RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)

COMPUTER SCIENCE AND ENGINEERING

SEVENTH SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			**Total Credits**
				L	**T**	**P**	
1.	18HS71	Constitution of India and Professional Ethics	HSS	3	0	0	3
2.	18CS72	Computer Graphics and Virtual Reality (Theory and Practice)	CS	3	0	1	4
3.	18CS73	Parallel Architecture and Distributed Programming (Theory and Practice)	CS	3	1	1	5
4.	18CS74	Internship	CS	0	0	2	2
5.	18CS7FX	Elective F (PE)	CS	3	0	0	3
6.	18CS7GX	Elective G (PE)	CS	3	0	0	3
7.	18G7HXX	Elective H (OE)	Res. BOS	3	0	0	3
Total Number of Credits				**18**	**1**	**4**	**23**
Total number of Hours/Week				**18**	**2**	**10**	

EIGHT SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			**Total Credits**
				L	**T**	**P**	
1.	18CSP81	Major Project	CS	0	0	16	16
Total Number of Credits				**0**	**0**	**16**	**16**
Total number of Hours/Week						**32**	

VII Semester			
PROFESSIONAL ELECTIVES (GROUP F)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	18CS7F1	Linux Internals	03
2.	18CS7F2	An Introduction to Game Theory	03
3.	18CS7F3	Information Storage Management	03
4.	18CS7F4	Software Defined Networks (Common to CSE &ISE)	03
5.	18CS7F5	Introduction to Optimization Techniques	03

VII Semester			
PROFESSIONAL ELECTIVES (GROUP G)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	18CS7G1	Cyber Security for Industry 4.0	03
2.	18CS7G2	Application Delivery Controller and Virtualization **(Industry Offered)**	03
3.	18CS7G3	Fuzzy Graphs, Fuzzy Soft Sets and Petrinets	03
4.	18CS7G4	Computer Vision	03
5.	18IS7G5	Deep Learning (Common to CSE &ISE)	03

VII Semester				
OPEN ELECTIVES (GROUP H)				
Sl. No.	**Course Code**	**Host**	**Course Title**	**Credits**
1.	18XX7H1	AS		
2.	18XX7H2	BT		
3.	18XX7H3	CH		
4.	18G7H04	CS	Web Programming	03
5.	18XX7H5	CV		
6.	18XX7H6	EC		
7.	18XX7H7	EE		
8.	18XX7H8	EI		
9.	18XX7H9	ET		
10.	18XX7H10	IM		
11.	18XX7H11	IS		
12.	18XX7H12	ME		
13.	18XX7H13	PY		
14.	18XX7H14	CY		
15.	18XX7H15	MA		
16.	18XX7H16	HSS		
17.	18XX7H17	HSS		

Semester: VII						
COMPUTER GRAPHICS AND VIRTUAL REALITY (Theory and Practice)						
Course Code	**:**	**18CS72**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**39L+35P**		**SEE Duration**	**:**	**3 Hrs + 3 Hrs**

Course Learning Objectives: The students will be able to

1	Acquire the basic concepts of 2D and 3D graphics, underlying mathematical aspects and Algorithms such as Line drawing, Circle drawing, Polygon filling, Clipping and Transformations.
2	Understand and explore the concepts of Computer Graphics and Virtual reality using industry standard software OpenGL.
3	Design and Implement real time projects using OpenGL.
4	Develop problem solving skills using advanced rendering techniques.

Unit-I	**08 Hrs**
Introduction to Computer Graphics and Virtual Reality: Application areas of Computer Graphics, Introduction to Graphics Programming with OpenGL, The openGL API: Graphics Functions, The Graphics Pipeline and state Machines, The openGL Interface, Primitives and Attributes, Polygon Basics: polygon types in openGL, Attributes, Color, RGB Color, Indexed Color, Control Functions, The Three- Dimensional Sierpinski Gasket. Display Lists Definition and execution of display Lists, Programming. *Introduction to Virtual Reality:* The three I's of virtual reality, commercial VR technology and the five classic components of a VR system.	
Unit – II	**06 Hrs**
Input and Output Devices: Input and Interaction: Input Devices. Physical Input Devices, Logical Devices. Measure and trigger. Input Modes. Event-Driven Input: Using the pointing device, Window events, and Keyboard events. Menus. VR related Input Devices: Trackers, Navigation, and Gesture Interfaces VR related Output Devices: sound displays & haptic feedback	
Unit –III	**10 Hrs**
Raster graphics algorithms and Geometric Transformations: Points and lines, line drawing algorithms, mid-point circle, Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms. Cohen-Sutherland and Liang Barsky line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm. 3-D Geometrical Transformations: Translation, Scaling, Rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems, composite transformations.	
Unit –IV	**6 Hrs**
Viewing, Curves and Visible Surface Detection: Viewing pipeline: viewing coordinates, Aspect Ratio and view ports, view volume, 3-D clipping. Projections: Classification of planar geometric projections, Projections in openGL. Curves: Hermite, B-spline, Bezier, Visible surface detection: Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP-tree methods, area sub-division and octree methods.	
Unit –V	**6 Hrs**

Modelling in Virtual Reality:
Geometric modelling: Virtual Object Shape, Object Visual Appearance, Kinematics Modelling: Homogeneous Transformation Matrices, Object Position, Transformation Invariants, Object Hierarchies, Viewing the Three-Dimensional World, Physical Modelling: Collision Detection, Surface Deformation, Force Computation, Force Smoothing and Mapping, Haptic Texturing, Behaviour modelling

Laboratory Component

Implement the following programs in C/C++ with OpenGL Libraries:

1. **Write a program to generate a line using line drawing techniques** (DDA/ Bresenham's). Consider slopes greater than one and slopes less than one. User must able to draw as many lines and specify inputs through keyboard/mouse.
2. **Write a program to generate a circle and ellipse using Bresenham's circle drawing and ellipse drawing techniques.** Use two windows to draw circle in one window and ellipse in the other window. User can specify inputs through keyboard/mouse.
3. Write a program to **create a house like figure and perform the following operations.**
   i. Rotate it about a given fixed point using OpenGL transformation functions.
   ii. Reflect it about an axis y=mx+c using OpenGL transformation functions.
4. Write a program to **recursively subdivides a tetrahedron to form 3D Sierpinski gasket.** The number of recursive steps is to be specified at execution time.
5. Write a program to **demonstrate the approximation of a 3D sphere** with appropriate mathematical formulations. Write the complete C program to approximate a sphere using OpenGL primitives.
6. Develop a **menu driven program to fill any given 2D polygon using area filling algorithm** (Scan-line/ Boundary fill/ Flood Fill).
7. **Write a program to implement the line clipping algorithm (Liang-Barsky/Cohen Sutherland).** Make provision to specify the input for multiple lines, window for clipping and viewport for displaying the clipped image.
8. Write a program to **draw a color cube and allow the user to move the camera suitably to experiment with perspective viewing**. Use OpenGL functions.
9. Design and develop an Interactive Computer Graphics program using appropriate OpenGL transformation functions to perform the following operations (independently) on a (3D tetrahedron /3D Cube/ 3D Sphere):
   - orient tetrahedron with one mouse button (left button),
   - to translate it with a second (right button) and
   - zoom in and out with a third button (middle button).

