M. Tech.

COMPUTER SCIENCE AND ENGINEERING SYLLABUS



Department of Computer Science and Engineering (M. Tech. CSE Programme Accredited by NBA)

VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING COLLEGE

(An Autonomous, ISO 9001:2015 Certified Institution) (Approved by AICTE, Accredited by NAAC with 'A' Grade, Affiliated to JNTUK, Kakinada) (Sponsored by Siddhartha Academy of General & Technical Education)

> Kanuru, Vijayawada Andhra Pradesh - 520007, INDIA. www.vrsiddhartha.ac.in

INSTITUTE VISION

To nurture excellence in various fields of engineering by imparting timeless core values to the learners and to mould the institution into a centre of academic excellence and advanced research.

INSTITUTE MISSION

To impart high quality technical education in order to mould the learners into globally competitive technocrats who are professionally deft, intellectually adept and socially responsible. The institution strives to make the learners inculcate and imbibe pragmatic perception and proactive nature so as to enable them to acquire a vision for exploration and an insight for advanced enquiry.

DEPARTMENT VISION

The department vision is clearly defined and is in line with the college's vision. The vision of the department is:

"To evolve as a centre of academic excellence and advanced research in Computer Science and Engineering discipline."

DEPARTMENT MISSION

This mission of the Department is concise and supports the College's mission. The mission of the Computer Science and Engineering Department is:

"To inculcate students with profound understanding of fundamentals related to discipline, attitudes, skills, and their application in solving real world problems, with an inclination towards societal issues and research."

Program Educational Objectives(PG)

We have program educational objectives for our Computer Science and Engineering Program. Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

Our Computer Science and Engineering program objectives

- I. Will solve wide range of computing related problems to fulfil the needs of industry and society.
- II. Will have successful careers in academia, research and industry.
- III. Will communicate effectively, work in collaboration and practice the profession in accordance with professional standards and ethical practices.

PROGRAM OUTCOMES

PO1: An Ability to independently carryout research/ investigation and development work to solve Practical Problems. [Problem solving and Research skills]

PO2: An ability to write and present a substantial technical report/document. [Communication]

PO3: Able to demonstrate a degree of mastery over the area as per the specialization of the program. [Lifelong Learning]

Program Specific Outcomes

PSO1: An ability to learn the state of art emerging technologies related to computer science and apply the learned concepts in related fields.

PSO2: Have a clear understanding of professional and ethical responsibility

VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING COLLEGE **COMPUTER SCIENCE AND ENGINEERING** SCHEME OF INSTRUCTION FOR TWO YEAR PG PROGRAM [M. TECH 19] **SEMESTER I Contact Hours: 23** Р С CE S.No Т SE Course Course Title of the L Т Code Course Category Programme 19CSCS1001 Data Structures 3 0 0 3 40 60 100 1. Core - I and Algorithms Programme 19CSCS1002 Machine 3 3 40 60 100 2. 0 0 Core - II Learning Programme 19CSCS1003 Wireless and 100 3 60 3. 0 0 3 40 Core - III Mobile Networks Programme 19CSCS1014 A. Image 3 0 0 3 40 60 100 4. Elective - I Processing and Pattern Recognition B. Embedded Software Design and Validation C. Advances in Operating System Design D. Bioinformatics E. Industry need based elective Programme 19CSCS1015 A. Data 5. 3 0 0 3 40 60 100 Elective -Science Π B. Information Retrieval Systems C. Natural Language Processing D. Graph Theory E. Industry need based

			Elective							
6.	Mandatory Learning Course	19MTMC1026	Research Methodology and IPR	2	0	0	-	40	60	100
7.	Laboratory - I	19CSCS1051	Data Structures and Algorithms Laboratory	0	0	3	1.5	40	60	100
8.	Laboratory - II	19CSCS1052	Machine Learning Laboratory	0	0	3	1.5	40	60	100
			Total	17	0	6	18	320	480	800

L – Lecture, T – Tutorial, P – Practical, C – Credits

CE - Continuous Evaluation, SE - Semester-end Evaluation, T – Total Marks

SEME	STER II						Co	ntact	Hou	rs: 2
S.No	Course Category	Course Code	Course	L	T	Р	С	CE	SE	Т
1.	Programme Core – IV	19CSCS2001	High Performance Computing	3	0	0	3	40	60	100
2.	Programme Core – V	19CSCS2002	Cloud Computing	3	0	0	3	40	60	100
3.	Programme Core – VI	19CSCS2003	Cyber Security	3	0	0	3	40	60	100
4.	Programme Elective – III	19CSCS2014	 A. Internet of Things B. Digital Forensics C. Geographic Information System D. Algorithms for Bioinformatics E. Industry need based Elective 	3	0	0	3	40	60	100
5.	Programme Elective – IV	19CSCS2015	A Blockchain Technologies B Software Defined Networks C Open source programming D Modern Software Engineering E Industry need based Elective	3	0	0	3	40	60	100
6.	Audit Course	19MTAC2036	Technical Report Writing	2	0	0	-	0	0	0
7.	Term Paper	19CSCS2063	Term Paper#	0	0	2	1	40	60	100
8.	Laboratory - I	19CSCS2051	High Performance Computing Laboratory	0	0	3	1.5	40	60	100
9.	Laboratory - II	19CSCS2052	Cloud Computing Laboratory	0	0	3	1.5	40	60	100

Total 17	0	8	19	320	480	800	
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L – Lecture, T – Tutorial, P – Practical, C – Credits

CE - Continuous Evaluation, SE - Semester-end Evaluation, T – Total Marks

*Students to be encouraged to go industrial training for at least Six weeks during semester break

#Students should conduct the Literature Survey for the proposed research topic and they need to develop a proto type or simulation based (must be outcome oriented) – the same to be presented in any conference (national or international)

Sen	emester III Contact Hours: 24										
S.	No	Course	Course	Course	L	Т	Р	C	CE	SE	Т
		Category	Code								
	1.	Programme Elective - V	19CSCS3011	 A. Joy of Computing using Python B. User Interface Design C. Deep Learning D. Data Visualization E. Industry offered Cartification 	0	0	0	3	-	10 0#	100
	2	Project	19CSCS3061	$\frac{\text{Certification}}{\text{Project} - \text{Part } \Delta^*}$	0	0	20	10	10	(0)	100
	∠.	Part-A			U	U	20	10	40	60	100
	3.	Internship	19CSCS3052	Internship (After II Sem)	0	0	4	2	-	10 0	100
				Total	0	0	24	15	40	260	300

L – Lecture, T – Tutorial, P – Practical, C – Credits

CE - Continuous Evaluation, SE - Semester-end Evaluation, T – Total Marks

Evaluation done by MOOC's providers will be considered

*To be continued in the IV Semester

Program Elective V may be completed in semester I or II by satisfying the pre-requisites those who are going for industrial project.

Seme	Semester IV Contact Hours: 32									
S.No	Course Category	Course Code	Course	L	Т	Р	С	CE	SE	Т
1.	Project Part-B	19CSCS4061	Project - Part B	0	0	32	16	40	60	100
			Total	0	0	32	16	40	60	100

L – Lecture, T – Tutorial, P – Practical, C – Credits

CE - Continuous Evaluation, **SE** - Semester-end Evaluation, **T** – Total Marks

Total Credits: 68

Semester	Credits
1	18
2	19
3	15
4	16

19CSCS1001 DATASTRUCTURES AND ALGORITHMS

Course Category:	Programme Core	Credits:	3
Course Type:	Theory	Lecture - Tutorial-Practice:	3 - 0 - 0
Prerequisites:	Programming in C	Continuous Evaluation:	40
		Semester end Evaluation:	60
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Implement various tree	operations
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CO2	Compare	greedv	and	dvnamic	algorithms
	Compare	8		a j manne	

- **CO3** Understand graph algorithms and their applications
- **CO4** Implement number theoretic algorithms

CO5 Analyze string matching and Approximate algorithms.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	3			3	
CO2			1		
CO3		2			
CO4			1	3	
CO5		2	2		

UNIT I

Binary Search Trees: BST, Querying BST, Insertion and Deletion, Randomly built binary search trees.

