ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M.E. COMPUTER SCIENCE AND ENGINEERING
(SPECIALIZATION IN OPERATIONS RESEARCH)
REGULATIONS – 2015
CHOICE BASED CREDIT SYSTEM

PROGRAM EDUCATIONAL OBJECTIVES:

1. Prepare students to review and understand foundational Concepts in Computer Science and Engineering
2. Empower students to critically analyze current trends and learn future issues from a system perspective at multiple levels of detail and abstraction
3. Enable students to apply the interaction between theory and practice for problem solving based on case studies
4. Enable students to pursue lifelong multidisciplinary learning as professional engineers and scientists to effectively communicate technical information, function effectively on teams, and apply computer engineering solutions and optimization techniques within a global, societal, and environmental context by solving the problem faced by the people to alleviate the society of hardship.

PROGRAM OUTCOMES:
Students will be able to:

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer based systems of varying complexity
b. Critically analyze problems which prove to be impediment to the development of society, identify and formulate solution by applying Operations Research and Computer Science and Engineering techniques considering current and future trends.
c. Acquire leadership and managerial capabilities in decision making, analysing the alterable and managing the assets
d. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, and sustainability.
e. Function effectively on teams to accomplish a common goal
f. Communicate effectively with a range of audiences and prepare technical documents and make effective oral presentations
g. Critically analyse existing literature in the area(s) of specialization and develop innovative and research oriented methodologies to tackle the identified gaps
h. Recognize the need for and possess an ability to engage in lifelong learning continuing professional development
i. Have ability to develop systems using software tools
j. Demonstrate the knowledge gained in the selected areas of Computer Engineering and Operations Research.

Mapping of Programme Educational Objectives with Programme Outcomes

A broad relation between the programme educational objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES									
	POa	POb	POc	POd	POe	POf	POg	POh	POi	POj
1.	√	√		√						
2.	√	√	√	√			√	√	√	√
3.	√	√	√	√		√	√	√	√	√
4.			√	√	√	√		√	√	√

			POa	POb	POc	POd	POe	POf	POg	POh	POi	POj
YEAR 1	SEM 1	Advanced Mathematics for Computing	√	√								
		Advanced Data Structures and Algorithms	√	√		√					√	
		Advanced Software Engineering	√	√	√							
		Advances in Operating System	√	√		√						
		Linear Programming and Applications	√	√	√	√			√	√		√
		Advanced Data Structures and Algorithms Lab	√	√		√					√	
		Professional Practices			√		√	√	√			
	SEM 2	Networking Technologies	√	√	√	√			√	√		√
		Machine Learning Techniques	√	√	√				√			√
		Non Liner programming	√	√	√				√			√
		Advanced Database Management Systems	√	√	√	√	√					√
		Elective I										
		Elective II										
		Advanced Database Management Systems Lab	√	√	√	√	√				√	√
YEAR 2	SEM 3	Project Management With PERT/CPM	√	√	√	√	√	√	√			√
		Elective III										
		Elective IV										
		Elective V										
		Project Work Phase I	√	√		√		√			√	√
	SEM 4	Project Work Phase II	√	√		√		√			√	√

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CURRICULA AND SYLLABI

I SEMESTER

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7153	Advanced Mathematics for Computing	FC	4	4	0	0	4
2.	CP7151	Advanced Data Structures and Algorithms	PC	3	3	0	0	3
3.	CP7152	Advanced Software Engineering	PC	3	3	0	0	3
4.	CP7153	Advances in Operating Systems	PC	3	3	0	0	3
5.	SO7102	Linear Programming and Applications	PC	3	3	0	2	4
PRACTICALS								
6.	CP7161	Advanced Data Structures and Algorithms Lab	PC	4	0	0	4	2
7.	CP7162	Professional Practices	EEC	2	0	0	2	1
			TOTAL	**22**	**16**	**0**	**8**	**20**

II SEMESTER

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CP7155	Networking Technologies	PC	3	3	0	0	3
2.	CP7253	Machine Learning Techniques	PC	5	3	0	2	4
3.	SO7301	Non Linear Programming	PC	3	3	0	2	4
4.	SO7251	Advanced Databases Management Systems	PC	3	3	0	0	3
5.		Elective I	PE	3	3	0	0	3
6.		Elective II	PE	3	3	0	0	3
PRACTICALS								
7.	SO7211	Advanced Databases Management Systems Lab	PC	4	0	0	4	2
			TOTAL	**24**	**18**	**0**	**8**	**22**

III SEMESTER

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	OR7301	Project Management with PERT/CPM	PC	3	3	0	2	4
2.		Elective III	PE	3	3	0	0	3
3.		Elective IV	PE	3	3	0	0	3
4.		Elective V	PE	3	3	0	0	3
PRACTICALS								
5.	OR7311	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**24**	**12**	**0**	**14**	**19**

IV SEMESTER

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	OR7411	Project Work Phase II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 73

(Project work must be carried out in the area of Specialization)

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CURRICULAM AND SYLLABI (PART TIME)

I SEMESTER

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7153	Advanced Mathematics for Computing	FC	4	4	0	0	4
2.	CP7151	Advanced Data Structures and Algorithms	PC	3	3	0	0	3
3.	SO7102	Linear Programming and Applications	PC	3	3	0	2	4
PRACTICALS								
4.	CP7161	Advanced Data Structures and Algorithms Lab	PC	4	0	0	4	2
			TOTAL	**14**	**10**	**0**	**6**	**13**

IISEMESTER

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CP7155	Networking Technologies	PC	3	3	0	0	3
2.	SO7301	Non Linear Programming	PC	3	3	0	2	4
3.	SO7251	Advanced Database Management Systems	PC	3	3	0	0	3
PRACTICALS								
4.	SO7211	Advanced Database Management Systems Lab	PC	4	0	0	4	2
			TOTAL	**13**	**9**	**0**	**6**	**12**

III SEMESTER

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CP7153	Advances in Operating Systems	PC	3	3	0	0	3
2.	OR7301	Project Management With PERT/CPM	PC	3	3	0	2	4
3.		Elective I	PE	3	3	0	0	3
PRACTICALS								
4.	CP7162	Professional Practices	EEC	2	0	0	2	1
			TOTAL	**11**	**9**	**0**	**2**	**11**

IV SEMESTER

SL NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	CP7253	Machine Learning Techniques	PC	5	3	0	2	4
2.		Elective II	PE	3	3	0	0	3
3.		Elective III	PE	3	3	0	0	3
			TOTAL	**11**	**9**	**0**	**2**	**10**

V SEMESTER

SL NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	CP7152	Advanced Software Engineering	PC	3	3	0	0	3
2.		Elective IV	PE	3	3	0	0	3
3.		Elective V	PE	3	3	0	0	3
PRACTICALS								
4.	OR7311	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**21**	**9**	**0**	**12**	**15**

VI SEMESTER

SL NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	OR7411	Project Work Phase II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 73

FOUNDATION COURSES (FC)

SL NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA7153	Advanced Mathematics for Computing	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP7151	Advanced Data Structures and Algorithms	PC	3	3	0	0	3
2.	CP7152	Advanced Software Engineering	PC	3	3	0	0	3
3.	CP7153	Advances in Operating System	PC	3	3	0	0	3
4.	OR7101	Linear Programming and applications	PC	3	3	0	2	4
5.	CP7161	Advanced Data Structures and Algorithms Lab	PC	4	0	0	4	2
6.	CP7155	Networking Technologies	PC	3	3	0	0	3
7.	CP7253	Machine Learning Techniques	PC	2	3	0	2	4
8.	OR7201	Non Linear Programming	PC	3	3	0	2	4
9.	SO7251	Advanced Database Management Systems	PC	3	3	0	0	3
10.	SO7211	Advanced Database Management Systems Lab	PC	4	0	0	4	2
11.	OR7301	Project Management With PERT/CPM	PC	3	3	0	2	4

PROFESSIONAL ELECTIVES (PE)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP7071	Adhoc and Wireless Sensor Networks	PE	3	3	0	0	3
2.	CP7077	Database Administration and Tuning	PE	3	3	0	0	3
3.	CP7080	Ethical Hacking	PE	3	3	0	0	3
4.	CP7081	Fault Tolerant Systems	PE	3	3	0	0	3
6.	CP7084	Models of Computations	PE	3	3	0	0	3
7.	CP7087	Parallel Algorithms	PE	3	3	0	0	3
8.	CP7088	Parallel and Distributed Databases	PE	3	3	0	0	3

9.	CP7089	Real Time Systems Design	PE	3	3	0	0	3
10.	CP7090	Secure Network System Design	PE	3	3	0	0	3
11.	CP7091	Service Oriented Architecture and Design	PE	3	3	0	0	3
12.	CP7095	Virtualization Techniques and Applications	PE	3	3	0	0	3
13.	CP7252	Compiler Optimization Techniques	PE	3	3	0	0	3
14.	IF7004	Building Internet of Things	PE	3	3	0	0	3
15.	IF7071	Bio Informatics	PE	3	3	0	0	3
16.	IF7202	Data Science and Analytics	PE	5	3	2	0	4
OPERATIONS RESEARCH ELECTIVES								
17.	SO7004	Dynamic Programming	PE	3	3	0	0	3
18.	SO7002	Business Process Management	PE	3	3	0	0	3
19.	SO7008	System Modelling and Simulation	PE	3	3	0	0	3
20.	SO7103	Principles of Systems Engineering	PE	3	3	0	0	3
21.	SO7201	Supply Chain Management	PE	3	3	0	0	3
22.	OR7001	Python Programming for Operations Research Applications	PE	3	3	0	0	3
23.	OR7002	Statistical Quality Control	PE	3	3	0	0	3
24.	OR7003	Scheduling Algorithms	PE	3	3	0	0	3
25.	SO7003	Design Patterns	PE	3	3	0	0	3
26.	OR7004	Java Programming and Operations Research Applications	PE	3	3	0	0	3

A minimum of 3 of 5 electives have to necessarily be chosen from the list of “Operations Research Electives”

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP7162	Professional Practices	EEC	2	0	0	2	1
2.	OR7311	Project Work Phase I	EEC	12	0	0	12	6
3.	OR7411	Project Work Phase II	EEC	24	0	0	24	12

Project work must be carried out in the area of Operations Research.

MA7153 ADVANCED MATHEMATICS FOR COMPUTING L T P C
4 0 0 4

OBJECTIVES:

- To understand the basics of random variables and standard distributions
- To understand the arrival process and various queueing and server models
- To appreciate the use of simulation techniques
- To apply testing of hypothesis to infer outcome of experiments
- To apply mathematical linear programming techniques to solve constrained problems.

UNIT I RANDOM VARIABLES 12

Random variables – Bernoulli, Binomial, Geometric, Poisson, Uniform, Exponential, Erlang and Normal distributions – Function of a Random variable - Moments, Moment generating function.

UNIT II QUEUING MODELS 12

Poisson Process – Markovian Queues – Single and Multi-server Models – Little's formula – Machine Interference Model – Steady State analysis – Self Service Queue.

UNIT III SIMULATION 12

Discrete Event Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to Queuing systems.

UNIT IV TESTING OF HYPOTHESIS 12

Sampling distributions – Estimation of parameters - Statistical hypothesis – Tests based on Normal, t, Chi-square and F distributions for mean, variance and proportion.

UNIT V LINEAR PROGRAMMING 12

Formulation – Graphical solution – Simplex method – Two phase method -Transportation and Assignment Problems.

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, the student will be able to

- Identify the type of random variable and distribution for a given operational conditions/scene
- Study and Design appropriate queuing model for a given problem/system situation
- Simulate appropriate application/distribution problems
- Differentiate/infer the merit of sampling tests.
- Formulate and find optimal solution in the real life optimizing/allocation/assignment problems involving conditions and resource constraints.