   The output must be adjusted suitably when the window is resized or moved to a new position.
10. **Design and develop an OpenGL application program to create two windows.** Draw a rectangle of specified width and height by setting four different colors to its corners in the ***first window***. In the ***second window***, draw the same rectangle and spin it continuously. Use the double buffer concept.
11. Design and develop **C program using OpenGL libraries *to create two windows: display a cylinder in one window and parallelepiped in second window.***

    Note: Create a cylinder and a parallelepiped by extruding a circle and quadrilateral respectively.

12. **Design and develop a C program using OpenGL libraries with the following specifications to display a Line graph:**

    Write a procedure to display a line graph for any input set of data points in any selected area of the screen, with the input data set scaled to fit the selected screen area. Data points are to be displayed as asterisks joined with straight-line segments, and the *x* and *y* axes are to be labelled according to input specifications. (Instead of asterisks, small circles or some other symbols could be used to plot the data points /each plotted line is to be displayed in a different line style, width, and color.)

13. **Design and develop C program using OpenGL libraries with the following specifications to display a Pie chart:**

    Using a circle function, write a routine to display a pie chart with appropriate labeling. Input to the routine is to include a data set giving the distribution of the data over some set of intervals, the name of the pie chart, and the names of the intervals. Each section label is to be displayed outside the boundary of the pie chart near the corresponding pie section.

14. **Design and develop a C program using OpenGL libraries with the following specifications to display a bar graph:**

    Write a procedure to display two data sets defined over the same *x*-coordinate range, with the data values scaled to fit a specified region of the display screen. The bars for one of the data sets are to be displaced horizontally to produce an overlapping bar pattern for easy comparison of the two sets of data. Use a different color or a different fill pattern for the two sets of bars

Additional Programs

1. Write a program to create a chess board using DDA line algorithm.
2. Write a program to create a square /rectangle and rotate continuously. Use two windows to demonstrate single buffering and the double buffering.
3. Write a Program to create a wire frame model of globe using equation of ellipse.
4. Write a program to create (without using built in function) a cube by implementing translation algorithm by translating along (i) X-axis (ii) Y- axis and (iii) XY plane.
5. Write a Program to create (without using built-in function) and rotate (1. given angle, 2. around X and Y axis) a triangle by implementing rotation algorithm.
6. Write a Program to create (without using built-in function) a triangle by implementing scaling algorithm by zooming/un-zooming along (i) X axis (ii) Y axis (iii)XY plane.
7. Write a program to create (without using built-in function) a cube and implement reflection algorithm (i) X axis (ii) Y axis
8. Write a program to create (without using built-in function) a square and implement shear algorithm along (i) X axis (ii) Y axis
9. Write a program to animate a flag using Bezier curve algorithm.
10. Write a program to draw 2D object and perform translation, rotation and scaling transformations.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand and explore the basic concepts of Computer Graphics which illustrates the use of the pipeline architecture, OpenGL library.
CO2:	Analyze and make an appropriate choice of methods required for computer representation of 2D/3D objects.
CO3:	Analyze and make an appropriate choice of methods required for computer representation of 2D/3D objects.
CO4:	Implement common geometric construction techniques as a solution to engineering applications.

Reference Books	
1	Computer Graphics with OpenGL, Donald D. Hearn, M. Pauline Baker, Warren Carithers, 4th Edition, 2010, Pearson Education, ISBN-13: 978-0136053583.
2	Interactive Computer Graphics: A Top-Down Approach Using OpenGL, Edward Angel, 5th Edition, 2010, Pearson Education, ISBN: 978131725306.
3	Computer Graphics, Zhigang Xiang and Roy Plastock, 2nd Edition, 2007, ASIN: 0070601658, Tata McGraw-Hill, ISBN-13: 978-0070601659.
4	Burdea, G. C. and P. Coffet. Virtual Reality Technology, 2nd Edition. Wiley-IEEE Press, 2003/2006

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Scheme of Continuous Internal Evaluation (CIE); Practical Test for 50 Marks

The Laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average marks (AM) over number of weeks is considered for 30 marks. At the end of the semester a test (T) is conducted for 10 marks. The students are encouraged to implement additional innovative experiments (IE) in the lab and are rewarded for 10 marks. Total marks for the laboratory is 50.

Total CIE is 30(AM) +10 (T) +10 (IE) =50 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

Scheme of Semester End Examination (SEE); Practical Exam for 50 Marks

SEE for the practical courses will be based on experiment conduction with proper results, is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

Semester End Evaluation (SEE): Theory (100 Marks) + Practical (50 Marks) = Total 150 Marks

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**1**
CO2	**3**	**3**	**3**	**3**	**1**	**-**	**-**	**-**	**3**	**3**	**-**	**1**
CO3	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**1**
CO4	**3**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**3**	**2**	**-**	**1**

High-3: Medium-2 : Low-1

Semester: VII						
Parallel Architecture and Distributed Programming (Theory and Practice)						
Course Code	**:**	**18CS73**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:1:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**39L+26T+35P**		**SEE Duration**	**:**	**3 Hrs + 3 Hrs**

Course Learning Objectives: The students will be able to

1	To review the trends in parallelism programming.
2	To demonstrate the basic ideas of multiprocessing and parallel operations with case studies.
3	To focus on performance of different processor architectures.
4	To demonstrate parallel programming using OpemMP, MPI, OpenCL and CUDA.

Unit-I	**08 Hrs**
Fundamentals of computer design: Introduction; Defining computer architecture; Dependability, Measuring, reporting and summarizing Performance attributes; Quantitative Principles of computer design **Pipelining:** Introduction, pipeline hazards **Instruction level parallelism(ILP):** ILP basic concepts and challenges, basic complier techniques for exposing ILP, reducing branch costs with prediction, overcoming data hazards with dynamic scheduling, hardware based speculation. Exploiting ILP using multiple issues and static scheduling, Exploring ILP using dynamic scheduling, multiple issue and speculation.	
Unit – II	**08 Hrs**
Multiprocessors and Thread level parallelism: Introduction, Symmetric shared memory architectures; Performance of symmetric shared memory multiprocessors, Distributed shared memory and directory-based coherence, Basics of synchronization, Models of memory consistency.	
Unit –III	**08 Hrs**
Data-Level Parallelism in Vector, SIMD, and GPU Architectures: Introduction, Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, Detecting and Enhancing Loop-Level Parallelism, Introduction to CUDA: Data Parallelism, CUDA Program Structure, A Matrix-Matrix Multiplication Example, Device Memories and Data Transfer. Self-Study: Kernel Functions and Threading.	
Unit –IV	**08 Hrs**
Introduction to Parallel Programming: Principles of Parallel Algorithm design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for containing Interaction Overheads, Parallel Algorithms Models. **Programming Using the Using Message Passing Paradigm:** Principles of Message Passing Programming, Building Blocks, MPI, Collective Communication and computation operations, Groups and Communicators.	
Unit –V	**06 Hrs**
An Introduction to OpenCL: Background, Data Parallelism Model, Device Architecture Kernel Functions, Device Management and Kernel Launch, Electrostatic Potential Map in OpenCL	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explore the fundamentals of parallel architecture.
CO2:	Analyze the performance of parallel processors.
CO3:	Design parallel computing constructs for different applications.
CO4:	Demonstrate Parallel computing concepts for suitable applications.

