M.Sc. (Computer Science)-I

Semester – II

Syllabus

(2022 Pattern)

w.e.f. A.Y.2022-23

M.Sc. (Computer Science)-I (Sem. II)

2019 Pattern		2022 Pattern	
Paper Title	**Paper Code**	**Paper Code**	**Paper Title**
Digital Image Processing	COMP4201	PSCS121	Digital Image Processing
Data Mining and Data Warehousing	COMP4202	PSCS122	Data Mining and Data Warehousing
Python Programming	COMP4203	PSCS123	Emerging Technologies: Python Programming
Advanced Operating System	COMP4204	PSCS124	Dot Net (Advanced): ASP.NET Core using MVC.
Lab Course on Python Programming & Advance Operating System	COMP4205	PSCS125	Lab course on Dot Net and Python
Project	COMP4206	PSCS126	Project
Artificial Intelligence	COMP4206	PSCS127(A) Or PSCS127(B)	Artificial Intelligence Or Advanced Operating System
Introduction to Cyber Security – I	CYS-101	CYS-102	Introduction to Cyber Security – II

Class: M.Sc. (Computer Science) Semester-II | Paper Code: PSCS121
Title of Paper: Digital Image Processing | Paper: I
Credit: 4 | No. of lectures:48

Course Objectives:

- To Understand and create an ability to use current techniques, skills, and tools necessary for computing practice.
- To provide a detailed approach towards image processing applications like enhancement, segmentation, and compression.

Course Outcomes:

- To study the image fundamentals and mathematical transforms necessary for image processing.
- To study the image enhancement techniques
- To study image restoration procedures.
- To study the image compression procedures

Unit No.	Contents	No. of Lectures
Unit – I	**Introduction to DIP** • Introduction to Digital Image Processing • The origins of Digital Image Processing • Examples of Fields that use Digital Image Processing • Gamma-Ray Imaging • X-Ray Imaging • Imaging in the Ultraviolet Band • Imaging in the Visible and Infrared Bands • Imaging in the Microwave Band • Imaging in the Radio Band	03
Unit – II	**Digital Image Fundamentals** • Motivation and Perspective, Applications • Components of Image Processing System • Fundamentals Steps in Image Processing, Image Sampling and Quantization • Some Basic Relationships like Neighbors, Connectivity, Distance Measures between pixels.	10
Unit – III	**Image Enhancement in the Spatial and Frequency Domain** • Image enhancement point and neighborhood processing, Basic Gray Level Transformation, Histogram Processing, Enhancement Using Arithmetic and Logic Operations, Zooming • Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters • Combining Spatial Enhancement Methods. • Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering.	10

Unit – IV	**Image Restoration** • Models of Image Degradation / Restoration Process, Noise Models, Restoration in presence of Noise using Spatial Filters • Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering • Constraint Least Square Filtering • Geometric Mean Filter and Geometric Transformations	08
Unit – V	**Image Segmentation and Morphological Image Processing** • Discontinuity based Segmentation, similarity-based segmentation • Edge linking and boundary detection • Threshold, Region based Segmentation • Introduction to Morphology, Dilation, Erosion • Some basic Morphological Algorithms	7
Unit – VI	**Object Representation and description** • Representation, Boundary Descriptors, Regional Descriptors, Chain Code, Structural Methods. • Different Application Areas of Digital Image Processing.	10

NOTE: Internal Evaluation of this Subject includes Case Studies on different application areas.
NOTE: 48 LECTURES FOR CURRICULUM (TEACHING) &12 LECTURES FOR LEARNING

Reference Books:

1) Rafael C. Gonzalez and Richard E. Woods, "Digital Image processing", 2Nd edition, Pearson Education.
2) David A. Forsyth, jean ponce, "computer Vision: A Modern Approach", Prentice Hall
3) A.K. Jain "Fundamental of Digital Image processing", PHI.
4) W.K Pratt, "Digital Image Processing"

Class: M.Sc. (Computer Science) (Semester – II) Paper Code: PSCS122

Title of Paper: Data Mining and Data Warehousing Paper: II

Credit: 4 No. of Lectures :60

Prerequisites:

- Basic Knowledge of databases handling.