AVL Trees: Properties of AVL trees, Rotations, Insertion, Deletion.

B-Trees: Definition of B-trees, Basic operations on B-Trees, Deleting a key from a B-tree.

UNIT II

Dynamic Programming: Matrix Chain Multiplication, Elements of dynamic programming, longest common subsequences, optimal binary search trees.

Greedy Algorithms: An activity-selection problem, Elements of the greedy strategy, Huffman codes.

Amortized Analysis: Aggregate analysis, The Accounting method, Potential method, dynamic tables.

UNIT III

Single-Source Shortest Paths: Bellman-Ford Algorithm, Single-source shortest paths in directed acyclic graphs, Dijkstra's algorithm.

All-Pairs Shortest Paths: Floyd-Warshall algorithm.

String Matching: The naïve string-matching algorithm, Rabin-Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm.

UNIT IV

NP-Completeness: Polynomial time, Polynomial time verification, NP-completeness and reducibility, NP-complete problems

Approximate Algorithms: The vertex-cover problem, Travelling – salesman problem, Set-covering problem, Randomization and linear programming, subset- sum problem.

TEXT BOOKS

[1] Cormen, Leiserson, Rivest, and Stein, "Introduction to Algorithms", Third Edition, McGraw Hill, 2010.

REFERENCE BOOKS

- [1] Robert Sedgewick Philippe Flajolet, "An Introduction to the Analysis of Algorithms", First Edition, McGraw Hill, 1995.
- [2] Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd edition, Pearson Education.
- [3] Horowitz Sahni and Anderson-Freed," Fundamentals of Data Structures in C",

2nd edition, Universities Press.

[4] Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson; 1st edition

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] Dr.P.P. Chakraborty, IIT Kharagpur, May 19, 2010, Data Structures, NPTEL, Available:www.youtube.com/ watch? v=S47aSEqm_0I
- [2] Dr. Naveen Garg, IIT Delhi, Sep 24, 2008, Data Strucutres, NPTEL, Available:http://nptel.iitm.ac.in,

http://freevideolectures.com/ Course /2279/Data-Structures-And-Algorithms

- [3] Shai Simonson, Jun 16, 2014, Data Structures, NPTEL, Available: http://nptel.ac.in/video.php? subjectId=106102064
- [4] https://nptel.ac.in/courses/106101060/
- [5]https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-2015/
- [6] https://theory.stanford.edu/~tim/videos.html

		19C S	SCS1002						
		MACHIN	E LEARNIN	G					
Course C	ategory:	Programme Core		Credits					
Course T	ype:	Theory	Lecture -T	Lecture - Tutorial-Practice:					
Prerequis	sites:	Data Mining	Contin	Continuous Evaluation:					
			Semester	end Evaluatio	n: 60				
				Total Mark	as: 100				
COURS	E OUTCO	MES							
Upon suc	ccessful con	mpletion of the co	urse, the stude	nt will be able t	0:				
CO1	O1 Identify instance based learning algorithms								
CO2	Design neural network to solve classification and function approximation problems								
CO3	Build opt	Build optimal classifiers using genetic algorithms							
CO4	Analyze p	probabilistic metho	ods for learnin	g					
Contribu Outcome	ution of Co es (1 – Low	ourse Outcomes t v, 2 - Medium, 3 -	owards achie – High)	vement of Prog	ram				
	PO 1	PO 2	PO 3	PSO 1	PSO 2				
CO1	2		2	2					
CO2	2		2	2					
CO3	2		2	2					
CO4	2		2	2					

UNIT I

Introduction - Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning

Concept learning and the general to specific ordering - Concept learning as

search, General-to-specific ordering of hypotheses, Find-S: finding a maximally specific hypothesis, List then eliminate algorithm, Candidate elimination learning algorithm

UNIT II

Decision Tree learning – Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning

Artificial Neural Networks – Neural network representation, Appropriate problems for neural network learning, Perceptrons- Gradient descent and the Delta rule, Multilayer networks and the back propagation algorithm

Evaluation Hypotheses – Estimation hypothesis accuracy, Basics of sampling theory, A general approach for deriving confidence intervals

UNIT III

Bayesian learning – Bayes theorem, Bayes theorem and concept learning, Bayes optimal classifier, Naïve Bayes classifier, Bayesian belief networks- Conditional independence, Learning Bayesian belief networks, The EM algorithm- general statement of EM algorithm,

Computational learning theory – Sample complexity for Finite Hypothesis Space, Sample Complexity for infinite Hypothesis Spaces- Shattering a Set of Instances

Instance-Based Learning- k -Nearest Neighbour Learning- Locally Weighted Regression, Case-Based Reasoning

UNIT IV

Genetic Algorithms – An illustrative Example, Genetic Programming-**Representing Programs, Illustrative Example**, Models of Evolution and Learning

Learning Sets of Rules – Sequential Covering Algorithms- General to Specific Beam Search, Learning First Order Rules, Learning Sets of First Order Rules: FOIL [CO3,CO4]

TEXT BOOKS

[1] Tom M. Mitchell, "Machine Learning", McGraw Hill, Indian Edition, 2017.

[2] William W Hsieh, "Machine Learning Methods in the Environmental Sciences, Neural Networks and kernels" Cambridge Univ Press, 1st Edition.

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] Evaluating a hypothesis, Stanford University, https://www.coursera.org/learn/machine-learning/lecture/yfbJY/evaluating-ahypothesis, Last accessed on 26-8-2019
- [2] Balaraman Ravindran, NPTEL Lecture 1 Introduction to Machine Learning, https://www.youtube.com/watch?v=fC7V8QsPBec, Last accessed on 26-8-2019
- [3] Benchmarking Neural Networks on Oracle Cloud Infrastructure with Mapr, https://mapr.com/whitepapers/benchmarking-neural-networks-on-oraclecloud-infrastructure-with-mapr/ Last accessed on 26-8-2019
- [4] George Crump, Dealing with The AI and Analytics Data Explosion https://mapr.com/whitepapers/dealing-with-the-ai-and-analytics-dataexplosion/ Last accessed on 26-8-2019

19CSCS1003 WIRELESS AND MOBILE NETWORKS

Course Category:	Programme Core	Credits:	3
Course Type:	Theory	Lecture -Tutorial-Practice:	3 - 0 - 0
Prerequisites:	Computer Networks	Continuous Evaluation:	40
		Semester end Evaluation:	60
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Understand the concepts of wireless communication.
CO2	Analyze WPAN, WMAN and WWAN technologies
CO3	Compare 3G and 4G technologies of communications.
CO4	Familiarize with concepts of Wireless Adhoc Networks

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1			2		
CO2			2	1	
CO3	1		3	2	
CO4	1			2	

COURSE CONTENT

UNIT I

Fundamentals of Wireless Communication: Digital Communications, Wireless Communication Systems, Wireless Media, Frequency Spectrum, Technologies in Digital Wireless Communication, Wireless Communication Channel Specifications, Types of Wireless Communication Systems **Introduction to Mobile Communications:** Growth of Mobile Communications, A Little History, Mobile Communication fundamentals, Mobile Data, WiFi, Bluetooth, Cable Systems, Wireless Migration Options

UNIT II

Wireless Personal Area Networks (WPAN): WPAN, Network Architecture, WPAN Components, WPAN Technologies and Protocols, WPAN Applications

Wireless Metropolitan Area Networks (WMAN): WMAN, WMAN Architecture, Network Protocols, Broadband Wireless Networks, WMAN Applications

Wireless Wide Area Networks (WWAN): Cellular Networks, Satellite Networks, WLAN Versus WWAN, Interworking of WLAN and WWAN, WWAN Applications