REFERENCES:

1. Johnson, R.A. Miller and Freund's," Probability and Statistical for Engineers, Prentice Hall of India Pvt., Ltd., New Delhi, Seventh Edition, 2005.
2. Hamdy A. Taha, "Operations Research: An Introduction", Prentice Hall of India Pvt., Ltd. New Delhi, Eighth Edition, 2007.
3. Jay L. Devore," Probability and Statistics for Engineering and the Sciences", Cengage Learning, Seventh Edition, 2009.
4. Ross. S.M., "Probability Models for Computer Science", Academic Press, 2002.
5. Winston, W.L., "Operations Research", Thomson – Brooks/Cole, Fourth Edition, 2003.
6. Gross D. and Harris C.M., "Fundamentals of Queuing Theory", John Wiley and Sons, New York, 1998.
7. J.Medhi," Stochastic models of Queuing Theory", Academic Press, Elsevier, Amsterdam, 2003

CP7151 ADVACNED DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To extend the students' knowledge of algorithms and data structures
- To enhance their expertise in algorithmic analysis and algorithm design techniques.
- To learn a variety of useful algorithms and techniques
- To extrapolate from them in order to apply those algorithms and techniques to solve problems

UNIT I FUNDAMENTALS **9**

Mathematical Proof Techniques: Induction, proof by contradiction, direct proofs – Asymptotic Notations – Properties of Big-oh Notation –Conditional Asymptotic Notation – Algorithm Analysis – Amortized Analysis – Introduction to NP-Completeness/NP-Hard – Recurrence Equations – Solving Recurrence Equations – Time-Space Tradeoff.

UNIT II HEAP STRUCTURES **9**

Min/Max heaps – Deaps – Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps – Lazy-Binomial Heaps

UNIT III SEARCH STRUCTURES **9**

Binary Search Trees – AVL Trees – Red-Black trees – Multi-way Search Trees –B-Trees – Splay Trees – Tries.

UNIT IV GEOMETRIC ALGORITHMS **9**

Segment Trees – 1-Dimensional Range Searching – k-d Trees – Line Segment Intersection – Convex Hulls – Computing the Overlay of Two Subdivisions – Range Trees – Voronoi Diagram

UNIT V PARALLEL ALGORITHMS **9**

Flynn's Classifications – List Ranking – Prefix computation – Array Max – Sorting on EREW PRAM – Sorting on Mesh and Butterfly – Prefix sum on Mesh and Butterfly – Sum on mesh and butterfly – Matrix Multiplication – Data Distribution on EREW, Mesh and Butterfly

TOTAL : 45 PERIODS

OUTCOMES

Upon completion of this course, the student should be able to

- Have a basic ability to analyze algorithms and to determine algorithm correctness and time efficiency
- Master a variety of advanced data structures and their implementations and different algorithm design techniques in computational geometry and in parallel algorithms
- Apply and implement the learnt algorithm design techniques and data structures to solve problems

REFERENCES

1. Ellis Horowitz, SartajSahni, Dinesh Mehta, "Fundamentals of Data Structures in C", Silicon Pr, 2007.
2. Gilles Brassard, Paul Bratley, "Algorithmics: Theory and Practice", Prentice Hall, 1988.
3. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, "Computational Geometry Algorithms and Applications", Third Edition, 2008.
4. J.A. Storer, "An Introduction to Data Structures and Algorithms", Birkhäuser Boston, 2002.
5. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", MIT Press, 2009

CP7152 ADVANCED SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To comprehend software development process and formal specifications
- To know advanced software development techniques and its application in real world context
- To understand how to manage complex projects
- To use advanced software testing techniques
- To understand process improvement and re-engineering

UNIT I SOFTWARE ENGINEERING PROCESS AND FORMAL METHODS 9

Software Process models – Software Life Cycle – Development Activities – Managing Software Development – Unified Modeling Language – Requirement elicitation and specification – Understanding formal methods – motivation for formal methods – informal requirements to formal specifications – validating formal specifications – Overview of Z specification

UNIT II AGILE AND ASPECT ORIENTED SOFTWARE ENGINEERING 9

Agile Development: Agility – agile principles- Extreme Programming -– Agile process models – Agile modeling – Agile unified Process – tools set for agile process – Complex Projects: SCRUM – basics, SCRUM Process, Development using SCRUM – Aspect Oriented Software Development: Aspect-Orientation in the Software Lifecycle – Generic Aspect-Oriented Design with UML – Modeling for Aspect-Oriented Software Development-Developing Secure Applications Through Aspect-Oriented Programming.

UNIT III COMPONENT-BASED SOFTWARE ENGINEERING 9

Engineering of component-based systems, the CBSE process – Designing class based components – component design for WebApps – Component-based development – Component-level design patterns – Classifying and retrieving components, and economics of CBSE.

UNIT IV ADVANCED SOFTWARE TESTING TECHNIQUES 9

Software Review – Testing Strategies - Testing Conventional Applications – Testing Object-Oriented Applications – Testing Web Applications – Formal Modeling and verification – Metrics : Product, process, project, testing and quality metrics – Software Test Automation

UNIT V SOFTWARE PROCESS IMPROVEMENT AND REENGINEERING 9

SPI process – CMMI – SPI frameworks – SPI Trends – Emerging trends ion Software Engineering – identifying soft trends – Technology directions – Tool-related trends – Software Maintenance and Reengineering: software reengineering, reverse reengineering, restructuring, forward reengineering.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Analytically apply general principles of software development in the development of complex software and software- intensive systems
- Discuss methods and techniques for advanced software development and also to be able to use these in various development situations
- Apply testing techniques for object oriented software and web-based systems

REFERENCES:

1. Roger S. Pressman, “Software Engineering – A Practioner’s Approach”, MC Graw Hill, 7th edition, 2009.
2. Ian Sommerville, “Software Engineering”, Addison-Wesley 9th Edition, 2010
3. Bernd Bruegge, Allen H. Dutoit, "Object-Oriented Software Engineering", Prentice Hall, Third Edition, 2009.
4. Robert E. Filman, TzillaElrad, Siobhán Clarke, Mehmet Aksit, “Aspect-Oriented Software Development”, Addison-Wesley Professional, 2004.
5. Renu Rajni, Pradeep Oak, “Software Testing: Effective Methods, Tools and Techniques”, Tata McGraw Hill, 2004.
6. Jonathan Bowen, "Formal Specification and Documentation using Z - A Case Study Approach", Intl Thomson Computer Pr, 1996.
7. Antoni Diller, “Z: An Introduction to Formal Methods”, Wiley, 1994.
8. James Shore, Shane Warden “The Art of Agile Development - Pragmatic guide to agile software development”, O'Reilly Media, October 2007.
9. Ken Schwaber, “Agile Project Management with SCRUM”, Microsoft Press, 2004.

CP7153	ADVANCES IN OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of distributed systems
- To get an insight into the various issues and solutions in distributed operating systems
- To learn about mobile and real-time operating systems
- To gain knowledge on the design concepts of mainframe operating systems

UNIT I BASICS OF OPERATING SYSTEMS **9**

Overview – Synchronization Mechanisms – Processes and Threads – Process Deadlocks – Issues in Distributed Operating Systems – Communication Primitives – Limitations of a Distributed System

UNIT II DISTRIBUTED OPERATING SYSTEMS **9**

Lamport’s Logical Clocks – Vector Clocks – Causal Ordering of Messages – Distributed Mutual Exclusion Algorithms – Centralized, Distributed and Hierarchical Deadlock Detection Algorithms – Agreement Protocols

UNIT III DISTRIBUTED RESOURCE MANAGEMENT **9**

Distributed File Systems – Design Issues – Google File System – Hadoop Distributed File System – Distributed Shared Memory – Algorithms for Implementing Distributed Shared Memory – Load Distributed Algorithms – Issues in Task Migration – Synchronous and Asynchronous Check Pointing and Recovery – Fault Tolerance – Two-Phase Commit Protocol – Nonblocking Commit Protocol

UNIT IV MOBILE AND REAL TIME OPERATING SYSTEMS **9**

Basic Model of Real Time Systems – Characteristics – Applications of Real Time Systems – Real Time Task Scheduling – Handling Resource Sharing. Mobile Operating Systems – Architecture – Layers – Microkernel Design – Kernel Extensions – Processes and Threads – Memory Management – File system – Android – iOS

UNIT V MAINFRAME AND LINUX OPERATING SYSTEMS 9

Mainframe – z/OS – Overview of z/OS Facilities – Virtual Storage and other Mainframe Concepts – Workload Management – I/O and Data Management – Supervising the Execution of Work in the System – Cross-memory Services – Characteristics of z/OS. Linux – Design Principles – Kernel Modules – Process Management – Scheduling – Memory Management – I/O Management – File System – Interprocess Communication

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Demonstrate the various protocols of distributed operating systems
- Identify the different features of mobile and real-time operating systems
- Discuss the various features of mainframe operating systems

REFERENCES:

1. Mukesh Singhal, Niranjan Shivaratri, “Advanced Concepts in Operating Systems – Distributed, Database and Multiprocessor Operating Systems”, Tata McGraw-Hill, 2001.
2. Rajib Mall, “Real-Time Systems: Theory and Practice”, Prentice Hall, 2006.
3. Neil Smyth, “iPhone iOS 4 Development Essentials – Xcode”, Payload Media, Fourth Edition, 2011.
4. Nikolay Elenkov, “Android Security Internals: An In-Depth Guide to Android’s Security Architecture”, No Starch Press, 2014.
5. Jonathan Levin, “Mac OS X and iOS Internals: To the Apple’s Core”, John Wiley & Sons, 2012.
6. Andrew S. Tanenbaum and Herbert Bos, “Modern Operating Systems”, Fourth Edition, Prentice Hall, 2014.
7. Mike Ebbers, John Kettner, Wayne O’Brien, Bill Ogden, “Introduction to the New Mainframe: z/OS Basics”, Third Edition, International Business Machines Corporation, 2011.
8. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", Wiley, Eighth edition, 2008.

SO7102	LINEAR PROGRAMMING AND APPLICATIONS	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To introduce the basic concepts and tools in optimization.
- To explore the advanced concepts vertically to get clear understanding and to apply the concepts in engineering and scientific applications.

UNIT I INTRODUCTION 9

Formulation and Graphical Solutions – Solution of Maximization Model –Solution of Minimization Model – Simplex method – Degeneracy – Unbounded Solution –Infeasible Solution – Alternative Optima.

UNIT II ADVANCED LINEAR PROGRAMMING 9

BIG-M method –Two–Phase method – Special cases in the Simplex method –Transportation and Assignment Problems – Revised Simplex Method –Duality in Linear Programming Problems – Dual Simplex method – Bounded variable technique

UNIT III SENSITIVITY ANALYSIS 9

Sensitivity Analysis or Post Optimality Analysis – Changes in the Right hand side – Objective function – Changes affecting feasibility – Changes affecting optimality.

UNIT IV INTEGER PROGRAMMING 9

Knapsack Problem –Cutting plane algorithm – Branch and bound programming – Mixed integer Programming – travelling salesperson problem.

UNIT V CASE STUDIES AND TOOLS 9

Case Studies – Production Planning – Manpower planning – Solving LP problems using TORA/LINDO/LINGO.

TOTAL: 75 PERIODS

OUTCOMES:

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

- Conceptually understand and emerge toward optimization.
- Optimize effectively through LP methods and solve using R programming.