Learning Objectives:

- To study different data preprocessing techniques.
- To introduce the core concepts of data warehousing techniques and implementation.
- To introduce the core concepts of data mining techniques and applications.
- To study advanced data mining techniques.
- To use data mining software on various data sets by using proper algorithms.

Learning Outcomes:

- Students will understand both the theoretical and practical aspects data mining.
- Understand basic data mining algorithms, methods, and tools
- Understand data mining principles and techniques:
- Understanding the basic concepts of OLAP.
- Understanding the basic concepts of Data Warehouse.

Unit	Title and Contents	No. of Lectures
Unit – I	**1. Data Preprocessing** 1) Introduction 2) Data Processing prerequisites 3) Data Objects and Attribute Types i) Attribute , ii) Nominal Attributes iii) Binary Attributes iv) Ordinal Attributes v) Numeric Attributes vi) Discrete Attributes vii) Continuous Attributes 4) Need for Preprocessing 5) Major Tasks in Data Preprocessing i) Data Cleaning ii) Data Integration iii) Data Reduction iv) Data Transformation v) Data Discretization 6) Missing Values 7) Noisy Data	**4**

Unit – II	**2. Introduction to Data Warehousing** 1) Introduction 2) Data Warehouse: Basic Concepts i) Datawarehouse definition ii) Comparison of OLTP and OLAP iii) Datamart 3) Metadata Repository 4) Architecture of Data Warehouse 1) Data Warehouse Models a) Enterprise Warehouse b) Data Mart c) Virtual Warehouse 2) Data Cube and OLAP i) Dimension ii) Fact iii) Measures iv) Dimension Table v) Fact Table vi) Data Cube vii) Cuboid, Apex Cuboid, Base Cuboid 3) OLAP operations 4) Dimensional Data Modeling a) Star Schema b) Snowflake Schema 5) Fact Constellation Schema	**7**
Unit – III	**3. Introduction to Data Mining** 1) Introduction 2) Data Mining : Basic Concepts 3) Knowledge Discovery in Databases Process 4) Data Mining Tasks i) Descriptive ii) Predictive 5) Data Mining Issues 6) Data Mining Metrics 7) Social Implications of Data Mining Applications of Data Mining	6
Unit – IV	**4. Data Mining Techniques** 1) Introduction 2) Frequent item-sets and association rule mining a) Itemset b) Frequent Pattern c) Support d) Confidence e) Downward-Closure Property f) Market Basket Analysis g) Horizontal Data format h) Vertical Data format 3) Apriori algorithm 4) FP-Tree algorithm 5) Graph Mining a) Frequent Sub-graph mining b) Apriori-based Approach	**8**

	c) Pattern growth Approach 6) Tree mining	
Unit - V	**5. Classification & Prediction** 1) Introduction 2) Decision Tree Learning i) Construction ii) Basic Decision Tree Algorithm iii) Performance iv) Attribute Selection v) Issues 3) Classification and Regression Tree(CART) 4) Bayesian Classification i) Bays Theorem ii) Navie Baysian Classfier iii) Bayesian Network iv) Inference v) Parameter Learning vi) Structure Learning 5) Linear Classification a) Least Squares b) Perceptron c) Support Vector Machine(SVM) 6) Prediction a) Linear Regression b) Nonlinear Regression	**8**
Unit – VI	**6. Accuracy Measures** 1) Introduction 2) Precision 3) Recall 4) F-measure 5) Confusion Matrix 6) Cross Validation 7) Bootstrap	4
Unit – VII	**7. Clustering** 1) Introduction 2) K-means 3) Expectation Maximization (EM) algorithm 4) Hierarchical clustering Correlation clustering	4
Unit – VIII	**8. Data Mining Trends and Research Frontiers** 1) Introduction 2) Text mining i) Text Mining Approaches ii) Text Mining Applications 3) Web Mining a) Web Mining Tasks b) Web Mining Applications 4) Basic introduction of Mining Sequence Data a) Mining of Time-Series Data b) Mining of Symbolic Sequences Data c) Mining of Biological Sequences Data	4

	d) Mining of Spatial Data e) Mining of Visual and Audio Data	
Unit – IX	**9. Software for data mining** 1) Introduction 2) The Explorer 3) The Knowledge flow interface 4) Experimenter 5) Command Line Interface 6) Decision Tree with the help of weka 7) Apriori Algorithm with the help of weka	**3**

NOTE: *48 Lecture for curriculum (teaching) &12 lectures for learning*

References :

1. Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber, Jian Pei, Elsevier MorganKaumann Publishers.
2. Introduction to data mining : Pang Ning Tan, Michael Steinbach, Vipin Kumar
3. The WEKA Workbench Eibe Frank, Mark A. Hall, and Ian H. Witten Online Appendix for "Data Mining: Practical Machine Learning Tools and Techniques" Morgan Kaufmann, Fourth Edition, 2016
4. [Research-Papers]: Some of the relevant research papers that contain recent results and developmentsin data mining field.