UNIT III

Third Generation (3G) Overview: Introduction, UMTS, Services, Air Interface, 3GPP release 1999 Network architecture, Release 4 architecture, Release 5 All-IP architecture, Overview CDMA2000, TD-CDMA, TD-SCDMA, Commonality among WCDMA, CDMA2000,TD-CDMA and TD-SCDMA

Long-Term Evolution: LTE Ecosystem, Standards, Radio Spectrum, LTE Architecture, UE, eNodeB, Core Network, Radio Channel Components, TD-LTE, MIMO, LTE Scheduler, Carrier aggregation, Cell Search, Cell Reselection, Attach and Default Bearer Activation, Handover, SONs, Relay Cells, HetNET, RRH, VoLTE, LTE Advanced

UNIT IV

Wireless Adhoc Networks: Wireless Adhoc Networks, Mobile Adhoc Networks, Wireless Sensor Networks, Wireless Mesh Networks, Vehicular Adhoc Networks **Research Issues in Wireless Networks:** Modulation, Radio Resource Management, Channel Allocation, Error Control and coding, Congestion Control, Routing, Addressing, Network Access Control, Flow Control, Security and Privacy, QoS Management, Power Management, Cross Layer Control, Network Modelling, Simulation Modelling, Network Measurements.

TEXT BOOKS

[1] Dr. Sunilkumar, et al "Wireless and Mobile Networks: Concepts and

Protocols", Wiley India, 2014

[2] Clint Smith, Daniel Collins, "Wireless Networks-Design and Integration for LTE,EVDO,HSPA and WIMAX", Third Edition, McGraw Hill, 2014 UNIT -III

REFERENCE BOOKS

- [1] Raj Kamal, "Mobile Computing", Second Edition, Oxford University Press, 2012
- [2] Asoke K.Talukder, Roopa R. Yavagal, "Mobile Computing Technology, Applications and Service Creation" McGraw Hill, 2007
- [3] Iti Saha Misra, "Wireless Communications and Networks- 3G and Beyond", 2nd Edition, McGraw Hill, 2013
- [4] William Stallings "Wireless Communications and Networks", Second Edition, Pearson Education, 2007

E-RESOURCES AND OTHER DIGITAL MATERIAL

- Sciencedirect.com, 'Mobile Networks', 2019. [Online] Available: https://www.sciencedirect.com/topics/computer-science/mobilenetworks. [Accessed: 28- Aug- 2019].
- [2] Springer.com, 'The Journal of SPECIAL ISSUES on Mobility of Systems, Users, Data and Computing: Mobile Networks and Applications, 2019. [Online]. Available: https://link.springer.com/journal/11036. [Accessed: 28-Aug- 2019].

		19CSC	S1014A					
-	IMAGE P	ROCESSING AND	PATTER	N RECOGNITION	N			
Course C	ategory:	Programme		Credits:	3			
		Elective						
Course T	ype:	Theory	Lecture -'	Futorial-Practice:	3 - 0 - 0			
Prerequis	sites:	Computer	Conti	nuous Evaluation:	40			
		Graphics, Basic	Semeste	er end Evaluation:	60			
		knowledge of -		Total Marks:	100			
		rendem veriebles						
		Talluolli valtaoles						
COURS	E OUTCC	OMES						
Upon suc	ccessful co	mpletion of the cour	se, the stud	ent will be able to:				
001	Understa	nd the fundamental	concepts an	nd basic relations a	mong the			
COI	pixels.							
CO2	Analyze	the Spatial and F	requency c	lomain concepts for	or image			
	enhancen	nent.						
CO3	Identify t	he Image restoration	n and Imag	e segmentation tech	nique for			
005	image.							
CO4	Understand the basic of Pattern recognition and Feature Extraction							
Contribu Outcome	ution of Co es (1 – Lov	ourse Outcomes tov v, 2 - Medium, 3 – 1	vards achi High)	evement of Program	m			
	PO 1	PO 2	PO 3	PSO 1	PSO 2			
CO1	3		3	3				
CO2	3		3	3				
CO3	3		3	3				
CO4	3	3 3 3						
<u> </u>	1			1 1				

UNIT I

Introduction: Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System

Digital Image Fundamentals: Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some basic Relationships between Pixels

UNIT II

Intensity transformations: Some Basic intensity Transformation functions, Histogram Processing, Smoothing and Sharpening.

Spatial and Frequency Filtering for Image Enhancement: Fundamentals of Spatial Filtering, Smoothing spatial Filters, Sharpening spatial Filters, Fundamentals of Frequency Filtering, Smoothing frequency-domain Filters, Sharpening Frequency-domain Filters

UNIT III

Image restoration: A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering

Image Segmentation: Fundamentals, Point, Line and Edge Detection, Thresholding, Region-Based Segmentation, Color Image Processing: Color fundamentals, color models, pseudo color image processing, basics of full – color image processing.

UNIT IV

Feature Extraction And Dimension Reduction: Color, Texture, Shape, Local Features, Spatial and frequency domain, HOG, Corner Detection, SIFT and SURF, Hough Transform, Principal Component Analysis.

Pattern Recognition: The Unsupervised Clustering Algorithm, K-NN, Support Vector Machine, Neural Networks, Deep Learning-Overview.

TEXT BOOKS

- Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing. 4ed, PHI/Pearson Education, 2018.
- [2] Richard O. Duda, Peter E. Hart and David G. Stroke Pattern Classifications. 2

Edition Wiley Student Edition 2006

[3] Research Publications on feature extraction and pattern recognition.

REFERENCE BOOKS

- S. Jayaraman, S. Esakkirajan And T.Veerakumar, "Digital Image Processing" 3Ed, Tata McGraw - Hill Education Pvt. Ltd, 2010.
- [2] A.K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall India, 2000
- [3] Devi V.S.; Murty, M.N. Pattern Recognition: An Introduction, Universities Press, Hyderabad. 2011.

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] Lecture Series on Digital Image Processing by Prof. P.K.Biswas, IIT Khargapur Available at: http://nptel.ac.in/courses/117105079/1
- [2] Lecture Series on Pattern Recognition and Application by Prof. P.K.Biswas, IIT Khargapur Available at: https://nptel.ac.in/courses/117105101/

		19CS	SCS1014B			
	EMBEDI	DED SOFTWARF	E DESIGN AND VALIDATION	I		
Course C	ategory:	Programme	Credits:	3		
- •		Elective				
Course T	ype:	Theory	Lecture - Tutorial-Practice:	3 - 0 - 0		
Prerequis	sites:	Computer	Continuous Evaluation:	40		
-		Organization	Semester end Evaluation:	60		
			Total Marks:	100		
COURS	E OUTCO	OMES				
Upon suc	cessful co	mpletion of the co	urse, the student will be able to:			
CO1	Understa	and the different co	mponents for an embedded syste	m.		
CO2	Illustrate different devices used in embedded systems.					
CO3	Summarize different services used in real time operating systems.					
CO4	Compare various embedded software development tools.					
Contribu	tion of C	auna Antaamaa t	awards ashiovament of Dragon			

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	1		2	2	
CO2	1		2	2	
CO3	1		2	2	
CO4	1		2	2	

COURSE CONTENT

UNIT I

Introduction to Embedded Systems: Embedded systems; Processor embedded into a system; Embedded hardware units and devices in a system; Embedded software in a system; Examples of embedded systems; Embedded System-on-Chip (SoC) and use of VLSI circuit design technology; Complex systems design and processors; Design process in embedded system. Formalization of system design; Design process and design examples; Classification of embedded systems; Skills required for an embedded system designer.

UNIT II

Devices: I/O types and examples; Serial communication devices; Parallel device ports;Sophisticated interfacing features in device ports. Wireless devices; Timer and counting devices; Watchdog timer; Real time clock.