REFERENCES:

1. HamdyA.Taha, “Operations Research - An Introduction”, Prentice Hall, Ninth Edition, 2010.
2. J.K.Sharma, “Operations Research Theory and applications”, Macmillan, 5th Edition, 2013.
3. Hiller F.S, Liberman G.J, “Introduction to Operations Research”, 9th Edition, McGrawHill, Inc., 2009
4. Ronald L.Rardin, “Optimization in Operations Research”, Pearson Education, Asia, 1997.
5. Jit. S. Chandran, Mahendran P.Kawatra, KiHoKim, “Essentials of Linear Programming”, Vikas Publishing House Pvt. Ltd. New Delhi, 1994.
6. Harvey M. Wagner, “Principles of Operations Research with applications to Managerial Decisions”, PHI Learning Private Limited, 2nd Edition, 2009

CP7161 ADVACNED DATA STRUCTURES AND ALGORITHMS LAB

L	T	P	C
0	0	4	2

OBJECTIVES:

- To understand heap and various tree structures like AVL, Red-black, B and Segment trees
- To understand the problems such as line segment intersection, convex shell and Voronoi diagram

Experiments to construct and manipulate the following:

1. Min/Max Heap
2. Leftist Heap
3. AVL Trees
4. Red-Black Trees
5. B-Trees
6. Segment Trees
7. Line segment intersection
8. Convex Hull
9. Voronoi Diagram

TOTAL : 60 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Implement heap and various tree structure like AVL, Red-black, B and Segment trees
- Solve the problems such as line segment intersection, convex shell and Voronoi diagram

CP7162 PROFESSIONAL PRACTICES

L	T	P	C
0	0	2	1

OBJECTIVES:

- To facilitate analysis, design and problem solving skills
- To have a thorough domain knowledge
- To understand the best Industry practices by reading case studies
- To kindle innovative and professional thinking
- To explore possible alternative solutions
- To estimate feasibility, cost, risk and ROI

Identify an application (may be of social relevance) – Understand customer requirements – analyze and understand customers and stakeholders – value additions – innovations and research component – preparing plan / SRS document indicating feasibility, cost, risk, ROI and related design – suggest implementation methodology – perform risk assessment and management

TOTAL : 30 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Identify and formulate the problem
- Describe the background of the problem
- Assess the needs of stakeholders
- Make estimates like cost, risk, ROI etc., to justify the business opportunity.
- Describe the industry standards and procedures
- Predict the business opportunity
- Suggest system implications

CP7155 NETWORKING TECHNOLOGIES

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn about integrated and differentiated services architectures
- To understand the working of wireless network protocols
- To study the evolution made in cellular networks
- To get familiarized with next generation networks

UNIT I NETWORK ARCHITECTURE AND QoS 9

Overview of TCP/IP Network Architecture – Integrated Services Architecture – Approach – Components – Services – Queuing Discipline – FQ – PS – BRFQ – GPS – WFQ – Random Early Detection – Differentiated Services.

UNIT II WIRELESS NETWORKS 9

IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security – IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS – Bluetooth – Protocol Stack – Security – Profiles

UNIT III CELLULAR NETWORKS 9

GSM – Mobility Management and call control – GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS – UMTS – Channel Structure on the Air Interface – UTRAN – Core and Radio Network Mobility Management – UMTS Security

UNIT IV 4G NETWORKS 9

LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks –Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) - 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Introduction to 5G

UNIT V SOFTWARE DEFINED NETWORKS 9

Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Identify the different features of integrated and differentiated services
- Demonstrate various protocols of wireless and cellular networks
- Discuss the features of 4G and 5G networks

REFERENCES:

1. William Stallings, “High Speed Networks and Internets: Performance and Quality of Service”, Prentice Hall, Second Edition, 2002.
2. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", Wiley, 2014.
3. Savo G Glisic, “Advanced Wireless Networks – 4G Technologies”, John Wiley & Sons, 2007.
4. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015.
5. Martin Sauter, “Beyond 3G - Bringing Networks, Terminals and the Web Together: LTE, WiMAX, IMS, 4G Devices and the Mobile Web 2.0”, Wiley, 2009.
6. Naveen Chilamkurti, SheraliZeadally, Hakima Chaouchi, “Next-Generation Wireless Technologies”, Springer, 2013.
7. Erik Dahlman, Stefan Parkvall, Johan Skold, “4G: LTE/LTE-Advanced for Mobile Broadband”, Academic Press, 2013.
8. Thomas D.Nadeau and Ken Gray, “SDN – Software Defined Networks”, O’Reilly Publishers, 2013.

CP7253 MACHINE LEARNING TECHNIQUES L T P C
3 0 2 4

OBJECTIVES

- To understand the concepts of machine learning
- To appreciate supervised and unsupervised learning and their applications
- To understand the theoretical and practical aspects of Probabilistic Graphical Models
- To appreciate the concepts and algorithms of reinforcement learning
- To learn aspects of computational learning theory

UNIT I INTRODUCTION 8+6

Machine Learning - Machine Learning Foundations –Overview – Design of a Learning system - Types of machine learning –Applications Mathematical foundations of machine learning - random variables and probabilities - Probability Theory – Probability distributions -Decision Theory- Bayes Decision Theory - Information Theory

UNIT II SUPERVISED LEARNING 10+6

Linear Models for Regression - Linear Models for Classification – Naïve Bayes - Discriminant Functions -Probabilistic Generative Models -Probabilistic Discriminative Models - Bayesian Logistic Regression. Decision Trees - Classification Trees- egression Trees - Pruning. Neural Networks -Feed-forward Network Functions - Back- propagation. Support vector machines - Ensemble methods- Bagging- Boosting.

UNIT III UNSUPERVISED LEARNING 8+6

Clustering- K-means - EM Algorithm- Mixtures of Gaussians. The Curse of Dimensionality - Dimensionality Reduction - Factor analysis - Principal Component Analysis - Probabilistic PCA- Independent components analysis

UNIT IV PROBABILISTIC GRAPHICAL MODELS 10+6

Graphical Models - Undirected graphical models - Markov Random Fields - Directed Graphical Models -Bayesian Networks - Conditional independence properties - Inference – Learning- Generalization - Hidden Markov Models - Conditional random fields(CRFs)

UNIT V ADVANCED LEARNING 9+6

Sampling –Basic sampling methods – Monte Carlo. Reinforcement Learning- K-Armed Bandit- Elements - Model-Based Learning- Value Iteration- Policy Iteration. Temporal Difference Learning- Exploration Strategies- Deterministic and Non-deterministic Rewards and Actions Computational Learning Theory - Mistake bound analysis, sample complexity analysis, VC dimension. Occam learning, accuracy and confidence boosting

TOTAL : 45 + 30 = 75 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Design a neural network for an application of your choice
- Implement probabilistic discriminative and generative algorithms for an application of your choice and analyze the results
- Use a tool to implement typical clustering algorithms for different types of applications
- Design and implement an HMM for a sequence model type of application
- Identify applications suitable for different types of machine learning with suitable justification

REFERENCES:

1. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2007.
2. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
3. EthemAlpaydin, “Introduction to Machine Learning”, MIT Press, Third Edition, 2014.
4. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
5. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, Second Edition, 2011.
6. Stephen Marsland, “Machine Learning - An Algorithmic Perspective”, Chapman and Hall/CRC Press, Second Edition, 2014.

SO7301	NON LINEAR PROGRAMMING	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To introduce and familiarize non-linear approaches in optimization.
- To conceptualize the real life applications in terms of non-linearity and also to learn MATLAB for solving the same.

UNIT I INTRODUCTION 9

Linear Vs Non-linear Programming – Basic properties of solutions and Algorithms – First order necessary conditions – Examples of unconstrained problems – second-order conditions – convex and concave functions – minimization and maximization of convex functions – saddle points – Jacobian matrix.

UNIT II ONE DIMENSIONAL OPTIMIZATION 9

Descent methods an introduction – Global convergence of Decent Algorithms – Speed convergence – Fibonacci method – Golden section search method – Steepest Descent – Newton's method – Polynomial Approximation method.

UNIT III MULTI-DIMENSIONAL OPTIMIZATION 9

Unconstrained Optimization without derivatives – Conjugate directions – Descent properties of the conjugate Direction method – Conjugate gradient method – Partial conjugate gradient method – Powell's method – Variable metric Algorithms without derivatives – Quasi-Newton method – modified.

UNIT IV UNCONSTRAINED OPTIMIZATION FORCONSTRAINED PROBLEMS 9

Lagrange method – Inequality constraints – KKT conditions – Quadratic programming – Geometric programming – Separable Linear Programming – sequential linear Programming –Feasible Direction method.

UNIT V EVOLUTIONARY PROGRAMMING 9

Genetic Engineering – Genetic operators – reproduction – Crossover – mutation – Selection – Genetic local search – simulated Annealing – Ant colony Optimization – Particle swarm Optimization –Matlab – Simulation of NLP techniques / concepts with Matlab.

TOTAL : 45 + 30 = 75 PERIODS

OUTCOMES:

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

- Applying the concepts of non-linear programming in real life scenarios.
- Provide instant results through MATLAB.

REFERENCES:

1. Hamdy A Taha, "Operations Research - An Introduction", Prentice Hall, Eighth Edition, 2007.
2. David G.Luenberger, "Linear and Nonlinear Programming", Springer Publications, 3rd Edition,2008
3. Rao S S "Optimization -Theory and Applications", Wiley Eastern, New Delhi, 1978.
4. Sivanandam S. N ,Deepa S N, "Principles of Soft Computing" Wiley India Pvt.ltd, 2nd Edition,2007.
5. David E. Goldberg, "Genetic Algorithm in search, Optimization and machine learning", Pearson, 1999.

SO7251	ADVANCED DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the underlying principles of Relational Database Management System.
- To understand and implement the advanced features of DBMS.
- To develop database models using distributed databases.
- To implement and maintain an efficient database system using emerging trends.

UNIT I RELATIONAL MODEL 9

Data Model – Types of Data Models: – Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Structured Query Language – Database Normalization – Transaction Management.

UNIT II PARALLEL AND DISTRIBUTED DATABASES 9

Centralized and Client-Server Architectures – Parallel Systems – Distributed Systems – Parallel Databases – I/O Parallelism – Inter- and Intra-Query Parallelism – Inter- and Intra-operation Parallelism – Distributed Database Concepts: – Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing.

UNIT III XML DATABASES 9

XML Databases: XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity.

UNIT IV MULTIMEDIA DATABASES 9

Multidimensional Data Structures – Image Databases – Text / Document Databases – Video Databases – Audio Databases – Multimedia Database Design.

UNIT V CURRENT ISSUES 9

Active Databases – Deductive Databases – Data Warehousing – Data Mining – Database Tuning – Database Security

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to:

- Design and implement relational databases, distributed databases, XML databases and multimedia databases.
- Implement the concept of database connectivity with the applications.

REFERENCES:

1. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Addison-Wesley, 2011.
2. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Third Edition, Pearson Education, 2007.
3. Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Fifth Edition, McGraw Hill, 2006.
4. C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
5. V.S.Subramanian, “Principles of Multimedia Database Systems”, Harcourt India Pvt. Ltd., 2001.

SO7211 ADVANCED DATABASE MANAGEMENT SYSTEMS LAB

L	T	P	C
0	0	4	2

OBJECTIVES:

- To implement Relational Database and Perform Query Operations, Update Operations and Report Generation, Active Database Concepts, Distributed Database Concepts, Distributed Database Concepts, XML Databases, ODBC.

SOFTWARE:
Oracle 10 G or Higher / Equivalent

TOPICS TO BE COVERED:

1. Data Definition Language
   Create, Alter, Drop, Truncate, Comment, Rename Command Enforcing Integrity Constraints Views, Synonyms, Sequences, Indexes
2. DML Operations
3. Joining Data from Multiple Tables in Queries
   The join Condition / The Cartesian Product Equijoin, Self-join, Outer joins
4. Set Operations
5. Aggregate Functions and the GROUP By Clause
6. Using Sub-queries
7. Analytic Functions
8. Introduction to Procedures and Functions

Creating stored PL / SQL objects, procedures, functions

9. Creating Packages
10. Creating package specifications and bodies
11. Creating DML Triggers

Triggering events, Trigger behavior
Correlation identifiers, Multi-statement triggers
Trigger firing behavior, Enabling / Disabling triggers

12. Distributed Database Implementation

TOTAL : 60 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to:

- Design and implement relational database.
- Perform all the query manipulation operations and procedural querying language.
- Design and develop active and distributed databases.

OR7301 PROJECT MANAGEMENT WITH PERT/CPM

L	T	P	C
3	0	2	4

OBJECTIVES:

- To understand the concept of project planning and scheduling.
- To explore the different alternative schedules to complete a project.
- To study the effect of uncertainty in project completion.
- To find out the optimum cost effective project completion plan.

UNIT I **9**

PERT and CPM come of age – planning scheduling and control planning - scheduling networks – The activity – Node Diagram – Building a house – Network scheduling

UNIT II **9**

Finding the critical path – Multiple critical paths – Job slack – Algorithm for finding the critical path – Late start and Late finish times – Total slack – Free slack – project due dates that differ from earliest completion time – A digression on stack – Back to the contractor

UNIT III **9**

The PERT model – The problem of uncertainty – Expected times for activities – variability of activity times – The expected length of a critical path – Probability of completing a project by a given date – Effects of a near critical path - other methods for calculating project length and variance – Simulation of a network-criticality index - PERT's Event orientation - The PERT assumptions – The CPM model - Schedule-Related project Costs - The lowest cost schedule - stretching jobs - The problem of large projects - solutions by computers - cost optimization-L.P. Models - Non linear cost-time trade-off curves - non convex and discontinuous cost-time trade off curves.