Reference Books	
1	John L Hennessy, David A Patterson; "Computer Architecture: A Quantitative Approach", Elsevier, 5th Edition; 2011, ISBN: 9780123838728.
2	AnanthGrama, Anshul Gupta, George Karypis, VipinKumar : Introduction to Parallel Computing, Second Edition Pearson Education, 2013, ISBN 13: 9788131708071
3	David B Reference Books: Wen-mei W. Hwu, ―Programming Massively Parallel Processors on Approach‖, Second edition, Elsevier and nvidia publishers 2013, ISBN: 978-0-12-415992-1
4	CUDA Programming: A Developers Guide to Parallel Computing with GPUs, Shane Cook, First Edition, Morgan Kaufmann,2013, ISBN:9780124159334.

Laboratory

Students are supposed to execute the programs on computationally intensive algorithms like compression, decompression, encoding, decoding, encryption and decryptions using OpenMP, MPI, CUDA and OpenCL

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Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Scheme of Continuous Internal Evaluation (CIE); Practical Test for 50 Marks
The Laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average marks (AM) over number of weeks is considered for 30 marks. At the end of the semester a test (T) is conducted for 10 marks. The students are encouraged to implement additional innovative experiments (IE) in the lab and are rewarded for 10 marks. Total marks for the laboratory is 50.
Total CIE is 30(AM) +10 (T) +10 (IE) =50 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no

internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

Scheme of Semester End Examination (SEE); Practical Exam for 50 Marks
SEE for the practical courses will be based on experiment conduction with proper results, is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

Semester End Evaluation (SEE): Theory (100 Marks) + Practical (50 Marks) = Total 150 Marks

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**1**	**1**	**3**	**1**	**-**	**-**	**1**	**1**	**2**	**-**	**2**
CO2	**1**	**2**	**1**	**3**	**2**	**1**	**-**	**-**	**1**	**2**	**1**	**3**
CO3	**1**	**2**	**3**	**3**	**3**	**L**	**2**	**1**	**2**	**3**	**1**	**3**
CO4	**3**	**3**	**3**	**3**	**3**	**L**	**2**	**1**	**2**	**3**	**2**	**3**

High-3: Medium-2 : Low-1

Semester: VII						
Linux Internals **(Group F: Professional Elective)**						
Course Code	**:**	**18CS7F1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**38L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Reinforce the kernel level features of Linux operating system.
2	Develop and implement the system calls.
3	Gain knowledge about memory management techniques of the Linux OS.
4	Present an adequate programming environment in Linux OS.

Unit-I	**8 Hrs**
Introduction to the Linux Kernel History of Unix, Along Came Linus: Introduction to Linux, Overview of Operating Systems and Kernels, Linux Versus Classic Unix Kernels, Linux Kernel Versions, The Linux Kernel Development Community **Process Management** The Process, Process Descriptor and the Task Structure, Process Creation, The Linux Implementation of Threads, Process Termination.	
Unit – II	**8 Hrs**
Process Scheduling Multitasking, Linux's Process Scheduler, Policy, The Linux Scheduling Algorithm, The Linux Scheduling Implementation, Process Selection, Preemption and Context Switching, Real-Time Scheduling Policies, Scheduler-Related System Calls **System Calls** Communicating with the Kernel, APIs, POSIX, and the C Library, Syscalls, System Call Handler, System Call Implementation, System Call Context.	
Unit –III	**8 Hrs**
Interrupts and Interrupt Handlers Interrupts, Interrupt Handlers, Top Halves Versus Bottom Halves, Registering an Interrupt Handler, Writing an Interrupt Handler, Interrupt Context, Implementing Interrupt Handlers, /proc/interrupts, Interrupt Control. **Bottom Halves and Deferring work** Bottom Halves, A World of Bottom Halves, Softirqs, Tasklets, Work Queues, Which Bottom Half Should I Use?	
Unit –IV	**8 Hrs**
Memory Management Pages, Zones, Getting Pages, kmalloc() , vmalloc() , Slab Layer, Statically Allocating on the Stack, High Memory Mappings, Per-CPU Allocations, The New percpu Interface, Reasons for Using Per-CPU Data, Picking an Allocation Method. **The virtual File System** Common Filesystem Interface, Filesystem Abstraction Layer, Unix Filesystems	
Unit –V	**6 Hrs**
Kernel Synchronization Methods Atomic Operations, Spin Locks, Reader-Writer Spin Locks, Semaphores, Reader-Writer Semaphores, Mutexes, Completion Variables, BKL: The Big Kernel Lock	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand and Explore the fundamental concepts of Linux, kernel-level data-structure and Linux kernel development environments.
CO2:	Illustrate the use of data structures for process, memory, interrupt management and system calls within the Linux kernel
CO3:	Integrate the operating system concepts with relevant design issues associated with Linux kernel.
CO4:	Develop kernel modules using Linux Processes and Interrupt handling techniques with process synchronization.

Reference Books	
1	Robert Love; Linux Kernel Development; Pearson Education; 3rd Edition; 2010, ISBN8131758182.
2	M. Beck et.al ; Linux Kernel Programming; Pearson Education; 3rd Edition; 2002, ISBN-110-201-71975-4
3	Daniel Bovet ; Understanding the Linux Kernel, O'Reilly, 1st Edition, 2000, ISBN-10: 0596000022.
4	Michael kerrish; Linux Programming Interface; 1st Edition, 2010, ISBN-10159327220
5	Kivity, Avi, et al. "kvm: the Linux virtual machine monitor." Proceedings of the Linux symposium. Vol. 1. 2007.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	2	2	1	-	-	-	1	-	1	1
CO2	2	2	3	2	1	-	-	-	2	-	1	1
CO3	2	2	3	2	1	-	-	-	2	-	1	1
CO4	2	3	3	2	1	2	1	1	2	-	1	1

High-3: Medium-2: Low-1

Semester: VII						
AN INTRODUCTION TO GAME THEORY **(Group F: Professional Elective)**						
Course Code	**:**	**18CS7F2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**36L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Comprehend the basics of strategic gaming and mixed strategic equilibrium.
2	Enable students to develop skills on extensive gaming strategies.
3	Analyze and discuss various gaming models.
4	Illustrate some real time situations.