Device Drivers and Interrupts Service Mechanism: Device access without interrupts; ISR concept; Interrupt sources; Interrupt servicing mechanism; Multiple interrupts; Context and the periods for context-switching, interrupt latency and deadline.

UNIT III

8051 Architecture, Memory Organizations and Real World Interfacing : 8051 Architecture; Real world interfacing, Processor and Memory Organization.

Program Modeling Concepts, Processes, Threads, and Tasks: Program models; DFG models; State machine programming models for event controlled program flow; Modeling of multiprocessor systems. Multiple processes in an application; Multiple threads in an application; Tasks and task states; Task and data; Distinctions between functions, ISRs and tasks.

UNIT IV

Real-time Operating systems: Operating System services; Process management; Timer functions; Event functions; Memory management; Device, file and I/O sub-systems management; Interrupt routines in RTOS environment and handling of interrupt source calls.

Embedded SoftwareDevelopment, Tools: Introduction; Host and target machines; Linking and locating software; Getting embedded software in to the target system; Issues in hardware software design and co-design; Testing on host machine; Simulators; Laboratory tools.

TEXT BOOKS

 Rajkamal, Embedded Systems Architecture, Programming and Design. 2 ed, TMH, 2008.

REFERENCE BOOKS

- [1] Wayne Wolf, Computers as Components Principles of Embedded Computer System Design. Elsevier, 2005.
- [2] Steve Heath, Embedded Systems Design. 2 ed, Elsevier, 2003.
- [3] Dr. K.V.K.K. Prasad, Embedded/ Real-Time Systems: Concepts, Design and Programming The Ultimate Reference. Dreamtech. Press, 2004.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] https://nptel.ac.in/courses/108102045/

[2] https://tinyurl.com/yxfbpahn

	ADVA	19CSC ANCES IN OPERA	CS1014C ATING SYS	TEM DESIGN					
Course C	Category:	Programme Elective		Credits:	3				
Course T	ype:	Theory	Lecture -T	Sutorial-Practice:	3 - 0 - 0				
Prerequi	sites:	Introduction	Contin	uous Evaluation:	40				
		to operating systems	Semester	r end Evaluation: Total Marks:	60 100				
COURS	E OUTCO	OMES							
Upon su	ccessful co	mpletion of the cour	rse, the stude	ent will be able to:					
CO1	Demonstrate the mutual exclusion, deadlock detection and agreement protocols of distributed operating system.								
CO2	Learn th systems.	Learn the various resource management techniques for distributed systems.							
CO3	Identify system.	Identify the different features of real time and mobile operating system.							
CO4	Modify features	Modify existing open source kernels in terms of functionality or features used.							
Contrib Outcom	ution of C es (1 – Lov	ourse Outcomes to w, 2 - Medium, 3 –	wards achie High)	vement of Progra	m				
	PO 1	PO 2	PO 3	PSO 1	PSO 2				
CO1	3								
CO2		2							
CO3			1						
CO 4				1					
CO4				1					

UNIT-I

Operating System Overview, Process description & Control: Operating System Objectives and Functions, The Evolution of Operating Systems, Major Achievements, Developments Leading to Modern Operating Systems, Microsoft Windows Overview, Traditional UNIX Systems, Modern UNIX Systems, What is a Process?, Process States, Process Description, Process Control, Execution of the Operating System, Security Issues.

UNIT II

Threads, SMP, and Microkernel, Virtual Memory: Processes and Threads, Symmetric Multiprocessing (SMP), Micro Kernels, Windows Vista Thread and SMP Hours Management, Linux Process and Thread Management. Hardware and Control Structures, Operating System Software, UNIX Memory Management, Windows Vista Memory Management, Summary.

UNIT III

Multiprocessor and Real-Time Scheduling: Multiprocessor Scheduling, Real-Time Scheduling, Linux Scheduling, UNIX PreclsSl) Scheduling, Windows Vista Hours Scheduling, Process Migration, Distributed Global States, Distributed Mutual Exclusion, Distributed Deadlock.

UNIT IV

Kernel Organization: Using Kernel Services, Daemons, Starting the Kernel, Control in the Machine, Modules and Device Management, MODULE Organization, MODULE Installation and Removal, Process and Resource Management, Running Process Manager, Creating a new Task , IPC and Synchronization, The Scheduler, Memory Manager , The Virtual Address Space, The Page Fault Handler , File Management. The windows NT/2000/XP kernel: Introduction, The NT kernel, Objects, Threads, Multiplication Synchronization, Traps, Interrupts and Exceptions, The NT executive, Object Manager, Process and Thread Manager , Virtual Memory Manager, I/o Manager, The cache Manager Kernel local procedure calls and IPC, The native API, subsystems.

TEXT BOOKS

- [1] William Stallings, "Operating Systems: Internals and Design Principles", 6th Edition, Prentice Hall, 2013.
- [2] Gary Nutt, "Operating Systems", 3rd Edition, Pearson, 2014.

REFERENCE BOOKS

- [1] Silberschatz, Galvin, Gagne, "Operating System Concepts", 8th Edition, Wiley, 2008
- [2] Andrew S. Tanenbaum, Albert S. Woodhull, "Operating Systems, Design and Implementation", 3rd Edition, Prentice Hall, 2006.
- [3] Pradeep K Sinha, " Distribute Operating Systems, Concept and Design", PHI, 2007

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] Prof. P.K. Biswas sir, Ph.D.(IIT Kharagpur), Video Lectures on "Operating Systems"
- [2] http://nptel.ac.in/courses/Webcourse-contents/IISc- BANG/ Operating % 20 Systems/New_index1.html
- [3] http://www.ics.uci.edu/~ics143/lectures.html,2013
- [4] http://web.stanford.edu/~ouster/cgi-bin/cs140-winter16/index.php.

19CSCS1014D							
		BIOINF	ORMATICS				
Course C	ategory: P	rogramme		Credi	ts: 3		
	E	lective					
Course T	ype: T	heory	Lecture -T	utorial-Practic	e: $3 - 0 - 0$		
Prerequisites:		iology for	Contin	uous Evaluatio	on: 40		
		ngineers	Semester	end Evaluatio	on: 60		
				Total Marl	ks: 100		
COURSI	E OUTCOM	IES					
Upon suc	cessful comp	oletion of the co	urse, the stude	nt will be able t	:0:		
CO1	Understand	the biological s	equence and s	tructural databa	ses.		
CO2	Analyze the genome information and DNA sequence.						
CO3	Compare pa	air-wise and mu	ltiple sequence	e alignment met	hods.		
CO4	Apply second	ndary structures	on DNA data				
Contribu	tion of Cou	rse Outcomes t	owards achie	vement of Prog	gram		
Outcome	es (1 – Low,	2 - Medium, 3 -	– High)		- -		
	PO 1	PO 2	PO 3	PSO 1	PSO 2		
CO1	3		1				
CO2	3		1	2			
CO3	3		1	2			

3

1

UNIT-I

CO4

Introduction: Definitions, Sequencing, Biological sequence/structure, Genome

1

Projects, Pattern recognition and prediction, Folding problem, Sequence Analysis, Homology and Analogy.

Protein Information Resources: Biological databases, Primary sequence databases, Protein Sequence databases, Secondary databases, Protein pattern databases, and Structure classification databases.

UNIT II

Genome Information Resources: DNA sequence databases, specialized genomic resources

DNA Sequence analysis: Importance of DNA analysis, Gene structure and DNA sequences, Features of DNA sequence analysis, EST (Expressed Sequence Tag) searches, Gene hunting, Profile of a cell, EST analysis, Effects of EST data on DNA databases

UNIT III

Pair wise alignment techniques: Database searching, Alphabets and complexity, Algorithm and programs, Comparing two sequences, sub-sequences, Identity and similarity, The Dot plot, Local and global similarity, different alignment techniques, Dynamic Programming, Pair wise database searching.