UNIT IV **9**

PERT/ cost : A network cost accounting system - Basic concepts of Network Cost Systems - cost accounting by work packages - forecast of project costs - Analysis and control of project costs - Graphic displays of cost and time data - cost curve for activities and departments - possible accounting problems with PERT/cost

UNIT V **9**

Network scheduling with limited resources-The complexity of project scheduling with limited resources - Heuristic programs - Heuristic methods for resource leveling of project schedules - Example of a resource leveling programs - Heuristic methods for resource allocation in project scheduling- A simple heuristic program - The SPAR-1 resource allocation model - Conceptual problems of critical path analysis when resources are limited - Slack in a limited resource schedule-projects with uncertain activity estimates - planning versus scheduling - conclusion.

TOTAL: 45 + 30 = 75 PERIODS

OUTCOMES:

Upon completing this course, the students will be able to:

- Conceptually understand the project elements, activities and its effect on project planning.
- Identify the critical activities
- Identify parallel activities
- Create a project scheduling incorporating all critical values.
- Optimize effectively through complementary tools

REFERENCES:

1. Chandra, P., "Projects", Tata McGraw-Hill Education, 2009
2. Levy, F. K. and Wiest, J. D., "A Management Guide to PERT/CPM", Prentice Hall, 1969
3. Lewis, R., "Project Management", McGraw-Hill, 2006.
4. Moder, J. J. and Phillips, "C. R., Project Management With CPM, PERT and Precedence Diagramming", Van Nostrand Reinhold,1983.
5. Morris, P. W. G., and Pinto, J. K., "The Wiley Guide to Managing Projects", John Wiley& Sons, 2004.
6. Phillips, J., "PMP Project Management Professional Study Guide", McGraw-Hill, 2003.
7. Pritsker, A. A. B., "Modeling and analysis using Q-GERT networks", John Wiley & Sons Inc, 1979.

CP7071 ADHOC AND WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn about the issues in the design of wireless ad hoc networks
- To understand the working of protocols in different layers of mobile ad hoc and sensor networks
- To expose the students to different aspects in sensor networks
- To understand various security issues in ad hoc and sensor networks and solutions to the issues

UNIT I MAC & ROUTING IN AD HOC NETWORKS 9

Introduction – Issues and challenges in ad hoc networks – MAC Layer Protocols for wireless ad hoc networks – Contention-Based MAC protocols – MAC Protocols Using Directional Antennas – Multiple-Channel MAC Protocols – Power-Aware MAC Protocols – Routing in Ad hoc Networks – Design Issues – Proactive, Reactive and Hybrid Routing Protocols

UNIT II TRANSPORT & QOS IN AD HOC NETWORKS 9

TCP's challenges and Design Issues in Ad Hoc Networks – Transport protocols for ad hoc networks – Issues and Challenges in providing QoS – MAC Layer QoS solutions – Network Layer QoS solutions – QoS Model

UNIT III MAC & ROUTING IN WIRELESS SENSOR NETWORKS 9

Introduction – Applications – Challenges – Sensor network architecture – MAC Protocols for wireless sensor networks – Low duty cycle protocols and wakeup concepts – Contention-Based protocols – Schedule-Based protocols –Zig bee – Topology Control – Routing Protocols

UNIT IV TRANSPORT & QOS IN WIRELESS SENSOR NETWORKS 9

Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless Sensor Networks – Congestion Control – In-network processing – Operating systems for wireless sensor networks – Examples.

UNIT V SECURITY IN AD HOC AND SENSOR NETWORKS 9

Security Attacks – Key Distribution and Management – Intrusion Detection – Software based Anti-tamper techniques – Water marking techniques – Defense against routing attacks - Secure Ad hoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Identify different issues in wireless ad hoc and sensor networks
- Analyze protocols developed for ad hoc and sensor networks
- Identify different issues in wireless ad hoc and sensor networks
- Identify and critique security issues in ad hoc and sensor networks

REFERENCES:

1. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, "Ad-Hoc Mobile Wireless Networks", Auerbach Publications, 2007.
2. Holger Karl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", Wiley India Private Limited, 2011.
3. ErdalÇayirci ,ChunmingRong, "Security in Wireless Ad Hoc and Sensor Networks", John Wiley and Sons, 2009.
4. C. Siva Ram Murthy and B.S. Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2004.

5. Carlos De MoraisCordeiro, Dharma Prakash Agrawal, “Ad Hoc and Sensor Networks: Theory and Applications”, World Scientific Publishing, Second Edition, 2011.
6. WaltenegusDargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, Wiley India Private Limited, 2014.
7. Adrian Perrig, J.D. Tygar, “Secure Broadcast Communication: In Wired and Wireless Networks”, Kluwer Academic Publishers, Springer, 2002.

CP7077 DATABASE ADMINISTRATION AND TUNING

L	T	P	C
3	0	0	3

OBJECTIVES

- To design and implement relational database solutions for general applications
- To develop database scripts for data manipulation and database administration
- To understand and perform common database administration tasks such as database monitoring, performance tuning, data transfer, and security
- To balance the different types of competing resources in the database environment so that the most important applications have priority access to the resources

UNIT I INTRODUCTION TO DATABASE ADMINISTRATION 9

Database Administration - DBA Tasks - DBMS Release Migration - Types of DBAs - Creating the Database Environment – Defining the organizations DBMS strategy - Installing the DBMS - Upgrading DBMS Versions and Releases

UNIT II DATABASE SECURITY, BACKUP AND RECOVERY 9

Database Users - Granting and Revoking Authority - Authorization Roles and Groups - Using Views for Security - Using Stored Procedures for Security – Auditing - External Security - Backups - Recovery - Determining Recovery Options - Types of Recovery – DBA Tools – DBA Rules of Thumb

UNIT III FUNDAMENTALS OF TUNING 9

Review of Relational Databases – Relational Algebra – Locking and Concurrency Control – Correctness Consideration – Lock Tuning – Logging and the Recovery Subsystem – Principles of Recovery – Tuning the Recovery Subsystem – Operating Systems Considerations – Hardware Tuning

UNIT IV INDEX TUNING AND QUERY OPTIMIZATION 9

Types of Queries – Data Structures – B+ Tree - Hash Structures – Bit Map Indexes – Clustering Indexes – Non Clustering Indexes – Composite Indexes – Hot Tables – Comparison of Indexing and Hashing Techniques. Optimization Techniques - Tuning Relational Systems - Parameter Cache - Query Tuning – Triggers – Client Server Mechanisms – Objects, Application Tools and Performance –Tuning the Application Interface – Bulk Loading Data – Accessing Multiple Databases

UNIT V TROUBLESHOOTING 9

Query Plan Explainers – Performance Monitors – Event Monitors – Finding “Suspicious” Queries – Analyzing a Query’s Access Plan – Profiling a Query Execution – DBMS Subsystems

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Apply advanced features of databases in design, administration, and applications
- Provide techniques to improve the performance of a database
- Optimize the use of existing resources within the database environment

REFERENCES:

1. Craig S. Mullins, “Database Administration: The Complete Guide to Practices and Procedures”, Addison-Wesley Professional, 2012.
2. Dennis Shasha and Philippe Bonnet, “Database Tuning, Principles, Experiments and Troubleshooting Techniques”, Elsevier Reprint, 2005.
3. AviSilberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", Sixth Edition, McGraw-Hill, 2010.
4. Thomas Connoly and Carlolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Fifth Edition, Pearson Education, 2009.

CP7080	ETHICAL HACKING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about the importance of information security
- To learn different scanning and enumeration methodologies and tools
- To understand various hacking techniques and attacks
- To be exposed to programming languages for security professionals
- To get familiarized with the different phases in penetration testing

UNIT I INTRODUCTION TO HACKING 9

Introduction to Hacking – Importance of Security – Elements of Security – Phases of an Attack – Types of Hacker Attacks – Hacktivism – Vulnerability Research – Introduction to Footprinting – Information Gathering Methodology – Footprinting Tools – WHOIS Tools – DNS Information Tools – Locating the Network Range – Meta Search Engines.

UNIT II SCANNING AND ENUMERATION 9

Introduction to Scanning – Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools.

UNIT III SYSTEM HACKING 9

Introduction – Cracking Passwords – Password Cracking Websites – Password Guessing – Password Cracking Tools – Password Cracking Counter measures – Escalating Privileges – Executing Applications – Keyloggers and Spyware.

UNIT IV PROGRAMMING FOR SECURITY PROFESSIONALS 9

Programming Fundamentals – C language – HTML – Perl – Windows OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures – Linux OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures.

UNIT V PENETRATION TESTING 9

Introduction – Security Assessments – Types of Penetration Testing- Phases of Penetration Testing – Tools – Choosing Different Types of Pen-Test Tools – Penetration Testing Tools

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Defend hacking attacks and protect data assets
- Defend a computer against a variety of security attacks using various tools
- Practice and use safe techniques on the World Wide Web

REFERENCES:

1. Ec-Council, “Ethical Hacking and Countermeasures: Attack Phases”, Delmar Cengage Learning, 2009.
2. Michael T. Simpson, Kent Backman, James E. Corley, “Hands-On Ethical Hacking and Network Defense”, Cengage Learning, 2012.
3. Patrick Engebretson, “The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy”, Syngress Media, Second Revised Edition, 2013.
4. Jon Erickson, “Hacking: The Art of Exploitation”, No Starch Press, Second Edition, 2008.

CP7081	FAULT TOLERANT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide and appreciate a comprehensive view of fault tolerant systems
- To expose the students to the methods of hardware fault tolerance
- To understand the different ways of providing information redundancy and the ways of providing software fault tolerance.
- To expose the students to concept of check pointing and their role in providing fault tolerance.
- To understand how to handle security attacks.

UNIT I INTRODUCTION 9

Fault Classification, Types of Redundancy, Basic Measures of Fault Tolerance, Hardware Fault Tolerance, The Rate of Hardware Failures, Failure Rate, Reliability, and Mean Time to Failure, Canonical and Resilient Structures, Other Reliability Evaluation Techniques, Processor level Techniques

UNIT II INFORMATION REDUNDANCY 9

Information Redundancy, Coding, Resilient Disk Systems, Data Replication, Voting: Hierarchical Organization, Primary-Backup Approach, Algorithm-Based Fault Tolerance, Fault-Tolerant Networks: Measures of Resilience, Common Network Topologies and Their Resilience, Fault-Tolerant Routing

UNIT III SOFTWARE FAULT TOLERANCE 9

Acceptance Tests, Single-Version Fault Tolerance, N-Version Programming, Recovery Block Approach, Preconditions, Post conditions, and Assertions, Exception-Handling, Software Reliability Models, Fault-Tolerant Remote Procedure Calls

UNIT IV CHECKPOINTING 9

Introduction, Checkpoint Level, Optimal Checkpointing - An Analytical Model, Cache-Aided Rollback Error Recovery, Checkpointing in Distributed Systems, Checkpointing in Shared-Memory Systems, Checkpointing in Real-Time Systems, Case Studies: NonStop Systems, Stratus Systems, Cassini Command and Data Subsystem, IBM G5, IBM Sysplex, Itanium

UNIT V FAULT DETECTION IN CRYPTOGRAPHIC SYSTEMS 9

Security Attacks Through Fault Injection – Fault Attacks on Symmetric Key Ciphers – Fault Attacks on Public (Asymmetric) Key Ciphers – Counter Measures – Spatial and Temporal Duplication – Error Detecting Codes

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Define the traditional measures of fault tolerance
- Point out the processor level fault tolerance techniques
- Critically analyze the different types of RAID levels
- Discuss techniques like recovery blocks and N-version programming
- Identify techniques for check pointing in distributed and shared memory systems.
- Provide techniques to detect injected faults in ciphers.

REFERENCES:

1. Israel Koren, Mani Krishna, “Fault Tolerant Systems”, Morgan Kaufmann, 2010
2. Parag K. Lala “Fault Tolerant and Fault Testable Hardware Design”, Prentice-Hall International, 1984.
3. LL Pullam, “Software Fault Tolerance Techniques and Implementation”, Artech House Computer Security Series, 2002.
4. Martin L Shooman, “Reliability of Computer Systems and Networks: Fault Tolerance, Analysis and Design”, Willey, 2002.