Class: M.Sc. (Computer Science) (Semester – II) Paper Code: PSCS123

Title of Paper: Emerging Technologies - Python Programming Paper: III

Credit : 4 No. of Lectures: 48

Prerequisites:

- To introduce various concepts of programming to the students using Python.
- Students should be able to apply the problem-solving skills using Python

Learning Objectives: Student successfully computing this course will be able

- To understand and gain the knowledge of the all types of programming.
- To understand and solve the functional and procedural problems.

Learning Outcomes:

- Students will understand all the important and beneficial concepts of Python Programming.
- Students will learn Practical implementation of Python Programming concepts

Units	Title and Contents	No. of Lectures
Unit -I	**Introduction to Python** • What can Python do? • Why Python? • Good to know • Python Syntax compared to other programming languages • Python Install • The print Statement • Comments • Python Data Structures & Data Types, Dictionary • String Operations in Python • Simple Input & Output • Simple Output Formatting • Operators in python • If Statement, Loop Statement, range, Break & Continue Statement	**10**
Unit -II	**Function and Modules** • Create your own functions • Functions Parameters • Variable Arguments • Scope of a Function • Function Documentations • Lambda Functions& map • n Exercise with functions • Create a Module • Standard Modules	**08**

Unit –III	**Python Exception and File Handling** • Errors • Exception handling with try • handling Multiple Exceptions • Writing your own Exception • File handling Modes • Reading Files • Writing& Appending to Files • Handling File Exceptions • The with statement	**08**
Unit -IV	**Python Classes** • Creating Classes • Instance Methods • Inheritance • Interface • Polymorphism • Exception Classes & Custom Exceptions • Constructor	**08**
Unit – V	**Threads ESSENTIAL** • Class and threads • Multi-threading • Synchronization • Treads Life cycle • use cases	**08**
Unit –VI	**Mail and Scheduler** • How to Send Mail • How to Send Mail with attachment • How to Schedule the mail	**06**

NOTE: 48 LECTURES FOR CURRICULUM (TEACHING) &12 LECTURES FOR LEARNING

Reference Books:

1. Introducing Python- Modern Computing in Simple Packages – Bill Lubanovic, O,,Reilly Publication
2. Beginning Python: From Novice to Professional, Magnus Lie Hetland, Apress
3. Practical Programming: An Introduction to Computer Science Using Python 3, Paul Gries, et al., Pragmatic Bookshelf, 2/E 2014
4. Introduction to Computer Science Using Python- Charles Dierbach, Wiley Publication Learning with Python ", Green Tea Press, 2002
5. E-Books : python_tutorial. pdf, python_book_01.pdf
6. Beginning Programming with Python for Dummies Paperback – John PaulMueller, 2015
7. A Beginner"s Python Tutorial: http://en.wikibooks.org/wiki/A Beginner%27s Python Tutorial.

Class**: M.Sc. (Computer Science) (Semester-II)** Paper Code: **PSCS124**

Title of Paper: **Dot Net (Advanced) – ASP.NET Core Using MVC** Paper: I**V**

Credit: **4** No. of lectures: **60**

Prerequisites –

- Knowledge of Dot.Net Framework.
- Familiarity with programming language C #.

LearningObjectives:

- ✓ Able to understand the ASP. NET Core,
- ✓ To Learn MVC Framework and use it with ASP.Net Code.

LearningOutcome:

- ✓ Ability to write the Web application using ASP.Net Core MVC.
- ✓ Able to code different web-based applications.

