## Appendix-77 Resolution No. 38 {38-1 [38-1-10(1)]}

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## **CLUSTER INNOVATION CENTRE**

## **SEMESTER-II**

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## **CLUSTER INNOVATION CENTRE (CIC)**

## **Category I**

# CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

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

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

#### **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, puremathematical 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: (3 weeks)

## 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: (3 weeks)

#### **Eigenvalues and Eigenvectors**

Eigenvalues and eigenvectors, minimal polynomial, Cayley-Hamilton theorem and diagonalization

## Unit III: (4 weeks)

## 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: (4 weeks)

## Orthogonality

Orthogonal sets and projections, Gram Schmidt process, orthogonal diagonalisation

## Practical component –

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

## **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: (4 weeks)

## Program and data analysis

Introduction to Data structure, Basic concepts of Correctness, Efficiency and Application, Dynamic optimization Concept, Search Algorithms

## Unit II: (4 weeks)

## Data items arrangements and processing

Sorting Algorithms, Introduction to Linear Data Structures: Linked List, Stack and Queues

## Unit III: (3 Weeks)

## Hierarchical arrangements and processing

Introduction to Hierarchical Data structure: Tree, Introduction to Heap, Priority Queues and Hashing

## Unit IV: (3 weeks)

#### Network arrangements and analysis

Networks arrangements, Complex systems and real-world studies, Computational analysis

## Practical component:

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

## **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: (4 weeks)

## **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: (4 weeks)

## **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: (3 weeks)

## 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: (3 weeks) Multi Thread Programming

Thread creation, synchronization and priorities

## Practical component –

## **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, 10<sup>th</sup> Edition. Herbert Schildt. McGraw-Hill, 2017.
- C++: The Complete Reference, 4<sup>th</sup> Edition. Herbert Schildt. McGraw-Hill, 2012.
  Object Oriented Programming with C++, 6<sup>th</sup> 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 I

## Credit distribution, Eligibility and Pre-requisites of the Course

<b>Course title</b>	Credits	Credit	distributi	on of the	Eligibility	Pre-	Department
& Code			course		criteria	requisite of	offering the
		Lecture	Tutorial	Practical/		the course	course
				Practice			
Engineering	4	2	0	2	Class XII	Engineering	Physics
Physics II,					pass	Physics I,	Faculty of
GE-3						GE-1	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: (4 weeks)

## Electricity

Basics of Electrostatics and Electrodynamics - Electric Circuit elements and function - Current, voltage, capacitance, resistance - Power and efficiency in electrical appliances

## Unit II: (4 weeks)

## **Electromagnetism basics**

Joule heating - Electrical safety devices - Basics of Electromagnetism - Electromagnets and induction - Transformers. DC motors and generators

## Unit III: (3 weeks)

## **Electromagnetism applications**

AC motors - Using electromagnetic spectrum - Information transfer and broadcasting

## Unit IV: (3 weeks)

## **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 –

## 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	distributio	on of the	Eligibility criteria	Pre- requisite of	<b>Department</b> offering the
		Lecture	Tutorial	Practical/ Practice		the course	course
Engineering	4	2	0	2	Class XII	Engineering	Chemistry
Chemistry					pass	Chemistry	Faculty of
II,						I,	CIC
GE-4						GE-2	

## **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. (4 weeks)

## **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. (4 weeks) 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. (3 weeks)

## **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. (3 weeks)

## 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 –

- 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
		Lecture	Tutorial	Practical/ Practice		(if any)
To be offered in Colleges of UoD (DSC-04)	4	As per tl	he course	structure of	the respect	ive 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	Credits	Credit dis	tribution o	of the course	Eligibilit	Pre-requisite
& Code		Lecture	Tutorial	Practical/	у	of the course
				Practice	criteria	(if any)
To be	4	As per t	he course	structure of t	he respecti	ive disciplines
offered in						
Colleges of						
UoD (DSC-						
05)						

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

## **Credit distribution, Eligibility and Prerequisites of the Course**

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

## 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 &	Credit	Credit	distributi	ion of the	Eligibilit	Pre-	Departme			
Coue	5		course	-	y cincena	requisite	in oneing			
		Lectur	Tutoria	Practical/		of the	the course			
		е	1	Practice		course				
To be offered	4	As p	As per the course structure of the respective							
in Colleges of			disciplines							
UoD (DSC-							Dept.			
02A)										

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

## Credit distribution, Eligibility and Pre-requisites of the Course

Course title	&	Credits	Credi	t distributi course	ion of the	Eligibility criteria	Pre- requisite	Departmen t offering		
Code			Lectu	Tutorial	Practical/		of the	the course		
			re		Practice		course			
То	be	4	As	As per the course structure of the respective						
offered	in			disciplines						
Colleges								Dept.		
of Uo	οD									
(DSC-02E	3)									

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

## Credit distribution, Eligibility and Pre-requisites of the Course

Course	Credi	Credit distribution of the			Eligibility	Pre-	Department		
title &	ts		course	•	criteria	requisite	offering the		
Code		Lectur	Tutori	Practical/		of the	Course		
		е	al	Practice		course			
To be	4	As p	As per the course structure of the respective						
offered in				disciplir	nes		concerned		
Colleges							Dept.		
of UoD									
(DSC-02B)									