CP7084	MODELS OF COMPUTATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand computation and computability concepts.
- To study different approaches to facilitate computing
- To learn the abstractions of computation and their implementations

UNIT I TURING MACHINE MODEL **9**

Turing Machine Logic, Proof, Computability

UNIT II QUANTUM COMPUTATION **9**

Quantum Computing History, Postulates of Quantum Theory, Dirac Notation, the Quantum Circuit Model, Simple Quantum Protocols: Teleportation, Superdense Coding, Foundation Algorithms

UNITIII NATURE INSPIRED COMPUTING **9**

Nature-Inspired Computing Optimization and Decision Support Techniques, Evolutionary Algorithms, Swarm Intelligence, Benchmarks and Testing

UNIT IV SOCIAL COMPUTING **9**

Social Computing Online communities, Online discussions, Twitter, Social Networking Systems, Web 2.0, social media, Crowd sourcing, Facebook, blogs, wikis, social recommendations, Collective intelligence

UNIT V EVOLUTIONARY COMPUTING **9**

Evolutionary Computing Introduction to Genetic Algorithms, Genetic Operators and Parameters, Genetic Algorithms in Problem Solving, Theoretical Foundations of Genetic Algorithms, Implementation Issues

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Identify the terminology of the theory of computing
- Predict the major results in computability and complexity theory.
- Prepare the major models of computations

REFERENCES:

1. Danah Boyd, “It's Complicated: The Social Lives of Networked Teens”, Yale University Press, 2015
2. John E. Savage, “Models Of Computation - Exploring the Power of Computing”, Addison-Wesley, 2008
3. Margaret M. Fleck, “Building Blocks for Theoretical Computer Science”, University of Illinois, Urbana-Champaign, 2013.
4. Michael A. Nielsen & Isaac L. Chuang, “Quantum Computation and Quantum Information”, Cambridge University Press, 2010
5. M. Mitchell, “An Introduction to Genetic Algorithms”, Prentice-Hall, 1996.
6. G.Rozenberg, T.Back, J.Kok, Editors, “Handbook of Natural Computing”, Springer Verlag, 2012.

CP7087 PARALLEL ALGORITHMS L T P C

3 0 0 3

OBJECTIVES:

- To learn parallel algorithms development techniques for shared memory and DCM models
- To study the main classes of fundamental parallel algorithms
- To study the complexity and correctness models for parallel algorithms.

UNIT I INTRODUCTION 9

Introduction to Parallel Algorithms – Models of computation – Selection – Mergin on EREW and CREW – Median of two sorted sequence – Fast Merging on EREW – Analyzing Parallel Algorithms

UNIT II SORTING & SEARCHING 9

Sorting Networks – Sorting on a Linear Array – Sorting on CRCW, CREW, EREW – Searching a sorted sequence – Searching a random sequence – Bitonic Sort

UNIT III ALGEBRAIC PROBLEMS 9

Permutations and Combinations – Matrix Transpositions – Matrix by Matrix multiplications – Matrix by vector multiplication.

UNIT IV GRAPH & GEOMETRY 9

Connectivity Matrix – Connected Components – All Pair Shortest Paths – Minimum Spanning Trees – Point Inclusion – Intersection, Proximity and Construction Problems.

UNIT V OPTIMIZATION & BIT COMPUTATIONS 9

Prefix Sums – Job Sequencing – Knapsack - Adding two integers – Adding n integers – Multiplying two integers – Selection.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Familiarize with design of parallel algorithms in various models of parallel computation
- Familiarize with the efficient parallel algorithms related to many areas of computer science: expression computation, sorting, graph-theoretic problems, computational geometry, etc
- Familiarize with the basic issues of implementing parallel algorithms

REFERENCES:

1. Selim G. Akl, “The Design and Analysis of Parallel Algorithms”, Prentice Hall, New Jercy, 1989.
2. Michael J. Quinn, “Parallel Computing: Theory & Practice”, Tata McGraw Hill Edition, 2003.
3. Joseph JaJa, “Introduction to Parallel Algorithms”, Addison-Wesley, 1992.

CP7088 PARALLEL AND DISTRIBUTED DATABASES L T P C
3 0 0 3

OBJECTIVES:

- To realize the need of parallel processing
- To cater to applications that require a system capable of sustaining trillions of operations per second on very large data sets
- To understand the need of data integration over data centralization

UNIT I INTRODUCTION TO PARALLEL DATABASES 9

Need of Parallelism - Forms of parallelism – architecture – Analytical models. Basic Query Parallelism – Parallel Search- Parallel sort and Group By- Parallel Join

UNIT II ADVANCED QUERY PROCESSING IN PARALLEL DATABASES 9

Parallel indexing. Parallel Universal Qualification – Collection Join Queries. Parallel Query Scheduling – Optimization, Applications

UNIT III INTRODUCTION TO DISTRIBUTED DATABASES 9

Overview - Promises of DDB –Design Issues – DDB Design – DDB Integration – Data and Access Control

UNIT IV QUERY PROCESSING IN DISTRIBUTED DATABASES 9

Overview- of Query Processing – Query Decomposition and Data Localization – Optimization of Distributed Queries, Multi-database Query Processing

UNIT V TRANSACTION MANAGEMENT AND OTHER ADVANCED SYSTEMS 9

Introduction – Concurrency Control - Distributed DBMS Reliability – Data Replication – DDB Applications, Distributed Object Database Management – Peer -to-Peer Data Management – Web Data Management – Streaming Data and Cloud Computing

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Get good knowledge on the need, issues, design and application of both parallel and distributed databases
- Know how to write optimal queries to cater to applications that need these forms of databases
- Fragment, replicate and localize their data as well as their queries to get their work done faster
- Get idea on other similar trends of optimal data processing

REFERENCES:

1. David Taniar, Clement H.C.Leung, WennyRahayu, SushantGoel, “High Performance Parallel Database Processing and Grid Databases” (Wiley Series in Parallel and Distributed Computing), Wiley-Blackwell, 2008.
2. M. Tamer Ozsu and Patrick Valduriez, “Principles of Distributed Database Systems”, Springer Science + Business Media , Third Edition, 2011.

CP7089	REAL TIME SYSTEMS DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn real time operating system concepts and the associated issues & techniques.
- To understand design and synchronization problems in Real Time System.
- To understand the evaluation techniques present in Real Time System.

UNIT I REAL TIME SPECIFICATION AND DESIGN TECHNIQUES 9

Introduction– Structure of a Real Time System –Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Issues in Real Time Computing – Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms –Fault Tolerant Scheduling.

UNITII SOFTWARE REQUIREMENTS ENGINEERING 9

Requirements engineering process – types of requirements – requirements specification for real time systems – Formal methods in software specification – structured Analysis and Design – object oriented analysis and design and unified modelling language – organizing the requirements document – organizing and writing documents – requirements validation and revision.

UNIT III INTERTASK COMMUNICATION AND MEMORY MANAGEMENT 9

Buffering data – Time relative Buffering- Ring Buffers – Mailboxes – Queues – Critical regions – Semaphores – other Synchronization mechanisms – deadlock – priority inversion – process stack management – run time ring buffer – maximum stack size – multiple stack arrangement – memory management in task control block - swapping – overlays – Block page management – replacement algorithms – memory locking – working sets – real time garbage collection – contiguous file systems.

UNIT IV REAL TIME DATABASES 9

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two – phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems

UNIT V PROGRAMMING LANGUAGES 9

Assembly language – procedural languages – OO languages – Brief survey of languages – Faults, Failures and bugs – Fault Tolerance – Software integration – refactoring Real time code.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Apply principles of real time systems design.
- Make use of architectures and behavior of real time operating systems and database in real time applications.

REFERENCES:

1. C.M. Krishna, Kang G. Shin, “Real-Time Systems”, McGraw-Hill International Editions, 1997.
2. Philip.A.Laplante, “Real Time System Design and Analysis”, Prentice Hall of India, 3rd Edition, 2004.
3. Rajib Mall, “Real-time systems: theory and practice”, Pearson Education, 2009.
4. Stuart Bennett, “Real Time Computer Control-An Introduction”, Prentice Hall of India, 1998.
5. R.J.A Buhur, D.L Bailey, “An Introduction to Real-Time Systems”, Prentice Hall International, 1999.
6. Allen Burns, Andy Wellings, “Real Time Systems and Programming Languages”, Pearson Education, 2003.

CP7090	SECURE NETWORK SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand best security practices and how to take advantage of the networking gear that is already available
- To learn design considerations for device hardening, Layer 2 and Layer 3 security issues, denial of service, IPSec VPNs, and network identity
- To understand security design considerations for common applications such as DNS, mail and web
- To identify the key security roles and placement issues for network security elements such as firewalls, intrusion detection systems, VPN gateways, content filtering, as well as for traditional network infrastructure devices such as routers and switches
- To understand the various testing and optimizations strategies to select the technologies and devices for secure network design

UNIT I NETWORK SECURITY FOUNDATIONS 9

Secure network design through modeling and simulation, A fundamental framework for network security, need for user level security on demand, Network Security Axioms, security policies and operations life cycle, security networking threats, network security technologies, general and identity design considerations, network security platform options and best deployment practices, secure network management and network security management

UNIT II IDENTIFYING SYSTEM DESIGNER’S NEEDS AND GOALS 9

Evolution of network security and lessons learned from history, Analyzing top-down network design methodologies, technical goals and tradeoffs – scalability, reliability, availability, Network performance, security, Characterizing the existing internetwork, characterizing network traffic, developing network security strategies

UNIT III PHYSICAL SECURITY ISSUES AND LAYER 2 SECURITY 9

Control physical access to facilities, Control physical access to data centers, Separate identity mechanisms for insecure locations, Prevent password-recovery mechanisms in insecure locations, awareness about cable plant issues, electromagnetic radiation and physical PC security threats, L2 control protocols, MAC flooding considerations, attack mitigations, VLAN hopping attacks, ARP, DHCP, PVLAN security considerations, L2 best practice policies

UNIT IV IP ADDRESSING AND ROUTING DESIGN CONSIDERATIONS 9

Route summarizations, ingress and egress filtering, Non routable networks, ICMP traffic management, Routing protocol security, Routing protocol authentication, transport protocol management policies, Network DoS/flooding attacks

UNIT V TESTING AND OPTIMIZING SYSTEM DESIGN 9

Selecting technologies and devices for network design, testing network design – using industry tests, building a prototype network system, writing and implementing test plan, tools for testing, optimizing network design – network performance to meet quality of service (QoS), Modeling, simulation and behavior analysis of security attacks, future issues in information system security

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Follow the best practices to understand the basic needs to design secure network
- Satisfy the need for user and physical level security on demand for various types of network attacks
- Use best practice policies for different network layer protocols
- Understand the network analysis, simulation, testing and optimizing of security attacks to provide Quality of Service

REFERENCES:

1. SumitGhosh, “Principles of Secure Network System Design”, Springer, 2012.
2. Sean Convery, “Network Security Architectures”, Pearson Education, 2011.
3. Priscilla Oppenheimer, “Top-Down network Design”, Cisco press, Third edition, 2012.
4. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Morgan Kauffmann Publishers Inc., Fifth Revised Edition, 2011.
5. William Stallings, “Cryptography and Network Security Principles and Practices”, Pearson / PHI, Fourth Edition, 2006.
6. Wade Trappe, Lawrence C Washington, “Introduction to Cryptography with Coding Theory”, Second Edition, Pearson, 2007.