Multiple sequence alignment: Definition and Goal, The consensus, computational complexity, Manual methods, Simultaneous methods, Progressive methods, Databases of Multiple alignments and searching.

UNIT IV

Secondary database searching: Importance and need of secondary database searches, secondary database structure and building a sequence search protocol

Analysis packages: Analysis package structure, commercial databases, commercial software, comprehensive packages, packages specializing in DNA analysis, Intranet Packages, Internet Packages.

TEXT BOOKS

[1] T K Attwood & D J Parry-Smith, Introduction to Bioinformatics, Addison Wesley Longman. Bioinformatics –A Beginners Guide by Jean-Michel Claveriw, CerdricNotredame, WEILEY dreamtech India Pvt. Ltd.

REFERENCE BOOKS

[1] Bioinformatics- A Beginner's Guide, Jean-Michel Claveriw, CerdricNotredame, WILEY DreamTech India Pvt. Ltd

[2] Sequence Analysis in A Nutshell, Scott Markel & Darryl Leon, O'REILLY

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] www.rcsb.org
- [2] http://cebib.uonbi.ac.ke/uon_eresources
- [3] Prof. Todd Mezzulo, June 29, 2003, "Sequence analysis" https://www.bioinformatics.org/
- [4] Protein Secondary Structure Databases: http://cybionix.com/bioinformatics/databases/
- [5] Dong Xu, University of Missouri, Columbia, Missour, University of Missouri, Columbia, Missouri;Protein Databases on the Internet https://www.ncbi.nlm.nih.gov/

		19CSC DATA S	S1015A CIENCE					
Course Ca	ategory:	Programme Elective		Credits:	3			
Course Ty	ype:	Theory	Lecture -T	utorial-Practice:	3 - 0 - 0			
Prerequisites:		Database	Contin	uous Evaluation:	40			
		Management	Semester end Evaluation:		60			
		Systems		Total Marks:	100			
COURSI	E OUTCO	OMES						
Upon suc	cessful co	mpletion of the cour	se, the stude	nt will be able to:				
CO1	Understa	nd the concepts of D	ata Science					
CO2	Apply Data Science algorithms for Big Data.							
CO3	Apply advanced Analytical Theory and Methods on Time series and Text databases							
CO4	Solve the Data Science problems using various technologies and tools							
Contribu Outcome	ition of Co es (1 – Lov	ourse Outcomes tow w, 2 - Medium, 3 – 1	vards achie High)	vement of Progra	m			
	PO 1	PO 2	PO 3	PSO 1	PSO 2			
CO1	2							
CO2	3		1		2			
CO3	3		1		2			
CO4	3	3 1 2						

UNIT-I

Introduction to Big Data Analytics: Big Data Overview, State of the Practice in Analytics, Key Roles for the New Big Data Ecosystem, Examples of Big Data Analytics

Data Analytics Lifecycle: Data Analytics Lifecycle Overview, Discovery, Data Preparation, Model Planning, Model Building, Communicate Results, Operationalize.

Basic Data Analytics Methods: Introduction to R, Exploratory Data Analysis, Statistical Methods for Evaluation

UNIT II

Advanced Analytical Theory and Methods-Clustering: k-means, additional algorithms;

Association Rules: Apriori Algorithm, Evaluation of Candidate Rules, Applications of Association Rules, Transactions in a Grocery Store, Validation and Testing;

Regression: Linear Regression, Logistic Regression, Additional Regression Models

UNIT III

Advanced Analytical Theory and Methods-Classification: Decision Trees, Naïve Bayes;

Advanced Analytical Theory and Methods-Time Series Analysis: Overview of Time Series Analysis, ARIMA Model;

Advanced Analytical Theory and Methods-Text Analysis: Text Analysis Steps, Text Analysis Example, Collecting Raw Text, Representing Text, Term Frequency—Inverse Document Frequency (TFIDF), Categorizing Documents by Topics, Determining Sentiments

UNIT IV

Hadoop- Analytics for Unstructured Data- Use Cases, MapReduce, Apache

Hadoop, YARN

The Hadoop Ecosystem-Pig, Hive, HBase,

In-Database Analytics-SQL Essentials, Joins, Set Operations, Grouping Extensions

Putting It All Together: Communicating and operationalizing an Analytics Project, Creating the final deliverables, and Data Visualization basics.

TEXT BOOKS

[1] Data Science and Big Data Analytics, EMC2 Education Services, wiley, 2015

REFERENCE BOOKS

- [1] Vignesh Prajapati, Big Data Analytics with R and Hadoop, packet publishing, 2013Bill
 [2] John A. Rice, Mathematical Statistics and Data Analysis, 3rd Edition, Cengage
- [3] Tom White, Hadoop: The Definitive Guide, 4rd Edition, O'reilly Publication, 2015
- [4] Franks, Taming, The Big Data Tidal Wave, 1st Edition, Wiley, 2012.
- [5] Frank J. Ohlhorst, Big Data Analytics, 1st Edition, Wiley, 2012.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Prof, Nandan Sudarsan, and Prof. B. Ravindran, IIT Madras, NOC: Introduction to Data Analytics Video Lectures,

https://nptel.ac.in/courses/110106064/, last accessed on 18-09-2019.

[2] Prof Sankar Narasaimhan, and Prof Raghunathan Rengasamy, IIT Madars, NOC:Data Science for Engineers, https://nptel.ac.in/courses/106106179/, last accessed on 18-09-2019.

		19CSC	CS1015B					
	IN	FORMATION RE	TRIEVAL	SYSTEMS				
Course Category:		Programme		Credits:	3			
		Elective						
Course Ty	ype:	Theory	Lecture -T	utorial-Practice:	3 - 0 - 0			
Prerequisites:		Data structures	Contin	uous Evaluation:	40			
			Semester	r end Evaluation:	60			
				Total Marks:	100			
COUDO								
COURSI	E OUTCO	OMES						
Upon suc	cessful con	mpletion of the cou	rse, the stude	ent will be able to:				
CO1	Understar	nd the overview of	Information	Retrieval Systems				
CO2	Compute the process of indexing and Information Extraction.							
CO3	Analyze the concepts of term clustering and Information Visualization.							
CO4	Implemer	nt various text searc	h algorithms					
Contribu Outcome	ition of Co es (1 – Lov	ourse Outcomes to v, 2 - Medium, 3 –	wards achie High)	vement of Program	m			
	PO 1	PO 2	PO 3	PSO 1	PSO 2			
CO1	2							
CO2	3							
CO3		2						
CO 4	1							

UNIT I

Introduction: Definition, Objectives, Functional Overview, Relationship to DBMS, Digital libraries and Data Warehouses.

Information Retrieval System Capabilities: Search, Browse

UNIT II

Cataloguing and Indexing: Objectives, Indexing Process, Automatic Indexing, Information Extraction.

Data Structures: Introduction, Stemming Algorithms, Inverted file structures, Ngram data structure, PAT data structure, Signature file structure, Hypertext data structure.

UNIT III

Automatic Indexing: Statistical indexing: Probabilistic Weighting, Vector Weighting, Natural language, Concept indexing

Document and Term Clustering:

Introduction, Thesaurus generation, Item clustering, Hierarchy of clusters.

UNIT – IV

User Search Techniques: Search statements and binding, Similarity measures and ranking, Relevance feedback, Selective dissemination of information search, weighted searches of Boolean systems, Searching the Internet and hypertext.

Text Search Algorithms: Introduction, Software text search algorithms, Hardware text search systems.

Information System Evaluation: Introduction, Measures used in system evaluation, Measurement example – TREC results.