1.	**ASP.NET MVC** **a.** Pattern **b.** Environment Setup **c.** Getting Started **d.** Life Cycle	**06**
2.	**ASP.NET MVC - Databases** a) Validation b) Security c) Caching **d)** Razor **e)** Data Annotations	**10**
3.	**ASP.NET MVC - Web API** a) Scaffolding b) Bootstrap c) Unit Testing d) Deployment e) Self-hosting	**08**
4.	**Introduction to ASP.Net Core** a) Overview b) Environment Setup c) New Project d) Project Layout e) Project.Json f) Configuration g) Middleware h) Exceptions i) Static Files	**10**

5.	**ASP.NET Core - Routing** a) Attribute Routes b) Action Results c) Views d) Setup Entity Framework e) DBContext	**08**
6.	**ASP.NET Core - Razor View Start** a) Razor View Import b) Razor Tag Helpers c) Razor Edit Form d) Identity Overview **e)** Authorize Attribute	**06**

NOTE: 48 LECTURE FOR CURRICULUM (TEACHING) &12 LECTURES FOR LEARNING

ReferenceBooks:

1. Programming ASP.NET Core by Dino Esposito ,PHI LEARNING PVT. LTD. | MICROSOFT
2. ASP.NET Core for Jobseekers by Kemal Birer , bpb publication
3. Asp.Net Core Application Devlopment :: Building An Application In Four Sprints,David Paquette Simon James Chambers (Author) , PHI Learning
4. Learning ASP.NET Core MVC Programming (English, Paperback, RagupathiMugilan T. S.

Class: M.sc.(Computer science) (Semester-II) Paper Code: PSCS125
Title of Paper: Lab Course On Dot Net and Python Paper: V (Lab Course)
Credit:4 (3 Hr. Practical/week / batch) No. of Practicals:12

Learning Objectives:

- Student successfully computing this course will be able to understand and gain the knowledge of the Practical.
- To Understand and create an ability to use current techniques, skills, and tools necessary for Python and Dot Net Programming.

Learning Outcomes:

- Students will understand all the important and beneficial concepts of Python and Dot Net Programming.
- Students will learn Practical implementation of Python and Dot Net Programming (Advance).

Python Assignments	
Assignment 1	Basic python programs
Assignment 2	Tuples and sets
Assignment 3	Dictionary
Assignment 4	Functions
Assignment 5	Files and Directories
Assignment 6	Classes/objects
Assignment 7	Exception Handling
Assignment 8	Threads
Dot Net (Advanced) Assignments	
Assignment 1	Basic Programs
Assignment 2	Exceptions & Static Files
Assignment 3	Attribute Routes
Assignment 4	Results, Views, DB Context
Assignment 5	Razor View
Assignment 6	MVC Basic Programs
Assignment 7	MVC Databases
Assignment 8	MVC Web API

Class: M.Sc. (Computer science) (Semester-II) Paper Code: PSCS126
Title of Paper: Project Paper: VI (Lab Course)
Credit:4 (3 Hr. Practical/week/batch) No. of Practicals:12

Objectives:

- Provides students with an opportunity to develop understanding of the operations of a computer system and computer applications software.
- To develop the skill of using computer applications software for solving problems.

Outcomes:

- Applying Various Technologies.
- Create Solutions for real life problems.

Instructions for Project:

- The Project can be platform, language and technology independent.
- Project will be evaluated by the project guide weekly in the respective batch.
- Evaluation will be on the basis of project work, progress report, oral, results and documentation and demonstration.
- You should fill your status of project work on the progress report and get the signature of project guide regularly.
- Progress report should sharply focus how much time you have spent on specific task? You should keep all sign progress report.

Project will not be accepted, if progress report is not submitted and all the responsibilities remain with student. The format of Progress Report is:

Roll No. & Name of Student:	
Title of the Project:	
Project Guide Name:	

Sr. No.	**Date**	**Details of Project Work**	**Project Guide Sign (With Date)**
1			
2			
3			
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Head
Department of Computer Science

Class: M.Sc. (Computer Science) Semester-II Paper Code: PSCS127(A)

Title of Paper: Artificial Intelligence Paper: VII(A) Elective

Credit: 4 No. of lectures: 48

Learning Objectives:

- Understand and gain the knowledge of AI's fundamental concepts and methods.

Learning Outcome: On completion of the course, the students will be able to:

- Discuss the basic principles of AI towards problem solving.
- Differentiate between various AI techniques.
- Implement various AI techniques by applying it to various problems.