Unit-I	**8 Hrs**
Introduction to Strategic Games: What is game theory?, The theory of rational choice, Interacting decision makers, Strategic games; Examples: The prisoner's dilemma, Bach or Stravinsky, Matching pennies; Nash equilibrium; Examples of Nash equilibrium; Best response functions; Dominated actions; Cournot's model of oligopoly; Equilibrium in a single population: symmetric games and symmetric equilibrium	
Unit – II	**7 Hrs**
Mixed Strategy Equilibrium: Introduction; Strategic games in which players may randomize; Mixed strategy Nash equilibrium; Dominated actions; Pure equilibrium when randomization is allowed, Illustration: Expert Diagnosis; Equilibrium in a single population; The formation of players' beliefs; Extensions; Representing preferences by expected payoffs.	
Unit –III	**7 Hrs**
Extensive Games: Extensive games with perfect information; Strategies and outcomes; Nash equilibrium; Sub game perfect equilibrium; Finding sub game perfect equilibria of finite horizon games: Backward induction; Illustrations: The ultimatum game, Stackelberg's model of duopoly.	
Unit –IV	**7 Hrs**
Bayesian Games, Extensive Games with Imperfect Information: Motivational examples; General definitions; Two examples concerning information; Illustrations: Cournot's duopoly game with imperfect information, Providing a public good; Auctions: Auctions with an arbitrary distribution of valuations; Extensive games with imperfect information; Strategies.	
Unit –V	**7 Hrs**
Competitive and Iterated Games, Bargaining: Strictly Competitive Games, Evolutionary Equilibrium: Strictly competitive games and maximization; Case Study. Repeated games: The main idea; Preferences; Repeated games; Finitely and infinitely repeated Prisoner's dilemma; Strategies in an infinitely repeated Prisoner's dilemma; Nash equilibrium of an infinitely repeated Prisoner's dilemma, Nash equilibrium payoffs of an infinitely repeated Prisoner's dilemma, Bargaining.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Interpret the basics of strategic gaming and extensive games.
CO2:	Analyze gaming strategies on real-time incidence.
CO3:	Designing models of gaming on real-time incidence.
CO4:	Apply game theory in Economics, Political Science and Corporate world.

Reference Books	
1	An Introduction to Game Theory, Martin Osborne, Oxford University Press, First Indian Edition, 2009, 7th impression, ISBN – 0195128958.
2	Analysis of Conflict Game Theory, Roger B. Myerson, Re-print Edition, 2008, Harvard University Press, ISBN – 978-0674341166.
3	Introduction to Operations Research: Concepts and Cases, Frederick S. Hillier and Gerald J. Lieberman, 9th Edition; 2010, Tata McGraw Hill, ISBN – 0073376299.
4	An Introduction to Game Theory, Joel Watson; Strategy, 2nd Edition, 2007, W.W. Norton &Company, ISBN – 9780393929348.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	1	1	1	-	1	-	2	-	-	-	2
CO2	2	1	2	-	1	-	-	-	-	-	2	2
CO3	-	2	1	2		-	-	-	-	-	-	2
CO4	1	2	2	1	1	2	2	-	2	2	-	2

High-3: Medium-2: Low-1

Semester: VII						
INFORMATION STORAGE MANAGEMENT **(Group F: Professional Elective)**						
Course Code	**:**	**18CS7F3**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**36Hrs**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand storage architectures and key data center elements in classic, virtualized and cloud environments.
2	Understand storage networking technologies such as FC SAN, NAS.
3	Visualize storage virtualization functions in typical data center environment.
4	Articulate business continuity solutions such as backup, replication and archive for managing fixed content.

Unit-I	**06 Hrs**

Storage Fundamentals:

Computer system architecture: Memory Bandwidth requirements, Memory hierarchy of a computer system Hard Disk Drive (HDD): Disk geometry and Disk characteristics; Disk Access time and Disk performance parameters. Solid State Device (SSD): Flash Memory: NAND and NOR Organization, R/W performance of Flash memory. Array of Disks: Disk Reliability and different RAID Levels (0,1,2,3,4,5,6,1+0,0+1),RAID performance parameters, RAID Implementations Introduction to information storage: Information storage, Evolution of storage architecture, Data center infrastructure, Virtualization and Cloud Computing.

Unit – II	**08 Hrs**

File Systems and I/O Methods:

Unix file system as an example, Files and File descriptors, Virtual file system, and Local file system. Journaling Flash File System (JFFS) for SSDs: Wear level algorithm, Garbage collection. I/O Techniques: Polling, Interrupt, DMA and I/O Processors. Buses as data transporter: System Bus, I/O Bus, and PCI Bus protocol, SCSI Bus protocol and commands.

Network Attached Storage:

Network Attached Storage (NAS), NAS architectures and objectives, NAS File Server. Network File System protocol (NFS),Remote procedure call (RPC),NFS operation, NFS vs. CIFS (Common Internet File System) NFS performance issues, inconsistency

Unit –III	**08 Hrs**

Storage Applications:

Data Replication Technologies: Synchronous vs. Asynchronous, Application Layer, Logical Volume Manager based Replication, Hypervisor based replication, and Array based replication, Asynchronous Replication: Snapshot and Journal based replication, Replication Topologies: Three site cascade, Three site multi-target, Three site triangle.

Storage Virtualization:

SNIA shared storage model, Host based and Network based, Storage and Controller based virtualization, Capacity Optimization, Thin and Thick Provisioning, Compression, De-duplication, Storage Tiering

Unit –IV	**08 Hrs**

Storage Area Networks (SANs) :

Fibre Channel Protocol Stack, SAN vs. NAS, Protocol layers, Components, FC-SAN ports and connectivity, Fibre Channel SAN, FC-SAN topologies, Hardware Components of FC-SAN,FC-SAN Configurations and Traffic Management, SAN Addressing ,Zoning and Multi-pathing, Trunking and LUN Masking. IP-SAN Solutions :iSCSI SAN, iFCP SAN,FCIP SAN, Storage Traffic over Ethernet (FCoE)

Unit –V	06 Hrs
Backup and Recovery: Backup methods (Hot, Offline, LAN based, and SAN based) Backup types (Full, Incremental, Differential, Synthetic Application aware),Backup retention policies and Archiving, Network Data Management Protocol (NDMP) Capacity Management: Over provisioning, Trending, De-duplication and compression Performance Management: Latency and Response time, Performance Metrics Storage performance factors, Storage and the Cloud, Cloud storage model Data Durability and Consistency Model.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explore fundamentals of storage centric paradigm for large Data Centre.
CO2:	Analyze techniques used for data access and maintenance using different evolving technologies in SAN and NAS.
CO3:	Realize storage virtualization on different levels and backup/recovery processes.
CO4:	Evaluate various techniques used in intelligent storage systems.