TEXT BOOKS

[1] M. T. M. Gerald J Kowalski, Information Storage and Retrieval Systems: Springer International Edition, 2018

REFERENCE BOOKS

- [1] W. B. Frakes, Ricardo Baeza-Yates, Information Retrieval Data Structures and Algorithms: Prentice Hall PTR, 2016.
- [2] R. Baeza-Yates, Modern Information Retrival: Pearson Education, 2000.
- [3] R. Korfhage, Information Storage & Retrieval: John Wiley & Sons, 2006

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] https://nlp.stanford.edu/IR-book/pdf/01bool.pdf

[2]http://shodhganga.inflibnet.ac.in/jspui/bitstream/10603/141878/10/10_chapter0 2.pdf
		1905	SCS1015C				
	N	ATURAL LANC	GUAGE PROC	CESSING			
Course C	ategory:	Programme		Credits:	3		
		Elective					
Course T	ype:	Theory	Lecture -T	utorial-Practice:	3 - 0 - 0		
Prerequis	sites:	Artificial	Contin	uous Evaluation:	40		
		Intelligence	Semester	end Evaluation:	60		
				100			
COURS	E OUTCO	DMES					
Upon suc	ccessful co	mpletion of the co	ourse, the stude	nt will be able to:			
CO1	Understand the basic Notation in natural language processing.						
CO2	Solve NLP sub problems using tokenizing and tagging						
CO3	Apply va	rious Parsing Tec	hniques in NLI	P.			
CO4	Analyze the semantic of sentences						
Contribu	ution of C	ourse Outcomes	towards achie	vement of Progra	ım		
Outcom	es (1 – Lo ³	w, 2 - Medium, 3	– High)	_			
	PO 1	PO 2	PO 3	PSO 1	PSO 2		
CO1	1						
CO2	2			1			
CO3	3			1			

2

UNIT I

CO4

Introduction – Models and Algorithms, Regular Expressions and Automata -Regular Expression - Basic Regular Expression Patterns, Disjunction, grouping, and precedence, Finite State Automata – using an FSA to recognize sheeptalk, formal languages, Non-Deterministic FSAs, Using an NFAs to accept strings, Recognition as search, Relating Deterministic and Non Deterministic Automata. Regular Languages and FSAs,

Morphology and Finite-State Transducers survey of English Morphology -Inflectional Morphology, Derivational Morphology, Finite-State Morphological Parsing – The lexicon and Morphotactics, Morphological parsing with finite state transducers, orthographic rules and finite state transducers, Combining an FST Lexicon and Rules, thePorter Stemmer, Human Morphological Processing.

UNIT II

N-grams- Counting Words in Corpora, Unsmoothed N-grams, Smoothing – Add-One smoothing, witten-Bell Discounting, Good-Turing Discounting, Backoff, Deleted Interpolation, N-Grams for spelling and Pronunciation, context-sensitive spelling error correction, N-grams for pronunciation Modelling.

Word Classes and Part-of-Speech Tagging- English Word Classes, Tagsets for English, Part of Speech Tagging, Rule-Based Part of Speech Tagging, Stochastic Part of Speech Tagging

UNIT III

Context Free Grammars for English- Constituency, Context-Free Rules and Trees, Sentence- Level Constructions, the Noun Phrase, Coordination, Agreement, The Verb phrase and Sub Categorization, Auxiliaries, spoken language syntax, grammar equivalence and normal form, finite state and context free grammars, grammars and human processing.

Parsing with Context Free Grammars – Parsing as Search – top-down parsing, bottom-up parsing, comparing top-down and bottom-up parsing, A Basic Top-Down Parser, problems with the basic top down parser, left recursion, ambiguity, repeated parsing of subtrees, The Earley Algorithm, Finite State Parsing Methods.

UNIT IV

Semantic Analysis –Syntax, Driven Semantic Analysis – semantic augmentations to context free grammar rules, quantifier scoping and the translation for complex terms, attachments for a fragment of English, sentences, noun phrases, verb phrases, prepositional phrases, integrating semantic analysis into the early parser. **Lexical Semantics:** Relations among lexemes and their senses, homonymy,

polysemy, synonymy, hyponymy, wordnet, the internal structures of words.

TEXT BOOKS

 D. Jurafsky and J. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition" low price edition, Pearson Education, 2005.

REFERENCE BOOKS

[1] C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.

[2] James Allen. "Natural Language Understanding", Addison Wesley, 1995.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] http://nptel.iitm.ac.in/courses/106101007/

[2] https://nptel.ac.in/courses/106105158/#

		19CSC GRAPH /	S1015D Theory				
Course Category:Programme ElectiveCredits:3							
Course T	vpe:	Theory	Lecture - Tutorial-Practice: 3		e: 3 - 0 - 0		
Prerequis	ites:	Data Structures	Contin Semeste	nuous Evaluatio er end Evaluatio Total Mark	n: 40 n: 60 cs: 100		
COURSI	E OUTCC	OMES					
Upon suc	cessful co	mpletion of the cour	se, the stud	ent will be able t	0:		
CO1	Understa propertie	nd various types of s.	f graph A	lgorithms and g	raph theory		
CO2	Analyze	the NP – complete p	roblems.				
CO3	Distinguish the features of the various tree matching algorithms						
CO4	Understand the linear programming principles and its conversion.						
Contribu Outcome	ition of Co es (1 – Lov	ourse Outcomes tov w, 2 - Medium, 3 – 1	vards achi High)	evement of Prog	ram		
	PO 1	PO 2	PO 3	PSO 1	PSO 2		
CO1	2		1	1			
CO2	3		2	3			
CO3	2		2	2			
CO4	1		1	1			
COURSE UNIT I Basic de	CONTEN	T Degree of vertic	ces Com	nlement of a	oranh Self		

complementary graph, some eccentricity properties of graphs. Tree, spanning tree. Directed graphs standard definitions; strongly, weakly, unilaterally connected digraphs, deadlock communication network. Matrix representation of graph and digraphs. Some properties

UNIT II

Eulerian graphs and standard results relating to characterization. Hamiltonian graph-standard theorems (Dirac theorem, Chavathal theorem, closure of graph).Non Hamiltonian graph with maximum number of edges. Self-centered graphs and related simple theorems. Chromatic number; Vertex and edge - application to coloring. Planar graphs, Euler's formula, maximum number of edges in a planar graph. Five colour theorem.

UNIT III

DFS-BFS algorithm, shortest path algorithm, min-spanning tree and maxspanning tree algorithm, planarity algorithm. Matching theory, maximal matching and algorithms for maximal matching. Perfect matching (only properties and applications to regular graphs).

Flows in graphs, Ranking of participants in tournaments, simple properties and theorems on strongly connected tournaments. Application of Eulerian digraphs. PERT-CPM. Complexity of algorithms; P-NP- NPC-NP hard problems and examples.

UNIT IV

Linear- Integer Linear programming, Conversion of TSP, maxflow, Knapsack scheduling, shortest path problems for Linear programming types - branch bound method to solve Knapsack problems- critical path and linear programming conversion- Floor shop scheduling problem- Personal assignment problem.

Dynamic programming- TSP- compartment problems- Best investment problems

TEXT BOOKS

- [1] C.Papadimitriou&K.Steiglitz, "Combinatorial Optimization", Prentice Hall, 1982.
- [2] H.Gerez, "Algorithms for VLSI Design Automation", John Wiley, 1999

REFERENCE BOOKS

[1] B.Korte&J.Vygen, "Combinatorial Optimization", Springer-Verlag, 2000

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] https://www.hackerearth.com/practice/notes/graph-theory-part-i/

[2] https://www.hackerearth.com/practice/notes/graph-theory-part-ii/

[3] https://onlinelibrary.wiley.com/journal/10970118

		19M	ГМС1026				
	RE	SEARCH METI	HODOLOGY	AND IPR			
Course C	Category:	Programme Core		Credits	: -		
Course T	ype:	Theory	Lecture -	Futorial-Practice	2 - 0 - 0		
Prerequi	sites:		Contir	uous Evaluation	40		
			Semeste	r end Evaluation	60		
				Total Marks	100		
COURS	E OUTCO	OMES					
Upon su	ccessful con	mpletion of the co	urse, the stud	ent will be able to:			
CO1	Acquire an overview of the research methodology and techniques to define research problem						
CO2	Review th	Review the literature and identify the problem.					
CO3	Analyze t	he optimum samp	oling techniqu	es for collected da	ta.		
CO4	Apply var	rious forms of the	intellectual p	roperties for resear	ch work.		
Contrib Outcom	ution of Co es (1 – Lov	ourse Outcomes t v, 2 - Medium, 3 -	owards achie – High)	evement of Progra	am		
	PO 1	PO 2	PO 3	PSO 1	PSO 2		
CO1	3		2				
CO2	2		2				
CO3	2	2	2				

CO4	2	2	2

UNIT I

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Research Approaches, Significance of Research, Research and Scientific Methods, Research Process, Criteria of Good

Research, and Problems Encountered by Researchers in India.