CP7091 SERVICE ORIENTED ARCHITECTUREAND DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To understand the SOA architecture
- To understand the service oriented analysis and design
- To understand the development of deployment of web services
- To understand the security issues of SOA

UNIT I SOA FUNDAMENTALS 9

Principles of Service Orientation - Client-Server Architecture - Distributed Internet Architecture - SOA Characteristics - Anatomy of SOA - Components - Interaction - Technical and Business Benefits - Multi-channel access - Business Process Management

UNIT II SOA AND WEB SERVICES 9

Web Service Platform - Web Service Description - Service Contracts - Service Level Data Model - Service Discovery - Service Level Security - Service Level Interaction Patterns: SOAP basics - Messaging with SOAP - Message Exchange Patterns -Web WSDL basics, Writing a Java Web Service, writing a Java Web Service Client ,Describing Web Services: WSDL, Representing Data Types - XML Schema, Communicating Object Data, SOAP Related Technologies

UNIT III SERVICE ORIENTED ANALYSIS AND DESIGN 9

Design principles - Business Centric SOA - Deriving Business services - Service Modeling - Coordination - Atomic Transaction - Business activities - Web Service Orchestration Business Process Execution Language (BPEL) - Choreography - Metadata Management- Entity centric business service design - Application Service design - Task centric business service design

UNIT IV WEB SERVICES DEVELOPMENT AND DEPLOYMENT 9

XML and Web Services - WSDL basics - SOA support in J2EE - Java API for XML-based Web Services (JAX-WS) - Java Architecture for XML Binding (JAXB) - Java API for XML Registries (JAXR) - Web Services Interoperability Technologies - SOA support in .NET - Common Language Runtime - ASP.NET - Web forms - ASP.NET Web Services - Web Services Enhancements

UNIT V SOA APPLICATIONS AND SECURITY 9

Security Overview: e-commerce based security (public key cryptography) – Public key encryption – Security issues in XML document – SOAP security issue – XML Security framework: XML Digital Signature (Enveloped, enveloping and detached) – Signature validation - XML Encryption – Types – Canonicalization - XML Key management.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Develop and deploy simple and composite web services with SOA design principles considering the security issues
- Understand and describe the standards and technologies of modern web service implementations
- Efficiently use leading development tools to create and consume web services
- Implement a service oriented application

REFERENCES:

1. Eric Newcomer, Greg Lomow, “Understanding SOA with Web Services”, Pearson Education, 2004.
2. Thomas Erl, “Service Oriented Architecture: Concepts, Technology, and Design”, Pearson Education, 2006.
3. Shankar Kambhampaly, “Service Oriented Architecture for Enterprise Applications”, Wiley India Pvt Ltd, 2008.
4. Mark O’ Neill, “Web Services Security”, Tata McGraw-Hill Edition, 2003.
5. Frank Cohen, “Fast SOA”, Morgan Kaufmann, 2010.
6. SandeepChatterjee, James Webber, “Developing Enterprise Web Services”, Pearson Education, 2003.

CP7095	VIRTUALIZATION TECHNIQUES AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of virtualization and virtual machines
- To understand the implementation of process and system virtual machines
- To explore the aspects of high level language virtual machines
- To gain expertise in server, network and storage virtualization.
- To understand and deploy practical virtualization solutions and enterprise solutions

UNIT I OVERVIEW OF VIRTUALIZATION 9

System architectures - Virtual Machine basics - Process vs System Virtual Machines - Taxonomy. Emulation: Basic Interpretation - Threaded Interpretation - Precoded and Direct Threaded Interpretation - Binary Translation. System Virtual Machines - Key concepts - Resource utilization basics

UNIT II PROCESS VIRTUAL MACHINES 9

Implementation – Compatibility – Levels – Framework – State Mapping – Register – Memory Address Space – Memory Architecture Emulation – Memory Protection – Instruction Emulation – Performance Tradeoff - Staged Emulation – Exception Emulation – Exception Detection – Interrupt Handling – Operating Systems Emulation – Same OS Emulation – Different OS Emulation – System Environment

UNIT III HIGH LEVEL LANGUAGE VIRTUAL MACHINES AND SERVER VIRTUALIZATION 9

HLL virtual machines: Pascal P-Code – Object Oriented HLLVMs - Java VM architecture - Java Native Interface - Common Language Infrastructure. Server virtualization: Partitioning techniques - virtual hardware - uses of virtual servers - server virtualization platforms

UNIT IV NETWORK AND STORAGE VIRTUALIZATION 9

Design of Scalable Enterprise Networks – Layer2 Virtualization – VLAN - VFI - Layer 3 Virtualization – VRF - Virtual Firewall Contexts - Network Device Virtualization - Data- Path Virtualization - Routing Protocols. Hardware Devices – SAN backup and recovery techniques – RAID – Classical Storage Model – SNIA Shared Storage Model – Virtual Storage: File System Level and Block Level.

UNIT V APPLYING VIRTUALIZATION 9

Practical Virtualization Solutions: Comparison of Virtualization Technologies: Guest OS/ Host OS – Hypervisor – Emulation – Kernel Level – Shared Kernel, Enterprise Solutions: VMWare Server – VMWareESXi – Citrix Xen Server – Microsoft Virtual PC – Microsoft Hyper-V – Virtual Box, Server Virtualization: Configuring Servers with Virtualization – Adjusting and Tuning Virtual servers – VM Backup – VM Migration, Desktop Virtualization: Terminal services – Hosted Desktop – Web-based Solutions – Localized Virtual Desktops, Network and Storage Virtualization: Virtual Private Networks – Virtual LAN – SAN and VSAN – NAS

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Deploy legacy OS on virtual machines.
- Analyze the intricacies of server, storage and network virtualizations
- Design and develop applications on virtual machine platforms

REFERENCES:

1. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
2. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.
3. Kumar Reddy, Victor Moreno, “Network virtualization”, Cisco Press, July, 2006.
4. Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, A Press 2005.
5. Kenneth Hess, Amy Newman, “Practical Virtualization Solutions: Virtualization from the Trenches”, Prentice Hall, 2010.

CP7252 COMPILER OPTIMIZATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES

- To understand different forms of intermediate languages and analyzing programs
- To understand optimizations techniques for single program blocks
- To apply optimizations on procedures and low level code
- To explore and enhance inter procedural optimizations
- To enhance resource utilization

UNIT I INTERMEDIATE REPRESENTATION OF PROGRAMS AND ANALYSIS 9

Structure of an Optimizing Compiler – Compiler Construction tools - LIR, MIR, HIR – DAG – Syntax Tree – Postfix – Control Flow Analysis – Iterative Data Flow Analysis – Static Single Assignment – Basic Block Dependence DAGs – Alias Analysis.

UNIT II LOCAL AND LOOP OPTIMIZATIONS 9

Early Optimizations: Constant-Expression Evaluation - Scalar Replacement of Aggregates - Algebraic Simplifications and Re-association - Value Numbering - Copy Propagation - Sparse Conditional Constant Propagation. Redundancy Elimination: Common - Subexpression Elimination - Loop-Invariant Code Motion - Partial-Redundancy Elimination - Redundancy Elimination and Reassociation - Code Hoisting. Loop Optimizations: Induction Variable Optimizations - Unnecessary Bounds Checking Elimination.

UNIT III PROCEDURE OPTIMIZATION AND SCHEDULING 9

Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination - Procedure Integration - In-Line Expansion - Leaf-Routine Optimization and Shrink Wrapping. Code Scheduling: Instruction Scheduling - Speculative Loads and Boosting - Speculative Scheduling - Software Pipelining - Trace Scheduling - Percolation Scheduling. Control-Flow and Low-Level Optimizations : Unreachable-Code Elimination - Straightening - If Simplifications - Loop Simplifications -Loop Inversion – Un-switching - Branch Optimizations - Tail Merging or Cross Jumping - Conditional Moves - Dead-Code Elimination - Branch Prediction - Machine Idioms and Instruction Combining.

UNIT IV INTER PROCEDURAL OPTIMIZATION 9

Symbol table – Runtime Support - Interprocedural Analysis and Optimization: Interprocedural Control-Flow Analysis - The Call Graph - Interprocedural Data-Flow Analysis - Interprocedural Constant Propagation - Interprocedural Alias Analysis - Interprocedural Optimizations - Interprocedural Register Allocation - Aggregation of Global References.

UNIT V OPTIMIZING FOR MEMORY 9

Register Allocation: Register Allocation and Assignment - Local Methods - Graph Coloring – Priority Based Graph Coloring - Other Approaches to Register Allocation. Optimization for the Memory Hierarchy: Impact of Data and Instruction Caches - Instruction-Cache Optimization - Scalar Replacement of Array Elements - Data-Cache Optimization - Scalar vs. Memory-Oriented Optimizations.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Identify the different optimization techniques that are possible for a sequence of code
- Design performance enhancing optimization techniques
- Manage procedures with optimal overheads
- Ensure better utilization of resources

REFERENCES:

1. Steven Muchnick, “Advanced Compiler Design and Implementation”, Morgan Kaufman Publishers, 1997.
2. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", Addison Wesley, Second Edition, 2007.
3. Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation in Java", Cambridge University Press, Second Edition, 2002.
4. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011.
5. Randy Allen and Ken Kennedy, “Optimizing Compilers for Modern Architectures: A Dependence based Approach”, Morgan Kaufman, 2001.

IF 7004	BUILDING INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of Internet of Things.
- To build a small low cost embedded system using Arduino / Raspberry Pi or equivalent boards.
- To apply the concept of Internet of Things in the real world scenario

UNIT I FUNDAMENTALS OF IOT 9

Introduction-Characteristics-Physical design - Protocols – Logical design – Enabling technologies – IoT Levels – Domain Specific IoTs – IoTvs M2M.

UNIT II IOT DESIGN METHODOLOGY 9

IoT systems management – IoT Design Methodology – Specifications Integration and Application Development.

UNIT III BUILDING IOT WITH RASPBERRY PI 9

Physical device – Raspberry Pi Interfaces – Programming – APIs / Packages – Web services–

UNIT IV BUILDING IOT WITH GALILEO/ARDUINO 9

Intel Galileo Gen2 with Arduino- Interfaces - Arduino IDE – Programming - APIs and Hacks

UNIT V CASE STUDIES and ADVANCED TOPICS 9

Various Real time applications of IoT- Connecting IoT to cloud – Cloud Storage for Iot – Data Analytics for IoT – Software & Management Tools for IoT

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Design a portable IoT using Arduino/ equivalent boards and relevant protocols.
- Develop web services to access/control IoT devices.
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario

REFERENCES:

1. ArshdeepBahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers”, Apress, 2014.
3. Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014.

IF7071 **BIO INFORMATICS** **L T P C**
3 0 0 3

OBJECTIVE:

- To learn bio-informatics algorithms

UNIT I **9**

What is Bio-Informatics – Overview- Major databases in Bio Informatics- Molecular biology – Central Dogma Data retrieval tools – gene structure - Prokaryotic and Eukaryotic Genomes – Sequence Assembly – Gene mapping – Physical maps – cloning –– the genetic material –– chemical bonds – molecular biology tools – genomic information content.

UNIT II **9**

DNA: working with single DNA sequence : removing vector sequences- verifying restriction maps – PCR design – GC content – counting words – internal repeats – protein coding regions – ORFing – Genomescan Protein: predicting properties – primary structure analysis – transmembrane segments – PROSITE patterns – interpreting scanprosite results- finding domains – CD server results – pfscan results. – Alignment of Pair of Sequences

UNIT III **9**

Phylogenetics – phylogenetic trees –Parsimony – ancestral sequences – strategies for faster searches – consensus trees – tree confidence – comparison of phylogenetic methods – molecular phylogenie. Dot matrix – using scoring matrices – PAM matrices – BLOSUM. - Working with FASTA – Algorithm – output – E-values – Histogram. Working with BLAST – algorithm – output – services – gapped BLAST- PSIBLAST – comparison of FASTA and BLAST. - Multiple sequence alignment - Criteria for Multiple sequence alignment – applications – choosing the right sequences; FASTA, ClustalW, TCoffee methods

UNIT IV **9**

Interpreting multiple sequence alignment – getting in right format – converting formats – using Jalview – preparing for publication. - Protein Classification & Structure Prediction - Structure of amino acids – primary structure – secondary structure – folds and motifs – alpha and beta helix – structure based protein classification – protein structure Data bases – folding problem – PROPSEARCH – primary structure analysis and prediction – secondary structure analysis and prediction – motifs – profiles – patterns and fingerprints

UNIT V **9**

Drug Discovery – components – process – Perspectives – Numeric considerations – Algorithms – Hardware – Issues – Protein structure – AbInitio Methods – Heuristic methods – Systems Biology – Tools – Collaboration and Communications – standards - Issues – Security – Intellectual property

TOTAL:45 PERIODS

OUTCOMES:

Upon the completion of this course the student should be able

- To design and implement bio-informatics algorithms.