Reference Books	
1	Storage Networking-Real World Skills for the CompTIA Storage+ Certification and Beyond by Nigel Poulton, Publishers, SYBEX a Wiley brand, 2015: ISBN-13 : 978-8126557677
2	Storage Networks Explained – by Ulf Troppens, Wolfgang Muller-Freidt, Rainer Wolafka, IBM Storage Software Development, Germany. Publishers: Wiley
3	Information storage and management- Somasundaram, Gnanasundaram, AlokShrivatsava, 2nd Edition, 2015, Wiley publishing ISBN 978-81-265-3750-1.
4	Storage Networks Explained – Ulf Troppens, Rainer Erkens and Wolfgang Muller, 2012, John Wiley & Sons, ISBN: 978-81-265-1832-6.
5	Storage Networks: The Complete Reference – Robert Spalding, 2003, Tata McGraw Hill, ISBN: 978-007224764.
6	Introduction to Storage Area Networks - Jon Tate, Pall Beck, Hector Hugo, Ibarra Shanmuganathan Kumaravel, Libor Miklas, 9th Edition , December 2017, IBM Redbooks, ISBN-13: 9780738442884.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**1**
CO2	**-**	**2**	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
CO3	**2**	**1**	**2**	**2**	**3**	**-**	**-**	**-**	**2**	**1**	**-**	**1**
CO4	**-**	**2**	**-**	**2**	**2**	**-**	**-**	**-**		**-**	**-**	**-**

High-3: Medium-2 : Low-1

Semester: VII						
SOFTWARE DEFINED NETWORKS **(Group F: Professional Elective)** **(Common to CS & IS)**						
Course Code	**:**	**18CS7F4**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**36L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Explore definitions, standards and protocols for Software defined Networks (SDN).
2	Understanding SDN framework through its constituent elements.
3	Design SDN applications using different controllers and network programmable switches.
4	Explore future of network programming through advances of SDN.

Unit-I	**07 Hrs**
Introduction : The Modern Data Center, Traditional Switch Architecture, Autonomous and Dynamic Forwarding Tables, Can We Increase the Packet-Forwarding IQ? Open Source and Technological Shifts. **Why SDN?** Evolution of Switches and Control Planes, Cost, SDN Implications for Research and Innovation, Data Center Innovation, Data Center Needs	
Unit – II	**08 Hrs**
The Genesis of SDN: The Evolution of Networking Technology, Forerunners of SDN, Software Defined Networking is Born, Sustaining SDN Interoperability, Legacy Mechanisms Evolve Toward SDN, Network Virtualization. **How SDN Works:** Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Methods	
Unit –III	**07 Hrs**
The OpenFlow Specification - OpenFlow Overview, OpenFlow 1.0 and OpenFlow Basics, OpenFlow 1.1 Additions, OpenFlow 1.2 Additions, OpenFlow 1.3 Additions, OpenFlow Limitations.	
Unit –IV	**07 Hrs**
SDN in the Data Center- Data Center Definition, Data Center Demands, Tunneling Technologies for the Data Center, Path Technologies in the Data Center, Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center, Open SDN versus Overlays in the Data Center, Real-World Data Center Implementations. **SDN in Other Environments -** Consistent Policy Configuration, Global Network View, Wide Area Networks, Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks.	
Unit –V	**07 Hrs**
SDN Applications- Reactive versus Proactive Applications, Reactive SDN Applications, Proactive SDN Applications, Analyzing Simple SDN Applications, A Simple Reactive Java Application, Background on Controllers, Using the Floodlight Controller, Using the Open Daylight Controller, Switch Considerations.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the fundamental definitions, standards and protocols for Software defined Networks (SDN)
CO2:	Explore network programmability through different components such as network programming switches and controller that develop into SDN framework
CO3:	Design network programmable applications using SDN frameworks
CO4:	Analyze the applicability of SDN for future network programmability.

Reference Books	
1	Software Defined Networks: A Comprehensive Approach, by Paul Goransson and Chuck Black, Morgan Kaufmann, June 2014, Print Book ISBN: 9780124166752, eBook ISBN : 9780124166844
2	SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media, August 2013, ISBN: 978-1-4493-4230-2, ISBN 10:1-4493-4230-2.
3	Network Innovation through OpenFlow and SDN: Principles and Design, Edited by Fei Hu, CRC Press, ISBN-10: 1466572094, 2014.
4	Software defined networks: Design and Deployment, Particia A. Morreale and James M. Anderson. CRC Press, 1st edition, December 2014, ISBN: 9781482238631

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	2	-	-	-	-	-	-	-	-	1
CO2	3	2	2	1	2	-	-	-	-	-	-	1
CO3	3	3	2	2	2	-	-	-	-	-	-	1
CO4	3	3	3	2	2	-	-	-	-	-	-	1

High-3: Medium-2 : Low-1

Semester: VII						
INTRODUCTION TO OPTIMIZATION TECHNIQUES (Group F: Professional Elective)						
Course Code	**:**	**18CS7F5**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able	
1	To explore the concepts of optimization techniques
2	To learn the modelling frameworks for solving problems using optimization techniques.
3	To design and develop optimization models for real life situations.
4	To generate solutions using optimization methods for a given problem.
5	To compare models developed using various optimization techniques

Unit-I	**08 Hrs**
Introduction: Optimization Research (OR) Methodology, Definition of OR, Application of OR to Engineering and Managerial problems, Features of OR models, Limitations of OR. **Linear Programming:** Definition, Mathematical Formulation, Standard Form, Solution Space, Types of solution – Feasible, Basic Feasible, Degenerate, Solution through Graphical Method. Problems on Product Mix, Blending, Marketing, Finance, Agriculture and Personnel.	
Unit – II	**08 Hrs**
Simplex methods: Variants of Simplex Algorithm – Use of Artificial Variables. Duality**,** Dual simplex method, Revised simplex method.	
Unit –III	**08 Hrs**
Transportation Problem: Formulation of Transportation Model, Basic Feasible Solution using North-West corner, Least Cost, Vogel's Approximation Method, Optimality Methods, Unbalanced Transportation Problem, Degeneracy in Transportation Problems, Variants in Transportation Problems. **Assignment Problem:** Formulation of the Assignment problem, solution method of assignment problem-Hungarian Method, Variants in assignment problem, Travelling Salesman Problem (TSP).	
Unit –IV	**07 Hrs**
Queuing Theory: Queuing system and their characteristics, The M/M/I Queuing system, Steady state performance analysing of M/M/1 queuing models. Introduction to M/M/C and $M/E_k/1$ queuing models.	
Unit –V	**08 Hrs**
Project Management Using Network Analysis: Network construction, determination of critical path and duration, floats. PERT- Estimation of project duration, variance. CPM - Elements of crashing, least cost project scheduling.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explore the various optimization models and their areas of application.
CO2:	Analyse various models through formulating and solving problems using optimization techniques
CO3:	Identify and apply the appropriate optimization techniques to solve real world problems
CO4:	Develop models and create design solutions for engineering systems through optimization techniques.

Reference Books	
1	Taha H A, Operation Research an Introduction, PHI, 8th Edition, 2009, ISBN: 0130488089.
2	J K Sharma, Operations Research Theory and Application, Pearson Education Pvt Ltd, 4th Edition, 2009, ISBN 13: 978-0-23-063885-3.
3	Hiller, Liberman, Nag, Basu, Introduction to Operation Research, Tata McGraw Hill 9th Edition, 2012, ISBN 13: 978-0-07-133346-7.
4	Philips, Ravindran and Solberg - Principles of Operations Research – Theory and Practice, John Wiley & Sons (Asia) Pte Ltd, 2nd Edition, 2000, ISBN 13: 978-81-265-1256-0.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	2	2	1	-	1	-	2	1	1	1	2
CO2	2	1	2	1	1	-	-	-	2	-	2	1
CO3	-	2	1	-	2	-	-	-	1	-	-	1
CO4	1	2	2	1	1	2	2	-	2	2	1	2

High-3: Medium-2: Low-1

Semester: VII						
CYBER SECURITY FOR INDUSTRY 4.0 **(Group G: Professional Elective)**						
Course Code	**:**	**18CS7G1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**36L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the basic concepts of cyber security and Industry 4.0.
2	Apply the concepts of security at system and network leves.
3	Demonstrate the understanding of system management and net work management through cryptographic and network security solutions.
4	Use concepts of Threat and Incident management by forensic investigation.