Units	Title and Contents	No. of Lectures
Unit–I	**Introduction to Artificial Intelligence** • About AI ✓ History of AI ✓ What is AI ✓ Goals of AI • Ethics and Privacy issues • AI & Society • AI & related fields • AI technique	**04**
Unit–II	**Problem, Problem Spaces & Heuristics Search Techniques** • State space search • Production Systems • Search & Control Strategies • Problem Characteristics • Issues in the design of search programs. • Additional Problems • Heuristics search technique • Generate and test algorithm • Hill climbing ✓ Simple hill climbing ✓ Steepest hill climbing • Simulated annealing • Best First Search(A*algorithm) • Problem Reduction(AND-OR-Graphs, AO*algorithm) • Constraint Satisfaction • Mean-Ends Analysis	**14**
Unit – III	**Knowledge Representation** • Knowledge representation and mapping • Approaches to knowledge representation • Types of knowledge • Propositional Logic • Predicate Logic(FOL)	**12**

	• Logic Programming using Prolog. • CNF • Resolution • Forward & Backward chaining system	
Unit - IV	**Slot & Filler Structures** • Weak Structure ✓ Semanticnetwork ✓ Frames • Strong Structure ✓ CD(conceptual dependency) ✓ Script • CYC(CYC Motivation, CYC)	**08**
Unit - V	**Concepts of Game Playing** • Introduction • Min-Max algorithm • Adding alpha-beta cutoff • Uncertainty Reasoning (Basic probability axioms, Baye's rule, Certainty theory, Bayesian classification, Dempster - Shafer Theory)	**04**
Unit – VI	**Natural Language Processing & Neural Network** • Introduction to NLP. • Stages in NLP • NLP models • Use cases of NLP. • Types of Artificial Neural network ✓ Feed forward ✓ Feedback • Deep Neural Network	**06**

Note: Mandatory study tour to AI related organization/Company.

References:

1. Eberhart, "Computational Intelligence", Elsevier, ISBN9788131217832
2. Nils J. Nilsson, "Artificial Intelligence: ANewSynthesis", Morgan Kaufmann Publishers, ISBN9788181471901.
3. Elaine Rich, Kevin Knight, "Artificial Intelligence", Third Edition, Tata McGraw Hill, 2017.
4. Dan Patterson, "Introduction to Artificial Intelligence and Expert System" , Prentice Hall of India Pvt. Ltd., 1997.
5. Wolfgang Ertel, "Introduction to Artificial Intelligence", Second Edition, Springer, 2017.
6. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education (India) Pvt. Ltd., 2013.

Class : M.Sc. I (Computer Science) (Semester – II) **Paper Code** : PSCS127(B)
Title of Paper : Advanced Operating System **Paper** : VII (Elective)
Credit : 4 **No. of Lectures** : 48

Prerequisites :

- Working knowledge of C programming.
- Basic Computer Architecture concepts.
- Basic algorithms and data structure concepts.

Learning Objectives :

- To teach Advanced Operating Systems Concepts using Unix/Linux and Windows.
- To implement a delicate balance between theory (covered in TextBook-2,3) and practical applications (covered in TextBook-1, 4).
- To study theoretical concepts of Advanced Operating Systems and implement those concepts using C language.
- To learn the programming interface to the Unix/Linux system - the system call interface.
- To understand functions and functional modules of Operating Systems.
- To learn the concepts underlying in the design and implementation of Operating Systems.
- To learn Windows Threads Management.

Learning Outcomes :

- Students will understand all the important and beneficial concepts of Advanced Operating Systems.
- Students will learn Practical implementation of Advanced Operating Systems concepts using C language.

