. It intends to promote projects on robotics and solar energy.

Learning outcomes

- Understanding of physics principles in devices.
- Ability to conceptualize and build electrical devices for real life use.
- Reverse engineering of electrical devices and redesigning of such objects.
- Practical hands-on skills and understanding of simple engineering concepts derived from Electricity & Magnetism.

SYLLABUS OF GE-3

Unit I: (12 Hours)
Electricity
Basics of Electrostatics and Electrodynamics - Electric Circuit elements and function - Current, voltage, capacitance, resistance - Power and efficiency in electrical appliances

Unit II: (12 Hours)
Electromagnetism basics
Joule heating - Electrical safety devices - Basics of Electromagnetism - Electromagnets and induction - Transformers. DC motors and generators

Unit III: (09 Hours)
Electromagnetism applications
AC motors - Using electromagnetic spectrum - Information transfer and broadcasting

Unit IV: (12 Hours)
Alternate Energy
Use of Radiation energy and appliances - Photovoltaic cells and conversion of solar energy to electricity - Advantages, limitations and challenges of different solar cell technologies - Different forms of renewable energy and technology.

Practical component – 30 Hours
Engineering Kitchen Activities [Laboratory]

- Electric circuit, power requirement, cost of electricity, energy efficiency of sample appliances
- Potential divider, measurement of resistances of different scales
- Build a buzzer
- Conversion of solar power to electricity using photovoltaic cells: design, working principle, performance, application
- Build an autonomous robot
- Build a remote-controlled robot
- Understanding physics of devices – one implementation of "Tod-Phod-Jod" concept.
- Innovation project – designing instruments, devices, model & prototyping

Essential/recommended readings

1. *Introduction to Electrodynamics.* David. J. Griffiths, PHI Learning, 2012
2. *Textbook of Electrical Technology* – Volume I & II. B. L. Thareja, and A. K. Thareja, S. Chand Publishing, 2006

GENERIC ELECTIVES (GE-4): Engineering Chemistry II

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Engineering Chemistry II, GE-4	4	2	0	2	Class XII pass	Engineering Chemistry I, GE-2	Chemistry Faculty of CIC

Learning Objectives

This course has an aim of making students aware of the structure and properties of engineering materials, polymers and composites, which are most commonly used around us for various applications daily. Also, an elaborative discussion will be done, on one of the most important constituents of life i.e. water, it's properties, types, analysis etc., so that aspects related to water

impurities and its different types of treatment methods become clear to them and they can further contribute towards the cause of providing this basic amenity to our society, as and when they get a chance, either by indulging themselves in research with academia or industry. At the end, students will be exposed to various characterization instrumentation techniques, through which they should be able to get a better understanding about various kinds of materials (biomolecules, drugs, nanomaterials etc.)

Learning outcomes

- Students will develop a good understanding about the engineering materials, polymers and composites which are used in our daily life.
- Knowledge about one of the basic amenities of life i.e. water will be enhanced, so that students can further contribute towards solving various related problems in due course of life.
- Further, through learning characterization techniques, students will be able to understand better about various kinds of materials like nanomaterials, drugs and biomolecules.

SYLLABUS OF GE-4

Unit-I. (12 Hours)
Engineering Materials, Polymers and composites
Glass, Ceramics, Magnetic materials, Classification, functionality, general properties and types of polymers; (addition polymerization, step polymerization, copolymerization) Different types of polymers; natural and synthetic polymers; Linear, branched and cross-linked polymers; Thermoplastic and thermosetting polymers, their applications; Plastics: Properties of Polyethylene Plastics; Vinyl Plastics, Nylons, Phenol-formaldehyde resins (Bakelite) and Glyptal; Speciality Polymers: Engineering thermoplastics, Conducting polymers, Electroluminescent polymers, liquid crystalline polymers and biodegradable polymers.