REFERENCES:
1. Arthur M. Lesk, “Introduction to Bioinformatics”, Second Edition, Oxford University Press, 2005.
2. T. K. Attwood, D. J. Parry-Smith, and S. Phukan, “Introduction to Bioinformatics”, Pearson Education, 1999.
3. Vittal R. Srinivas, “Bioinformatics – A Modern Approach”, Prentice-Hall of India Pvt. Ltd., 2005
4. S.C Rostogi, Mendiratta, P.Rasogi, “ BioInformatics: methods and applications”,second edition, PHI 2006.
5. Jean MickelClavere&Cadrienotredom “Bio Informatics– A beginners guide” Wiley DreamTech, 2003.
6. T.K. Attwood and D.J Perry Smith, “Introduction to Bio Informatics”, Pearson Education, 1st Edition, 2001.

IF 7202 DATA SCIENCE AND ANALYTICS L T P C
3 2 0 4

OBJECTIVES:
- To know the fundamental concepts of data science and analytics
- To learn various techniques for mining data streams
- To learn Event Modelling for different applications.
- To know about Hadoop and Map Reduce procedure

UNIT I INTRODUCTION TO DATA SCIENCE AND BIG DATA 9
Introduction to Data Science – Applications - Data Science Process – Exploratory Data analysis – Collection of data – Graphical presentation of data – Classification of data – Storage and retrieval of data – Big data – Challenges of Conventional Systems - Web Data – Evolution Of Analytic Scalability - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.

UNIT II DATA ANALYSIS 9
Correlation – Regression – Probability – Conditional Probability – Random Variables – Analysis using Mean, Median, Mode, Standard Deviation, Skewness, Kurtosis- Regression Modeling - Multivariate Analysis - Bayesian Modeling - Inference and Bayesian Networks - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics .

UNIT III DATA MINING TECHNIQUES 9
Rule Induction - Neural Networks: Learning and Generalization - Competitive Learning - Principal Component Analysis and Neural Networks - Fuzzy Logic: Extracting Fuzzy Models from Data - Fuzzy Decision Trees - Stochastic Search Methods- Neuro-Fuzzy Modelling – Association rule mining – Clustering – Outlier Analysis – Sequential Pattern Mining – Temporal mining – Spatial mining – Web mining.

UNIT IV MINING DATA STREAMS 9
Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

UNIT V FRAMEWORKS AND VISUALIZATION 9
Map Reduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases – Cloud databases - S3 - Hadoop Distributed File Systems – Visualizations - Visual Data Analysis Techniques - Interaction Techniques – Social Network Analysis – Collective Inferencing – Egonets - Systems and Applications.

TOTAL : 45 + 30 = 75 PERIODS

OUTCOMES:

Upon the completion of the course the student should be able to

- Work with big data platform and its analysis techniques.
- Design efficient algorithms for mining the data from large volumes.
- Model a framework for Human Activity Recognition
- Development with cloud databases

REFERENCES:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. AnandRajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.
4. Jiawei Han, MichelineKamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.
5. Rachel Schutt, Cathy O'Neil, "Doing Data Science", O'Reilly Publishers, 2013.
6. Foster Provost, Tom Fawcet, "Data Science for Business", O'Reilly Publishers, 2013.
7. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2014.
8. S. N. Sivanandam, S. N Deepa, "Introduction to Neural Networks Using Matlab 6.0", Tata McGraw- Hill Education, 2006.

SO7004 DYNAMIC PROGRAMMING L T P C

3 0 0 3

OBJECTIVES:

- To make more specific linear and non-linear approaches that suits both stochastic and deterministic applications.
- To analyze systems to ensure optimal and faster results.

UNIT I INTRODUCTION AND APPLICATIONS OF DYNAMIC PROGRAMMING 9

Characteristics of Dynamic Programming Problems – Formulation – Examples – Disadvantages of Dynamic Programming – Bellman's Principal of Optimality of Dynamic Programming – Applications of Dynamic Programming–Capital Budgeting Problem – Reliability Improvement Problem (Shortest path Problem) – Minimizing Scheduling problem –Optimal Subdividing Problem solution of LPP through Dynamic Programming.

UNIT II DETERMINISTIC DYNAMIC PROGRAMMING 9

Introduction – Mathematical description – Principal of Optimality – Recursive computation – Multistage Forward and Backward Recursion – Selected Dynamic Programming Applications– Cargo loading model – work force size model – equipment replacement model – investment model – inventory models – Problem of Dimensionality.

UNIT III PROBABILISTIC DYNAMIC PROGRAMMING 9

Introduction – Distribution of effort example – New product introduction, – Elementary inventory model – optimal Batch size model – Stochastic regeneration Model–Equipment Replacement – Sales Forecasting problem – Applicability and Computational feasibility.

UNIT IV DYNAMIC PROGRAMMING IN MARKOV CHAINS 9

Introduction – Stochastic Shortest– Route Model – Unbounded horizon with discounting equivalent Average Return – Linear Programming Approach – Computational considerations – Markov chain version of the equipment replacement model.

UNIT V RISK AND UNCERTAINTY 9

Terminology and Classification – Decision making under risk – Multistage Optimization under Risk – Markovian Decision Processes – A variable stage Stochastic Problem – Uncertainty and Adaptive Optimization – Gambling with unknown Probabilities – Two-Person – Zero-Sum Games – Games in Extensive.

- **TOTAL: 45 PERIODS**

OUTCOMES:

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

- Discriminate the concepts of various optimization approaches.
- Choosing appropriate dynamic programming concept for a model.

REFERENCES:

1. Hamdy A. Taha, "Operations Research – An Introduction", PHI Learning Private Limited, Eighth Edition, 2007.
2. Harvey M. Wagner, "Principles of Operations Research with applications to Managerial Decisions", PHI Learning Private Limited, 2ndEdition, 2009.
3. Ronald L. Rardin, "Optimization in Operations Research", Pearson Education, 1997

SO7002 BUSINESS PROCESS MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- To learn business process structure, framework and management.

UNIT I ORGANIZATIONAL STRUCTURE 9

Structure of the Organization- Nature and Types of Organization – Organizational structures – Organizational Relationships – Formalization – Centralization – Forms and Outcomes – IT Industry and Organizational structures – Organizational Improvement – Emergence of Business Process Reengineering (BPR)

UNIT II BUSINESS PROCESS MANAGEMENT 9

Iceberg Syndrome – Change Management and performance measurement – Business Process Management – Significance of improving business process – Management of business process – Use of external BPM experts – Organization Strategy – Process architecture

UNIT III THE FRAMEWORK - I 9

Critical implementations aspects for a BPM Solution – Structured approach to implementing BPM – BPM Implementation framework – Organization approach to BPM implementations – Framework phases – Process –centric organization – Scenarios in implementing BPM – Iterative approach

UNIT IV THE FRAMEWORK - II 9

Organization strategy phase – Process architecture phase – Launch pad phase – Understand phase – Innovate phase – Develop phase – People phase – Implement phase – Realize value phase – Sustainable performance phase – Project Management – People change management – Leadership

UNIT V BPM AND THE ORGANIZATION 9

BPM maturity – BPM maturity model – Application of the BPMM model – Embedding BPM within the organization – Knowledge management and information technology – Process Modeling and formulation using a BPM suite in an organization as a case study.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand the life cycle of a business process in an organization.
- Model and optimize the business process flow in an organization.

REFERENCES:

1. John Jeston and Johan Nelis, Business Process Management: Practical Guidelines to Successful Implementations, 2nd Edition, Butterworth-Heinemann, An imprint of Elsevier, 2009.
2. Mathias Weske, Business Process Management: Concepts, Languages, Architectures, 2nd Edition, Springer, 2012.
3. T.A. Venkatachalam, C.M. Sellappan, Business Process, PHI Learning Private Ltd, 2011

SO7008 SYSTEMS MODELLING AND SIMULATION L T P C
3 0 0 3

OBJECTIVES:

- To obtain sufficient knowledge to model any given system.
- To simulate the modeled system for performance study.

UNIT I INTRODUCTION 9

System definition -Types and characteristics -Need for modeling and simulation -Types of Simulation -Introduction to discrete event simulation -Single server -Multiserver Exercises -System modeling -Simple Petrinets

UNIT II MODELLING APPROACHES 9

Modeling concurrent systems -Analysis of Petrinets -Finite state Automata and Regular Expressions -Relationship -FSA with silent transitions -Pumping lemma for regular sets -Analysis using DFS and model checking.

UNIT III QUEUING MODELS 9

Characteristics of queuing systems -Notations -Types of Queues -Markovian model -Non-Markovian model -Queuing Networks -Applications of queuing systems.

UNIT IV SIMULATION DATA 9

Methods for generating random numbers -Testing of random numbers -Methods of generating random variants -Problem formulation -input modeling -Verification and Validation -Output1ZX Analysis.

UNIT V CASE STUDY 9

NS2 -Simulation of Computer Systems -Simulation of Computer Networks -Simulation of Mobile Networks -Simulation of Manufacturing and Material Handling Systems

TOTAL: 45 PERIODS

OUTCOMES:

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

- Modeling any given system with rationality.
- Predicting the behavior through fine grained analysis.

REFERENCES:
1. Jerry Banks “Discrete-event system simulation”, Pearson Education, 2009.
2. Fitzgerald, John, Larsen, Peter Gorm, “Modeling Systems; Practical Tools and Techniques in software development”, Cambridge University Press, 2009.
3. Hopcroft, John E, Motwani, Rajeev, Ullman, Seffrey D, “Introduction to automata theory, languages and computation”, Pearson/Addison Wesley, 3rd Edition, 2007.
4. Donald Gross and Carl M. Harris, “Fundamentals of Queuing theory”, 2nd Edition, John Wiley and Sons, New York (1985).
5. Hamdy A Taha, “Operations Research an Introduction”, Prentice Hall, Eighth Edition, 2007.
6. Jeofrey Gordon “System Simulation”, Prentice Hall of India, 2009.

SO7103	PRINCIPLES OF SYSTEMS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concepts related to systems engineering with design, analysis, game theory and decision making analysis.

UNIT I SYSTEMS ENGINEERING PROCESSES 9

Systems Engineering – Basic Definitions – System Life cycles – Phases – Steps – Formulation of Issues: – Problem Identification – Scoping – Bounding – Problem definition – Identification of needs – Alterable – Constraints – Value System Design: – Objectives and objective measures – Functional decomposition and analysis – Tools:- Objective hierarchies – Trees – Cross interaction matrix – Functional analysis approaches – Node tree – Context diagram – System decomposition.

UNIT II ANALYSIS OF ALTERNATIVES 9

Generation of Alternatives / System synthesis – Identification of activities and activity measures – Uncertain / Imperfect information – Cross-impact analysis – Hierarchical inference – Logical reasoning inference – Coupled / Uncoupled events – Baye’s Model – Event Trees – Probability Trees – Causal loop diagrams – Influence diagrams.

UNIT III STRUCTURAL MODEL & SYSTEM DYNAMICS 9

Structural modeling: – System Dynamics – Structural models – Tree structures – Reachability graph and matrix – System Dynamic Models: – Population models – Urban dynamics – World dynamic models – Economic models.

UNIT IV OPERATIONS RESEARCH AND SYSTEMS ENGINEERING 9

Operations Research – Operations Research and Systems Engineering – Operations research methods – Generating and Screening Actions – Multiple-criteria Decision Making – Multiple participant decision Making – Heuristic Programming

UNIT V DECISION MAKING AND DECSION ANALYSIS 9

Types of decisions: – Descriptive – Prescriptive – Normative – Decision assessment effort types: – Under certainty – Probabilistic uncertainty – Probabilistic imprecision – Information imperfection – Conflict and Co-operation – Prescriptive normative decision assessments – Utility theory

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will:

- Have the capability to design and analyze the system.
- Acquire decision making ability.
- Be familiar in system engineering design.

REFERENCES:
1. Andrew P.Sage and James E.Armstrong, “Systems Engineering”, Wiley InterScience Publications, 2004.
2. Andrew P.Sage, William B.Rouse, “Handbook of Systems Engineering and Management”, John Wiley and Sons, 2011.
3. Alexander Kossiakoff, William N.Sweet, “Systems Engineering: Theory & Practice”, John Wiley & Sons, 2002.
4. James N.Martin, “Systems Engineering Guidebook: A Process for Developing Systems and Products”, CRC Press, 1997.

SO7201	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To familiarize the management of supply chain assembly and role of IT in it.
- To learn about the capability of Inventory management, planning and decision making.