Unit	Title and Contents	No. of Lectures
Unit - I	**Introduction to UNIX/Linux Kernel** • Introduction of an Operating System: Objectives of Operating System and Functions of O.S. • Unix as an Operating System: History and Architecture of Unix Operating System • Introduction to kernel, Types of kernels (monolithic, micro) • Concepts of Linux Programming • Files, Filesystem, Processes, Users and Groups Permissions • Signals & Inter-process Communication • System Programming: ➢ Foundation of System Programming ➢ System calls for I/O • User Perspective • Assumptions about Hardware	**03**

Unit - II	**File and Directory I/O** • Introduction to File and Directory • Buffer Headers • Structure of the Buffer Pool • Scenarios for retrieval of a buffer • Reading and Writing disk blocks • Inodes (Accessing inodes and Releasing inodes) • Structure of Regular File • Directories • Pipes & Dup • Mounting and Unmounting of File Systems • File Sharing • Atomic Operations : stat, fstat, lsat functions, file types, file access permissions • Ownership of new Files and Directories ➢ Functions : Access, umask. chmode, fchmode • Sticky Bit • Functions : chown, fchown, lchown • File Size • File Truncation • File Systems ➢ Functions : link, unlink, remove, rename ➢ symbolic links, Functions : symlink and readlink ➢ File Times and utime Function • Functions : mkdir and rmdir ➢ Reading Directories ➢ Functions : chdir, fchdir, getcwd • Advanced File I/O • Mapping Files into Memory • Advice for Normal File I/O • I/O Schedulers and I/O Performance • Files and their Metadata • Copying and Moving files • Out of Band Communication	**13**
	Process Environment, Process Control and Process Relationships • Introduction • Process States and transitions • Context of a Process • Process Creation • Process Termination • Process Control Block	

Unit - III	➢ Process Id ➢ Obtaining the Process ID and Parent Process ID ➢ Changing Size of the Process ➢ The Shell ➢ Running a New Process • Environment List ➢ Memory layout of a C program ➢ Functions : setjump() and longjump() ➢ Functions : getrlimit() and setrlimit() ➢ Rules for Changing the Resource Limits • System Functions • Launching and Waiting for a New Process • Race Conditions • Changing User IDs and Group IDs • Daemons • Process Scheduling • Classification of Process • Yielding the Processor • Threads • Process Priorities • Processor Affinity	**13**
Unit - IV	**Memory Management** • Introduction to Memory Management • Process Address Space ➢ Pages and Memory Regions • Allocating Dynamic Memory ➢ Allocating Arrays ➢ Resizing Allocation ➢ Freeing Dynamic Memory • Alignment • Data Segment • Anonymous Memory Mappings • Advanced Memory Allocation • Debugging Memory Allocations • Stack-Based Allocations • Choosing a Memory Allocation Mechanism • Manipulating Memory • Locking and Unlocking Memory • Locking Limits • Opportunistic Allocation • Swapping and Demand Paging • Disk Management	**10**

	➢ Disk Structure & Disk Scheduling algorithm ➢ Numerical exercise based on Disk algorithms ➢ Disk management ➢ RAID structure ➢ Disk performance issues	
Unit - V	**Signal Handling** • Introduction to Signal Handling • Signal Concepts and signal Function • Unreliable Signals • Interrupted system calls • Reentrant Functions and SIGCLD semantics • Reliable-Signal Terminology ad Semantic • Functions : kill() , raise() , alarm() , pause() • Process Blocking Signal Mask Using sigpromask() • Signal Sets • Retrieving Pending Signals • sigaction Function and Some More Functions • Nonlocal Braching • Advanced Signal Management • Sending a Signal with a Payload	**05**
Unit - VI	**Windows Thread Management** • Thread Internals: Birth of a Thread and Examining a Thread Activity • Worker Factory • Thread Scheduling ➢ Overview of Windows Scheduling API ➢ Priority Levels ➢ Windows API Function ➢ Relevant Tools ➢ Real Time Priorities ➢ Thread States ➢ Dispatcher Database ➢ Scheduling Scenarios ➢ Preemption • Context Switching ➢ Priority Boosts ➢ Job Objects	**04**

Note : 48 hours for theory lectures and 12 hours for internal assessment and learning.

References:

1. Silberschatz A. ,Galvin P.B. & Gagne G. (2008). *Operating System Concepts, 8th Edition.* Wiley.
2. Robert L.(2007). *Linux System Programming*. O'Reilly Media, Inc.
3. Russinovich M.E. & Soloman D.A. (2009). *Windows Internals*. Microsoft Press.
4. Bach M.J. .*The Design of the UNIX Operating System*. Prentice-Hall, Inc.Stevens W.R.
5. Rago S.A. .*Advanced Programming in the UNIX Environment*. Addison-Wesley.