Unit-II. (12 Hours)
Analysis of Water
Analytical aspects of water: Sources, conservation of water, impurities in water and their effects. WHO guideline and BIS guideline for drinking water. Water quality standards, physical, chemical and biological characteristics; hardness of water, disadvantages of hardness, determination of hardness (EDTA method). Alkalinity and its determination; Boiler problems with hard water and their prevention: Municipal water supply – its treatment and disinfection using break -point chlorination. Desalination, Reverse Osmosis, Electrodialysis and defluoridation of water.

Unit-III. (12 Hours)
Material characterization Techniques
Spectroscopy, General features of spectroscopy, Discussion on various kinds of spectra obtained using various spectroscopic techniques like UV-Visible spectroscopy, Fourier-Transform Infra-red spectroscopy, Fluorescence spectroscopy, Circular Dichroism spectroscopy etc.

Unit-IV. (09 Hours)

Nanomaterials and their Characterization

Characterization of Nanomaterials using UV-Visible Absorption spectroscopy, Flourier transform Infra-red spectroscopy, Transmission electron microscopy (TEM), Scanning Electron Microscopy and FESEM etc.

Practical component – 30 Hours

1. Experimental demonstration of the synthesis of various types of polymers (like nylon, rayon fibre/ artificial silk etc.)
2. Molecular dynamics simulation of small molecules like water using softwares like LAAMPS
3. Demonstration of different experiments for determination of hardness of water
4. Interpretation and analysis of experimental data/ figures of various structures (biomolecules, and nano-structures) from some already published research papers/ reviews for understanding various spectroscopic and physicochemical techniques

Essential/recommended readings

1. Engineering Materials: Polymers, Ceramics and Composites, 2nd ed. Kindle Edition by A.K. Bhargava
2. Engineering Chemistry by O.G. Palanna, McGraw Hill, 2017.
3. Water Treatment (Hardness of Water) by Subodh Bhandarkar
4. Materials Science and Engineering: An Introduction, by Callister, 8th Edition, John Wiley and sons inc., Jan 2010.
5. Plastics Materials, Newness, Butterworths and Brydson, J.A., London, 1975
6. Spectroscopy and Characterization of Nanomaterials and Novel Materials: Experiments, Modelling, Simulations, and Applications, by Prabhakar Misra
7. Optical Properties and Spectroscopy of Nanomaterials, 2009 by Jin Zhong Zhang

B.A. (Honours) Humanities & Social Sciences

COURSE OFFERED BY CLUSTER INNOVATION CENTRE

Category II

DISCIPLINE SPECIFIC CORE COURSE - 4 (DSC-04): To be offered in Colleges of UoD

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
To be offered in Colleges of UoD (DSC-04)	4	As per the course structure of the respective disciplines				

DISCIPLINE SPECIFIC CORE COURSE - 5 (DSC-05): To be offered in Colleges of UoD

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
To be offered in Colleges of UoD (DSC-05)	4	As per the course structure of the respective disciplines				

DISCIPLINE SPECIFIC CORE COURSE – 6 (DSC-06): To be offered in Colleges of UoD

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
To be offered in Colleges of UoD (DSC-06)	4	As per the course structure of the respective disciplines				

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES

GENERIC ELECTIVES (GE-02A): To be offered in Colleges of UoD

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
To be offered in Colleges of UoD (DSC-02A)	4	As per the course structure of the respective disciplines					Faculty of concerned Dept.

GENERIC ELECTIVES (GE-02B): To be offered in Colleges of UoD

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
To be offered in Colleges of UoD (DSC-02B)	4	As per the course structure of the respective disciplines					Faculty of concerned Dept.

GENERIC ELECTIVES (GE-02C): To be offered in Colleges of UoD

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the Course
		Lecture	Tutorial	Practical/ Practice			
To be offered in Colleges of UoD (DSC-02B)	4	As per the course structure of the respective disciplines					Faculty of concerned Dept.

REGISTRAR