Unit-I	**6 Hrs**
Defining Cyberspace and Cybersecurity, The Value of Standards and Best Practices Documents, The Standard of Good Practice for Information Security, The ISO Suite of Information Security Standards, NIST Cybersecurity Framework and Security Documents, The CIS Critical Security Controls for Effective Cyber Defense, COBIT 5 for Information Security, Payment Card Industry Data Security Standard, ITU-T Security Documents, Effective Cybersecurity.	
Unit – II	**8 Hrs**
Industrial Internet: Security in Manufacturing, PLCs and DCS, Securing the OT, Network Level: Potential Security Issues, System Level: Potential Security Issues, Identity Access Management. Introducing Industry 4.0: Defining Industry 4.0, Why Industry 4.0 and why now?, Four main characteristics of Industry 4.0, The Value chain, Industry 4.0 design principles, Building Blocks of Industry 4.0.	
Unit –III	**8 Hrs**
System Management: Server Configuration, Virtual Servers, Network Storage Systems, Service Level Agreements, Performance and Capacity, Management, Backup, Change Management, System Management Best Practices. Network Communication: Network Management Concepts, Firewalls, Virtual Private Networks and IP Security, Security Considerations for Network Management, Electronic Communications, Network and Communications Best Practices.	
Unit –IV	**8 Hrs**
Technical Security Management: Security Architecture, Malware Protection Activities, Malware Protection Software, Identity and Access Management, Intrusion Detection, Information Leakage Protection, Digital Rights Management, Cryptographic Solutions, Cryptographic Key Management, Public Key Infrastructure.	
Unit –V	**6 Hrs**
Threat and Incident Management: Technical Vulnerability, Management, Security Event Logging, Security Event Management, Threat Intelligence, Cyber Attack Protection, Security Incident Management Framework, Security Incident Management Process, Emergency Fixes, Forensic Investigations, Threat and Incident Management, Best Practices.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	To understand the cybersecurity discipline and Industry 4.0
CO2:	To define security governance, assess risks and manage strategy and tactics
CO3:	To harden systems across the system development life cycle
CO4:	To mitigate security risks and attacks using security measures

Reference Books	
1	"Effective Cybersecurity", William Stallings, Pearson Education, 2019, ISBN-13:978-0-13-477280-6
2	"Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress)2. 2016, ISBN-13 (pbk): 978-1-4842-2046-7
3	Cyber security: The Essential Body of Knowledge, Dan Shoemaker, Ph.D., William Arthur Conklin, Wm Arthur Conklin, 2012 by cengage learning, ISBN13:978-1-4354-8169-5.
4	James Graham, Richard Howard, Ryan Olson- "Cyber Security Essentials" CRC Press, 2011by Taylor and Francis Group. ISBN13: 978-1-4398-5126-5.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	-	-	-	-	1	-	1
CO2	3	2	2	1	-	-	-	-	-	1	-	1
CO3	3	3	2	2	-	-	-	-	-	1	-	1
CO4	3	3	3	3	-	-	-	-	-	1	-	1

High-3: Medium-2 : Low-1

Semester: VII						
APPLICATION DELIVERY CONTROLLER AND VIRTUALIZATION **(Group G: Professional Elective)** **(Industry Offered)**						
Course Code	**:**	**18CS7G2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	:	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	:	**36L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1.	Understand the functionalities of various network functions.
2.	Analyze the design issues involved in load balancers, traffic management.
3.	Introduce students the concept of Application delivery controller.
4.	Illustrate the operation of cloud and virtualization.

Unit – I	**7Hrs.**
Load balancers: Concepts of L4 load balancing, Managing application delivery using load balancers, L7 Load balancing, Persistence methods, Health monitoring **ADC**: Introduction, Why ADC is needed and a brief introduction, How ADC is different from a legacy load balancer, Overview of broadened ADC use cases	
Unit – II	**8 Hrs.**
SSL details, SSL offloading and acceleration, Deployment models for Enterprise Apps, Deep Packet Inspection, Web Application Firewalls (WAF), Intrusion prevention system (IPS), Difference Between an IPS and WAF, Deployment modes for NSX.	
Unit – III	**7Hrs.**
Traffic Management: Core principles of traffic management, Multiprotocol Label Switching, DNS and global server load balancing,Content switching, AppQoE, TCP and SSL profiles, Introduction to Optimization and Security.	
Unit – IV	**7Hrs.**
Virtualization and Cloud: Why virtualizing ADCs is important, Essentials of virtualization and cloud computing, Cloud computing infrastructure,Public clouds like AWS, Azure & Google cloud, How to deliver Apps through Cloud and virtual data centers.	
Unit – V	**7Hrs.**
Micro services and Containers : Introduction to Micro services& Containers, Container Orchestration, Kubernetes, Monitoring, Logging & Tracing tools	

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Understand and explore the importance of various network functionalities like load balancer, offloading.
CO 2:	Identify the components of application delivery controller and its importance
CO 3:	Analyze the operation of internetwork and solve problems related to traffic management.
CO 4:	Investigate the relevance of virtualization and cloud in the present business scenario.

Reference Books:	
1.	Rick Roetenberg, Marius Sandbu, "Mastering NetScaler VPX", 2nd edition, Packt Publishing, ISBN: 978-1-78528-898-2
2.	Citrix ADC 13.0, Citrix Product Documentation dated May 28, 2021
3.	Citrix NetScaler Deployment Guide and Citrix whitepapers from Citrix website

4.	Deepak Vohra, "Kubernetes Microservices with Docker", ISBN-13: 978-1-4842-1906-5
5.	Instructor notes

Continuous Internal Evaluation (CIE); Theory (100 Marks)
CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.
Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)
SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**-**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	
CO2	**2**	**-**	**-**	**-**	**1**		**-**	**-**	**-**	**1**	**-**	**1**
CO3	**2**	**-**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**1**
CO4	**-**	**-**	**-**	**1**	**-**		**-**	**1**	**1**	**-**	**-**	

High-3: Medium-2: Low-1

Semester: VII						
FUZZY GRAPHS, FUZZY SOFT SETS AND PETRI NETS (Group G: Professional Elective)						
Course Code	**:**	**18CS7G3**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**36L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Learn basic skills of Fuzzy Graph Theory, Fuzzy sets, Fuzzy graphs in Database theory, Fuzzy Decision trees and Network Models using fuzzy graphs.
2	Analyze constructing the fuzzy graphs which gives the student a good insight into various topics like Trees, level cut, chords and eccentricity.
3	Know the Knowledge of different forms of fuzzy graphs, interval-valued fuzzy graphs and intuitionistic fuzzy graphs.
4	Investigate other forms of fuzzy graphs like Petri nets.