UNIT I INTRODUCTION 9

Introduction to SCM – Development chain – Global Optimization – Managing uncertainty and risk – Evolution of SCM – Issues in SCM – Decision phase – Supply chain drivers and obstacles – SCM complexity.

UNIT II FORECASTING 9

Demand forecasting – Role of forecasting-Characteristics – Basic Approach – Time series method – Measures of forecast error – Aggregate planning in SCM – Aggregate planning using Linear Programming – Excel – Supply and demand planning in supply chain – Managing supply – Demand – Implementing solution.

UNIT III INVENTORY MANAGEMENT AND RISK POOLING 9

Introduction to inventory – Forms of inventory – Single stage control – Economic Order Quantity (EOQ)– Lot size model – Demand uncertainty – Single period model – Review Policies – Risk Pooling – Centralized v/s Decentralized systems – Practical issues – Approaches for future demand.

UNIT IV NETWORK PLANNING AND PROCUREMENT STRATEGY 9

Network design – Inventory positioning and logistics and logistics co-ordination – Resource allocation – Transportation in a supply chain – Outsourcing benefits and risks – Buy/make Decisions – Procurement strategy – E-Procurement.

UNIT V INFORMATION TECHNOLOGY IN SUPPLY CHAINS 9

Enabling supply chain through IT –ERP vendor platforms – Service oriented architecture (SOA) – RFID

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the management of supply chain assembly and role of IT in it.
- Capability of Inventory management, planning and decision making

REFERENCES:

1. Sunil Chopra, Peter Mendil, “Supply chain Management – Strategy, Planning and Operation”, Pearson, 5th Edition, 2012.
2. HartmatStadtler, ChristoperKilger, “Supply Chain Management and Advanced Planning Concepts, Models, Software and Case Studies”, 5th edition, Springer, 2015.
3. Simchi-Levi David, Kaminsky Philip, Simchi-Levi Edith, “Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies”, McGraw Hill, 3rd edition, 2008.
4. Handfield R.B, Nicholas E.L, “Introduction to Supply Chain Management”, PHI, 1999.
5. Shapiro, J.F, “Modelling the Supply Chain”, Dubury, 2nd Edition 2006.

		L	T	P	C
OR7001	**PYTHON PROGRAMMING FOR OPERATIONS RESEARCH APPLICATIONS**	**3**	**0**	**0**	**3**

OBJECTIVES:

- Students will learn the grammar of Python programming language.
- Students will understand the process and will acquire skills necessary to effectively attempt a Optimization problem and implement it with a specific programming language - Python.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquiredover the 5 Units of the subject for improved employability skills

UNIT I INTRODUCTION TO PYTHON 9

Introduction to Python language – Using the interpreter – Python datatypes and functions – Working with Data – List, Dictionary and Set – Processing Primitives – List comprehensions – File Handling – Object model including Variables, Reference counting, Copying, and Type checking – Error handling – Control structures.

UNIT II PROGRAM ORGANIZATION AND FUNCTIONS 9

Organize Large programs into functions – Python functions including scoping rules and Documentation strings – Modules and Libraries – Organize programs into modules – Installing third - party libraries. System administration, Text processing, Subprocesses, Binary data handling, XML parsing and Database Access.

UNIT III CLASSES AND OBJECTS 9

Introduction to Object - oriented programming – Basic principles of Object - oriented programming in Python – Class definition, Inheritance, Composition, Operator overloading and Object creation – Solving problems in calculus, linear algebra and differentiation using libraries like scipy, numpy, sympy – Plotting using matplotlib

UNIT IV SOLVING OPTIMIZATION PROBLEMS USING SCIPY.OPTIMIZE 9

Solving optimization problems using SciPy. optimize : Unconstrained and constrained minimization of multivariate scalar functions– Global optimization routines – Least-square minimization and curve fitting algorithms – Scalar univariate functions minimizers and root finders – Multivariate equation system solvers - Multidimensional general nonlinear solvers – General linear programming solver

UNIT V MATHEMATICAL MODELING AND SOLVING USING PYOMO 9

Mathematical modeling – Overview of modeling components and processes – Abstract vs Concrete models – Simple abstract pyomo model – simple concrete pyomo model – Solving simple examples

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Students will be able to develop skill in programming by learning Python.
- Students will attempt to solve mathematical optimization problems by programming.
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent Trends in modeling optimization using Python.

REFERENCES:

1. Mark Lutz, "Learning Python, Powerful OOPs,O'reilly,2011
2. Guttag, John. Introduction to Computation and Programming Using Python. MIT Press, 2013.
3. Zelle, John M. Python Programming: An Introduction to Computer Science. 1st ed. Franklin Beedle & Associates, 2003
4. Budd, Timothy. Exploring Python. McGraw- Hill Science, 2009.
5. W.E. Hart, C. Laird, J.-P. Watson, and D.L. Woodruff, Pyomo - Optimization Modeling in
6. Python, Springer, 2012
7. https://docs.scipy.org/doc/scipy/reference/tutorial/optimize.html
8. https://software.sandia.gov/downloads/pub/pyomo/PyomoOnlineDocs.html

OR7002 STATISTICAL QUALITY CONTROL L T P C

3 0 0 3

OBJECTIVES:

- To facilitate the students in knowing the application of statistical techniques in Quality control and assurance.

UNIT I INTRODUCTION 9

Quality Dimensions – Quality definitions – Inspection - Quality control – Quality Assurance – Quality planning - Quality costs – Economics of quality – Quality loss function

UNIT II CONTROL CHARTS 9

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X , R and S charts, attribute control charts - p, np, c and u- Construction and application.

UNIT III SPECIAL CONTROL PROCEDURES 9

Warning and modified control limits, control chart for individual measurements, multi-vari chart, X chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV STATISTICAL PROCESS CONTROL 9

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT V ACCEPTANCE SAMPLING 9

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS2500 standards.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Control the quality of processes using control charts for variables in manufacturing industries.
- Control the occurrence of defective product and the defects in manufacturing Companies.
- Control the occurrence of defects in services.

REFERENCES:

1. K Krishnaiah, Applied Statistical Quality control and Improvement, PHI, 2014.
2. Douglas C Montgomery, Introduction to Statistical Quality Control, John Wiley, Seventh Edition, 2012.
3. Grant E.L. and Leavensworth, Statistical Quality Control, TMH, 2000.
4. IS 2500 Standard sampling plans

OR7003 SCHEDULING ALGORITHMS L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on various scheduling algorithms applicable to single machine, parallel machines, flow shop and job shop models.

UNIT I SCHEDULING THEORY 9

Scheduling background – Scheduling function – Sequencing – Ready time – Flow time – Tardiness - Weighted flow time – Inventory – Regular measures of performance – Dominant schedules – SPT, EDD, WSPT sequences – Scheduling Theorems

UNIT II SINGLE MACHINE SCHEDULING 9

Pure sequencing model – Hodgson's algorithm – Smith's rule – Wilkerson Irwin algorithm – Neighborhood search – Dynamic programming technique – Branch and Bound algorithm – Non simultaneous arrivals – Minimizing T and F for dependent jobs – Sequence dependent set up times.

UNIT III PARALLEL MACHINE SCHEDULING 9

Preemptive jobs: McNaughton's algorithm – Non preemptive jobs – Heuristic procedures – Minimizing Fw : H1 &Hm heuristics – Dependent jobs: Hu's algorithm – Muntz Coffman algorithm

UNIT IV FLOW SHOP SCHEDULING 9

Characteristics – Johnson's algorithm – Extension of Johnson's rule – Campbell Dudek Smith algorithm – Palmer's method – Start lag, stop lag – Mitten's algorithm – Ignall Schrage algorithm - Despatch index heuristic.

UNIT V JOB SHOP SCHEDULING 9

Characteristics –Graphical tools – Jackson's algorithm – Feasible, Semi-active and Active schedules – Single pass approach – Non delay schedule – Priority dispatching rules – Heuristic schedule generation – Open shop scheduling.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Students will be able to design, analyse and implement single machine, parallel machine, flow shop, and job shop scheduling algorithms

REFERENCES:

1. Kenneth R.Baker, “Introduction to sequencing and scheduling”, John Wiley &Sons, New York, 2000.
2. Richard W. Conway, William L.Maxwell and Louis W. Miller, “Theory of Scheduling”, Dover Publications, 2003.

SO7003	DESIGN PATTERNS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept of patterns
- To learn various design patterns.
- To learn the usage of design patterns to keep code quality high.

UNIT I INTRODUCTION 9

History and Origin of Patterns – Introduction to OOAD - Apply Design Patterns – Prototype – Testing.

UNIT II DESIGN PATTERNS 9

Kinds of Pattern – Quality and Elements – Patterns and Rules – Creativity and Patterns – Creational Patterns – Structural Patterns – Behavioural Patterns, Factory Patterns.

UNIT III FRAMEWORKS 9

State and Strategy of Patterns. Singleton, Composite, Functions and the Command Patterns, Adaptor, Proxy Pattern, Decorator Pattern – Pattern Frameworks and Algorithms

UNIT IV CATALOGS 9

Pattern Catalogs and Writing Patterns, Anti-Patterns, Pattern Community, Pattern Based Software Development.

UNIT V CASE STUDIES 9

A7E - case study in utilizing architectural structures, WWW - case study in interoperability, Air Traffic Control – case study in designing for high availability, Celsius Tech – case study in product line development

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of the course, the student will be able to

- Comprehend most important design patterns
- Apply design patterns to design innovative software.
- Familiarize real time applications developed with case studies.

REFERENCES:

1. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, “Design patterns: Elements of Reusable object-oriented software”, Pearson First Edition, 2012.
2. James W- Cooper, Addison-Wesley,"Java Design Patterns – A Tutorial”, 2003.
3. Eric Freeman, Elisabeth Robson, Bert Bates, Kathy Sierra, “Head First Design Patterns”, O'Reilly, 2004.
4. Craig Larman, "Applying UML and Patterns: An Introduction to object-oriented Analysis and Design and the unified process”, Second Edition, Prentice Hall, 2001.
5. William J Brown et al., "Anti-Patterns: Refactoring Software, Architectures and Projects in Crisis", John Wiley, 1998.

OR7004	JAVA PROGRAMMING AND OPERATIONS RESEARCH APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about the concepts of java and it features.
- To learn about the concept of networking, API and GUI in java.
- To learn solve Operations Research problems using JAVA.

UNIT I INTRODUCTION TO JAVA 9

Java Virtual Machine -Reflection -I/O Streaming -Filter and Pipe Streams -Byte Codes -Byte Code Interpretation -Dynamic Reflexive Classes -Threading -Java Native Interfaces.

UNIT II NETWORKING, APPLETS and GUI 9

RMI and RMI-IIOP -Custom sockets -Object serialization -Retrieving Data with URLs -Sockets for clients -Sockets for servers -Secure Sockets -UDP datagrams and sockets -Multicast Sockets -Applets -Developing GUI Applications.

UNIT III ENTERPRISE JAVA 9

Java Beans Enterprise -Java Beans -Distributed Object models –URL Connection class -Protocol Handlers -Content Handlers -Distributed garbage collection -Interface definition language.

UNIT IV SOLVING OPERATIONS RESEARCH PROBLEMS 9

Solving Operations Research problems - Constraint programming problems - Linear programming problems - Integer programming problems

UNIT V SOLUTION USING GRAPH AND KNAPSACK ALGORITHMS 9

Graph and Knapsack algorithms - Bin packing and knapsack algorithms - Traveling Salesman Problem - Vehicle Routing Problem - Graph algorithms - shortest paths - min cost flow - max flow - linear sum assignment.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Write programs using java
- Develop solution to operation research problems.

REFERENCES:

1. Herbert Schildt, “Java - The Complete Reference”, 9th Edition, McGraw-Hill, 2014.
2. Robert Sebesta, “Programming with world wide web”, Pearson Education, 8th Edition,2015
3. Cay Horstmann and Gary Cornell, “Core Java”, Volume1 & Volume2, Pearson Education, 9th Edition, 2012.
4. HamdyA.Taha, “Operations Research - An Introduction”, Prentice Hall, Ninth Edition, 2010.
5. J.K.Sharma, “Operations Research Theory and applications”, Macmillan, 5th Edition, 2013.