Research Problem: Defining the Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, an Illustration.

UNIT II

Reviewing the literature: Place of the literature review in research, improving research methodology, broadening knowledge base in research area, enabling contextual findings.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Basic Principles of experimental Designs, Important Experimental Designs.

UNIT III

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, sources of error in measurement tools.

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method **Testing of Hypotheses**: Hypothesis, Basic Concepts, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing

UNIT – IV

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, and Significance of Report Writing **Intellectual Property:** The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999, The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act, 1957, Trade Secrets, Utility Models WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement.

TEXT BOOKS

[1] Research methodology: Methods and Techniques, C.R. Kothari, GauravGarg,

New Age International, 4th Edition, 2018.

- [2] Research Methodology a step-by-step guide for beginners. Ranjit Kumar, SAGE Publications Ltd.,3rd Edition, 2011
- [3] Study Material, Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body under an Act of Parliament, September 2013

REFERENCE BOOKS

- [1] An introduction to Research Methodology, Garg B.L et al ,RBSA Publishers 2002
- [2] An Introduction to Multivariate Statistical Analysis Anderson T.W, Wiley 3rd Edition,
- [3] Research Methodology, Sinha, S.C, Dhiman, EssEss Publications2002
- [4] Research Methods: the concise knowledge base ,Trochim ,Atomic Dog Publishing ,2005
- [5] How to Write and Publish a Scientific Paper, Day R.A, Cambridge University Press 1992
- [6] Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009
- [7] Proposal Writing, Coley S.M. Scheinberg, C.A, Sage Publications, 1990
- [8] Intellectual Property Rights in the Global Economy, Keith Eugene Maskus, Institute for International Economics.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1]https://www.enago.com/academy/intellectual-property-rights-what researchers-need-to-know/

[2] https://nptel.ac.in/courses/107/108/107108011/

			19C \$	SCS1051				
D	ATA STRU	JCTU	JRES AND	ALGORITH	MS LABORATO	RY		
Course C	Category:	Prog	ramme Core		Credits	1.5		
Course T	ype:	Labo	oratory	Lecture -T	Lecture -Tutorial-Practice:			
Prerequi	sites:			Contin	uous Evaluation:	40		
				Semester	r end Evaluation:	60		
					Total Marks :	100		
COURS	E OUTCO	MES						
Upon su	ccessful co	mplet	ion of the co	urse, the stude	ent will be able to:			
CO1	Implement various tree operations							
CO2	Compare greedy and dynamic algorithms							
CO3	Understand graph algorithms and their applications							
CO4	Implement number theoretic algorithms							
Contrib	ution of Co	ourse	Outcomes t	owards achie	vement of Progra	ım		
Outcom	es (1 – Lov	v, 2 -	Medium, 3 -	– High)				
	PO 1		PO 2	PO 3	PSO 1	PSO 2		
CO1	3				3			
CO2				1				
CO3			2					

1

3

COURSE CONTENT

CO4

Task 1: Implement Binary Search Tree operations

Task 2: Evaluate expressions by implementing expression trees

Task 3: Implement sorting algorithm using B-Trees

Task 4: Implement a data compression algorithm using Huffman coding

Task 5: Implementing matrix chain multiplication using dynamic programming

- Task 6: Implement Sequence alignment algorithm for biological sequences
- Task 7: Implement greedy algorithm for shortest job first (SJF) CPU scheduling algorithm
- Task 8: Implement Bellman-Ford algorithm using adjacency matrix
- Task 9: Implement distance vector routing algorithm
- Task 10: To check whether the graph is DAG or not
- Task 11: Implement Finite automata based string search algorithm
- Task 12: Implement Aho-Corasick string matching algorithm
- Task 13: Implement Hamiltonian Path using Java
- Task 14: Implement 0/1 Knapsack problem
- Task 15: Implement travelling salesman problem

TEXT BOOKS

[1] Cormen, Leiserson, Rivest, and Stein, "Introduction to Algorithms", Third Edition, McGraw Hill, 2010.

REFERENCE BOOKS

- [1] Robert Sedgewick Philippe Flajolet, "An Introduction to the Analysis of Algorithms", First Edition, McGraw Hill, 1995.
- [2] Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd edition, Pearson Education.
- [3] Horowitz Sahni and Anderson-Freed," Fundamentals of Data Structures in C", 2nd edition, Universities Press.

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] MHRD VIRTUAL LABS, IIT KHARAGPUR, 14.05.2015, Available: http://cse.iitkgp.ac.in/~rkumar/pds-vlab/
- [2] MHRD VIRTUAL LABS, IIIT HYDERABAD, 14.05.2015, Available: http://cse01-iiith.vlabs.ac.in/
- [3] Prof. Naveen Garg, IIT Delhi, August 27, 2011, "AVL Trees" http://nptel.iitm.ac.in [NPTEL]
- [4] Prof. Pradip K. Das, Jun 9, 2014, www.it4next gen.com/ free-computerscience-lectures-by-nptel.html

[5] IIT Delhi, http://nptel.ac.in/courses/106102064/25[6] IIT Guwahati B-Tree Construction, nptel.ac.in/courses/ 106103069/21

19CSCS1052
MACHINE LEARNING LABORATORY

Course Category:	Programme Core	Credits:	1.5
Course Type:	Laboratory	Lecture - Tutorial-Practice:	0 - 0 - 3
Prerequisites:	Data Mining	Continuous Evaluation:	40
-		Semester end Evaluation:	60
		Total Marks:	100

COURSE OUTCOMES

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

CO1	Identify instance based learning algorithms
CO2	Design neural network to solve classification and function approximation problems
CO3	Build optimal classifiers using genetic algorithms
CO4	Analyze probabilistic methods for learning

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	2		2	2	
CO2	2		2	2	
CO3	2		2	2	
CO4	2		2	2	

COURSE CONTENT

Task 1: Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

Task 2: For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples

Task 3: Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

Task 4: Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

Task 5: Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

Task 6: Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

Task 7: Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

Task 8: Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

Task 9: Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

Task 10: Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs

TEXT BOOKS

[1] John Anderson, Hands On Machine Learning with Python 1st Edition, AI Sciences Publisher, 2018

REFERENCE BOOKS

[1] Michael Bowles, Machine Learning in Python: Essential Techniques for Predictive Analysis 1st Edition, John Wiley,2015

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[1] Evaluating a hypothesis, Stanford University,

https://www.coursera.org/learn/machine-learning/lecture/yfbJY/evaluating-ahypothesis , Last accessed on 26-8-2019

- [2] Balaraman Ravindran, NPTEL Lecture 1 Introduction to Machine Learning, https://www.youtube.com/watch?v=fC7V8QsPBec, Last accessed on 26-8-2019
- [3] Benchmarking Neural Networks on Oracle Cloud Infrastructure with Mapr, https://mapr.com/whitepapers/benchmarking-neural-networks-on-oracle-cloudinfrastructure-with-mapr/ Last accessed on 26-8-2019
- [4] George Crump, Dealing with The AI and Analytics Data Explosionhttps://mapr.com/whitepapers/dealing-with-the-ai-and-analytics-data-explosion/ Last accessed on 26-8-2019