Unit-I	**8 Hrs**
Introduction to Fuzzy Graphs: Fuzzy graphs- partial fuzzy sub graphs, fuzzy sub graphs, weak isomorphism, co-weak isomorphism, isomorphism of fuzzy graphs, complement of a fuzzy graph, regular fuzzy graph and edge regular fuzzy graphs, Connectivity in Fuzzy Graphs: Path and connectedness, Connectivity in fuzzy graphs, Strong arcs, Bridges and cut vertices, Trees, Maximal Spanning tree, Fuzzy Spanning tree and cycles, Connectedness level, cut sets, fuzzy chords, fuzzy co trees, fuzzy twigs.	
Unit – II	**7 Hrs**
Operations and characterization in fuzzy graphs: Operations on fuzzy graphs: union, intersection, join, Cartesian product and composition, fuzzy line graphs, Fuzzy interval graphs, Edge connectivity, vertex connectivity, Eccentricity of fuzzy graph and density of fuzzy graph.	
Unit –III	**7 Hrs**
Applications of Fuzzy Graphs: Fuzzy node connectivity, Fuzzy arc connectivity, Cluster, cluster analysis, application to cluster analysis, fuzzy intersection equations, Intuitionistic fuzzy graph and properties of intuitionistic fuzzy graphs, Interval valued fuzzy graphs, Fuzzy graphs in Database theory**,** Fuzzy Decision trees, Network Models using fuzzy graphs.	
Unit –IV	**7 Hrs**
Theory of Fuzzy Soft Relations: Fuzzy Soft set Relations, Operations on Fuzzy Soft Set Relations, Properties of Fuzzy Soft set Relations and Composition of fuzzy Soft Set relation. **Introduction to Rough sets:** Definition of rough set, Approximations, Properties of approximations, Rough membership function, Reduct and core, Attribute dependency, Significance of attributes and approximate reducts.	
Unit –V	**7 Hrs**
Petri nets: Petri nets, Petri nets for Rule – Based Decision making, Introduction to Petri nets, firing rule, firing sequences and reachability, Behavioral properties of Petri nets, Analysis methods, Co-variability tree, reachability graph , Simple reduction rules, Characteristics of liveness and structural properties.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand and explore the concepts like fuzzy graph, connectivity, operations, rough sets and Petri nets.
CO2:	Demonstrate and analyze applications of various methodologies like cluster analysis and its applications by annualizing problems such as neural networks, database theory.
CO3:	Apply fuzzy graph theory to draw Petri nets to various engineering applications.
CO4:	Solve real world problems involving emerging technologies and multi-disciplinary tasks.

Reference Books	
1	Fuzzy graphs, Basics Concepts and Applications, S Mathew and M S Sunitha, 2012, Lambert Academic Publishing ISBN:978-3-659-21234-5.
2	Application to Petrinets-Thesis submitted by Bucket YILMAZ for degree of Master of Science-2008.
3	Fuzzy Graphs and Fuzzy Hypergraphs, J. N. Mordeson and P.S. Nair, Physica- Verlag, 2000, ISBN:3-7908-1286-2.
4	Fuzzy Discrete Structures, D.S. Malik and J.N. Mordeson, Physica – Verlag , 2000, ISBN:3790813257.
5	Modern Trends in Fuzzy Graph Theory, Pal, Madhumangal, Samanta, Sovan, Ghori, Ganesh, 2020, ISBN 978-981-15-8803-7
6	Research papers on Rough Sets by Pawlak

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	1	1	1	-	1	-	2	-	-	-	2
CO2	2	1	2	-	1	-	-	-	-	-	2	2
CO3	-	2	1	2		-	-	-	-	-	-	2
CO4	1	2	2	1	1	2	2	-	2	2	-	2

High-3: Medium-2: Low-1

Semester: VII						
COMPUTER VISION **(Group G: Professional Elective)**						
Course Code	**:**	**18CS7G4**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Acquire knowledge on problem solving skills in Computer Vision.
2	Select appropriate techniques or methods for Filtering, Segmenting, Recognition and classification.
3	Describe basic feature and applications of Computer Vision in real time applications.
4	Develop skills to work or carry out task on multi-disciplinary domains / projects.

Unit-I	**07 Hrs**
Geometric Camera Models: **Image Formation:** Pinhole Perspective, Weak perspective, Cameras with lenses; **Geometric Camera Calibration:** Linear approach to camera calibration, Non- Linear approach to camera calibration; **Light and Shading: Modeling Pixel brightness:** Reflection at surfaces, Sources and their effects, Lambertine aand Spectacular model, Area sources; **Inferences from shading:** Radiometric calibration and high dynamic range images, The Shape of Specularities , Inferring Lightness and Illumination, Photometric Stereo: Shape from Multiple Shaded Images.	
Unit – II	**08 Hrs**
Early vision: **Linear Filters:** Linear Filters and Convolution; Shift Invariant Linear Systems: Discrete Convolution, Continuous Convolution, Edge Effects in Discrete Convolution; Spatial Frequency and Fourier Transforms: Fourier Transforms; Sampling and Aliasing, Filters as Templates; **Stereopsis:** Binocular Camera Geometry and the Epipolar constraint- Epipolar geometry, The essential matrix , The fundamental matrix ; Binocular reconstruction : Image rectification.	
Unit –III	**08 Hrs**
Mid level Vision: Segmentation by clustering, Human Vision: Grouping and Gestalt; Important applications; Image Segmentations by Clustering pixels; Segmentation, Clustering, and Graphs. **Grouping and Model Fitting:** The Hough transform, Fitting lines and planes; Fitting Curved Structure; Robustness; Fitting using Probabilistic models; Motion Segmentation by Parameter estimation. **Tracking:** Simple Tracking strategies; Tracking using Matching; Tracking Linear dynamics models with Kalman filters.	
Unit –IV	**08 Hrs**
High level Vision: Registration; Model based Vision: Registering Rigid Objects; Registering deformable objects. **Classifying images:** Building good Image features; Classifying Images of Single Objects; Image Classification in practice.	
Unit –V	**08 Hrs**
Detecting Objects in Images: Sliding Window method; Detecting Deformable Objects; The State of the Art of Detection **Object recognition:** Basics of Object Recognition: Object Recognition System, Current Strategies, Categorization, Selection; Feature questions; Geometrical questions; Semantic questions.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explore and acquire knowledge on fundamentals of Computer Vision concepts.
CO2:	Analyze and interpret the inherent difficulties encountered in Computer Vision.
CO3:	Apply Computer Vision techniques to solve problems in the visible world around us.
CO4:	Investigate and draw inferences by processing Image in real time applications.

Reference Books	
1	Computer Vision: A Modern Approach, David Forsyth and Jean Ponce, 2nd edition, 2015, Pearson Education India, ISBN-10: 9332550115, ISBN-13 : 978-9332550117
2	Computer Vision: Algorithms and Applications, Richard Szeliski, Springer Verlag, 2013 Edition, ISBN-13: 978-1848829343, ebook :http://szeliski.org/Book/
3	Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, 4th Edition; 2018, Pearson Education, ISBN-10: 9353062985, ISBN-13: 978-9353062989

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**1**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**
CO2	**-**	**2**	**-**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**2**
CO3	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**2**
CO4	**2**	**1**	**-**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**-**	**2**

High-3: Medium-2 : Low-1

Semester: VII						
Deep Learning **(Group G: Professional Elective)** **(Common to CS & IS)**						
Course Code	**:**	**18IS7G5**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the basic concepts of neural networks and its variants
2	Use concepts of Convolutional Neural Networks to design computer vision applications
3	Demonstrate the understanding of Recurrent neural network in deploying sequence models
4	Discuss the features of autoencoders and their applications
5	Explore learning algorithms for deploying various deep learning models

Unit-I	**8 Hrs**
Neural Networks: What is a neural network, Models of a Neuron, Activation functions, Network Architectures, Knowledge representation, Learning Process. **Deep Feedforward Networks:** Multilayer Perceptron, Example: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation Algorithm	
Unit – II	**8 Hrs**
Convolutional Networks: Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the basic convolution function, Structured Outputs, Data types, Efficient Convolution Algorithms, Random or Unsupervised features, The Neuroscientific basis for convolutional networks.	
Unit –III	**8 Hrs**
Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, Echo State Networks, The Long Short-Term Memory and Other Gated RNNs	
Unit –IV	**8 Hrs**
Autoencoders: Undercomplete Autoencoders, Regularized Autoencoders, Representational Power, Layer Size and Depth, Stochastic Encoders and Decoders, Denoising Autoencoders, Contractive Auto encoders, Applications of Autoencoders	
Unit –V	**7 Hrs**
Pretrained models: Lenet, AlexNet, VGGNet, Densenet, Resnet, Improving Deep Neural Networks- Hyperparameter Tuning, Regularization and Optimization. Data Augmentation techniques. **Other Architectures:** Generative Adversarial Networks, Reinforcement Learning.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explain the concepts of neural network, its applications and various learning models
CO2:	Apply the knowledge of neural networks in Recurrent, Recursive Nets and Auto-encoder models
CO3:	Analyze different Network Architectures, learning tasks for various applications
CO4:	Evaluate and compare the solutions by various Neural Network approaches for a given problem

Reference Books	
1	Deep Learning (Adaptive Computation and Machine Learning Series), Ian Good Fellow, Yoshua Bengio and Aaron Courville, MIT Press (3 January 2017), ISBN-13: 978-0262035613.
2	Neural Networks and Learning Machines, Simon S. Haykin, 3rd Edition 2010, PHI Learning, ISBN- 9789332586253, 933258625X.
3	Introduction to Artificial Neural Networks, Gunjan Goswami, S.K. Kataria & Sons; 2012 Edition, ISBN-13: 978-9350142967.
4	Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, Nikhil Buduma, by O'Reilly Publications, 2016 Edition, ISBN-13: 978-1491925614.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and experiential learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.

Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	1	1	-	-	-	-	1	-	-
CO2	3	2	2	2	2	2	-	-	-	1	-	-
CO3	3	3	2	2	3	2	2	-	2	1	-	1
CO4	3	3	3	3	3	2	2	-	2	1	-	1

High-3: Medium-2 : Low-1

Semester: VII						
WEB PROGRAMMING **(Group B: Global Elective)**						
Course Code	**:**	**18G7H04**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**36**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the standard structure of HTML/XHTML and its differences.
2	Adapt HTML and CSS syntax & semantics to build web pages.
3	Learn the definitions and syntax of different web programming tools such as JavaScript, XML and Ajax to design web pages.
4	Design and develop interactive, client-side, server-side executable web applications using different techniques such as CSS, JavaScript, XML and Ajax.

Unit-I	**07 Hrs**
Introduction to Web, HTML and XHTML: Fundamentals of Web(Internet, WWW, Web Browsers and Web Servers, URLs, MIME, HTTP, Security, the Web Programmers Toolbox), XHTML: Basic syntax, Standard structure, Basic text markup, Images, Hypertext Links, Lists, Tables, Forms, Frames. **HTML 5:** Core HTML attributes, headings, paragraphs and breaks, quotations, preformatted text, lists, horizontal rules, block-level elements, text-level elements The audio Element; The video Element; Organization Elements; The time Element, Syntactic Differences between HTML and XHTML.	
Unit – II	**07 Hrs**
CSS (Cascading Style Sheet) Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images, The and tags, Conflict resolution. **The Basics of JavaScript:** Overview of JavaScript; Object orientation and JavaScript; General syntactic characteristics; Primitives, operations, and expressions; Screen output and keyboard input; Control statements.	
Unit –III	**07 Hrs**
JavaScript (continued): Object creation and modification; Arrays; Functions; Constructor; Pattern matching using regular expressions; Errors in scripts. **JavaScript and HTML Documents:** The JavaScript execution environment; The Document Object Model; Element access in JavaScript; Events and event handling; Handling events from the Body elements, Button elements, Text box and Password elements; The DOM 2 event model; The navigator object.	
Unit –IV	**08 Hrs**
Dynamic Documents with JavaScript: Introduction to dynamic documents; Positioning elements; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor; Reacting to a mouse click; Slow movement of elements; Dragging and dropping elements. **Introduction to PHP:** Origins and uses of PHP; overview of PHP; General syntactic characteristics; Primitives, Operations and Expressions; Output; Control statements; Arrays; Functions; Pattern Matching; Form Handling;Cookies; Session Tracking.	
Unit –V	**07 Hrs**

XML: Introduction; Syntax; Document structure; Document Type definitions; Namespaces; XML schemas; Displaying raw XML documents; Displaying XML documents with CSS; XSLT style sheets. **Ajax:** Overview of Ajax; Basics of Ajax: The Application; The Form Document; The Request Phase; The Response Document; The Receiver Phase.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the basic syntax and semantics of HTML/XHTML.
CO2:	Apply HTML/XHTML tags for designing static web pages and forms using Cascading Style Sheet.
CO3:	Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP and utilize the concepts of XML & Ajax to design dynamic web pages.
CO4:	Develop web based applications using PHP, XML and Ajax.

Reference Books	
1	Programming the World Wide Web – Robert W. Sebesta, 7th Edition, Pearson Education, 2013, ISBN-13:978-0132665810.
2	Web Programming Building Internet Applications – Chris Bates, 3rd Edition, Wiley India, 2006, ISBN: 978-81-265-1290-4.
3	Internet & World Wide Web How to H program – M. Deitel, P.J. Deitel, A. B. Goldberg, 3rd Edition, Pearson Education / PHI, 2004, ISBN-10: 0-130-89550-4
4	The Complete Reference to HTML and XHTML- Thomas A Powell, 4th Edition, Tata McGraw Hill, 2003, ISBN: 978-0-07-222942-4.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**-**	**2**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**
CO2	**-**	**-**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**
CO4	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**

High-3: Medium-2 : Low-1