SEMESTER II

		19CS	CS2001				
	ŀ	HIGH PERFORM	ANCE CON	IPUTING			
Course C	ategory:	Programme Core		Credits:	3		
Course T	ype:	Theory	Theory Lecture -Tutorial-Practice:		3 - 0 - 0		
Prerequis	sites:	Data Structures	Data Structures, Continuous Evaluation		40		
		Computer	Semester	r end Evaluation:	60		
		Organization		Total Marks:	100		
		& Architecture					
COURS	E OUTCO	OMES					
Upon suc	cessful co	mpletion of the cou	urse, the stude	ent will be able to:			
CO1	Understand the parallel programming platforms and parallel algorithms on parallel computer systems.						
CO2	Analyze t	Analyze the working group communication operations of MPI					
CO3	Understand the accelerator technologies of GPGPU's with CUDA, OpenCL.						
CO4	CO4 Implement algorithms for Matrix, Sorting and Graphs using OpenMP, Pthreads, MPI and CUDA Language/Library.						
Contribu Outcome	ution of Co es (1 – Lov	ourse Outcomes to w, 2 - Medium, 3 –	owards achie High)	evement of Progra	m		
	PO 1	PO 2	PO 3	PSO 1	PSO 2		
CO1			3	2			
CO2	1		3	2			

CO3

CO4

UNIT I

Parallel Programming Platforms: Implicit parallelism: Trends in Microprocessor Architectures, Limitations of memory system performance, Dichotomy of parallel computing platforms, physical organization of parallel platforms, Routing mechanisms for interconnection networks.

Principles of Parallel Algorithm Design: Preliminaries, decomposition Techniques, Characteristics of tasks and interactions, mapping techniques for load balancing, parallel algorithm models.

UNIT II

Basic communication operations: One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather.

Analytical modeling of parallel programs: sources of overhead in parallel programs, performance metrics for parallel systems.

Introduction to Heterogeneous Computing: Introduction to OPenCL, Platform and Devices, The Execution Environment, Memory Model, Writing Kernels.

UNIT III

Programming using the message passing paradigm: Principles of Message passing programming, The building blocks: Send and Receive Operations, MPI: the message passing interface, collective communication and computation Operations.

Programming shared address space platforms: Thread Basics, why Threads, The POSIX Thread API, Thread Basics: Creation and Termination, OpenMP: a standard for Directive based Parallel Programming.

UNIT IV

Dense Matrix Algorithms: Matrix-Vector Multiplication, Matrix – Matrix Multiplication.

Sorting: Issues in Sorting on Parallel Computers, Sorting Networks, Bubble sort and its variants.

Graph Algorithms: Minimum Spanning Tree: Prim's Algorithm, Single-Source shortest paths: Dijkstra's Algorithm.

Introduction to General-Purpose GPU programming (CUDA): The age of parallel processing, The Rise of GPU computing, CUDA, Applications of CUDA, Development Environment, Introduction to CUDA C, Parallel Programming in CUDA C.

TEXT BOOKS

- [1] AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar: Introduction to Parallel Computing, Second Edition Pearson Education, 2016.(Chapters:1-10)
- [2] Jason Sanders, Edward Kandrot, CUDA By Example An Introduction to General-Purpose GPU Programming, Addison Wesley, 2011. (Chapters:1-4)
- [3] Benedict R Gaster, Lee Howes, David R KaeliPerhaad Mistry Dana Schaa, *Heterogeneous Computing* with OpenCL McGraw-Hill, Inc. Newyork, 2012(Chapters-2)

REFERENCE BOOKS

- [1] Michael J. Quinn, Parallel Programming in C with MPI and OpenMP McGraw-Hill International Editions, Computer Science Series, 2004.
- [2] David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors
 A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] nptel.ac.in/courses/106108055/
- [2] http://www.nvidia.com/object/cuda_home_new.html
- [3]http://www.icrar.org/research/postgraduuate/igh-performance-computinghonours-course
- [4] http://www.openCL.org

Programme Core Theory Computer Networks OMES ompletion of the cor and the evolution of ure and characterize dif nodels the various technol n. the security issues	Lecture - Contin Semeste	Credits: Futorial-Practice: nuous Evaluation: or end Evaluation: Total Marks: ent will be able to: uting paradigm and deployment models s of cloud computin puting. evement of Progra	3 3 - 0 - 0 40 60 100 its s and g
Theory Computer Networks OMES ompletion of the cor and the evolution of ure and characterize dir nodels the various technol n. the security issues	Lecture - T Contin Semeste	Futorial-Practice: nuous Evaluation: r end Evaluation: Total Marks: ent will be able to: uting paradigm and deployment models s of cloud computin puting. evement of Progra	3 - 0 - 0 40 60 100 its and g
Computer Networks OMES ompletion of the cor and the evolution of ure and characterize dir nodels the various technol n. the security issues	Contin Semeste urse, the stude f cloud compu fferent cloud logical drivers in cloud comp owards achie	nuous Evaluation: r end Evaluation: Total Marks: ent will be able to: uting paradigm and deployment models s of cloud computin puting. evement of Progra	40 60 100 its g
Networks OMES Ompletion of the cor and the evolution of ure and characterize di nodels the various technol n. the security issues Course Outcomes t	Semeste urse, the stude f cloud compu fferent cloud ogical drivers in cloud comp owards achie	ent will be able to: uting paradigm and deployment models s of cloud computin puting.	60 100 its and g
OMES ompletion of the cor and the evolution of ure and characterize dir nodels the various technol n. the security issues	urse, the stude f cloud compu fferent cloud logical drivers in cloud comp owards achie	Total Marks: ent will be able to: uting paradigm and deployment models s of cloud computin puting.	100 its and g
OMES ompletion of the cor and the evolution of ure and characterize dir nodels the various technol n. the security issues	urse, the stude f cloud compu fferent cloud logical drivers in cloud comp owards achie	ent will be able to: uting paradigm and deployment models s of cloud computin puting.	its s and g
OMES ompletion of the cor and the evolution of ure and characterize dir nodels the various technol n. the security issues	urse, the stude f cloud compu fferent cloud logical drivers in cloud comp owards achie	ent will be able to: uting paradigm and deployment models s of cloud computin puting.	its s and g
ompletion of the con and the evolution of oure and characterize dia nodels the various technol n. the security issues	urse, the stude f cloud compu fferent cloud logical drivers in cloud comp owards achie	ent will be able to: uting paradigm and deployment models s of cloud computin puting.	its and g
and the evolution of ture and characterize di- nodels the various technol n. the security issues	f cloud compu fferent cloud logical drivers in cloud comp owards achie	uting paradigm and deployment models s of cloud computin puting. evement of Progra	its and g
and characterize dia nodels the various technol n. the security issues	fferent cloud ogical drivers in cloud comp owards achie	deployment models s of cloud computin puting. evement of Progra	s and g
the various technol n. the security issues Course Outcomes t	ogical drivers in cloud comp owards achie	s of cloud computin puting. evement of Progra	m
the security issues	in cloud comj owards achie	puting. evement of Progra	m
course Outcomes t	owards achie	evement of Progra	m
w, 2 - Medium, 3 -	– High)	0	
PO 2	PO 3	PSO 1	PSO 2
	2		
	2	1	
	3	2	
		2	
		2 2 3	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$

UNIT - I

Introduction

High-Performance Computing, ParallelComputing, DistributedComputing, Cluster Computing, Grid Computing, Cloud Computing, Biocomputing, Mobile Computing, Quantum Computing, Optical Computing, Nanocomputing, Network Computing

Cloud Computing Fundamentals

Motivation for Cloud Computing: The Need for Cloud Computing.

Defining Cloud Computing: NIST Definition of Cloud Computing, Cloud Computing Is a Service, Cloud Computing Is a Platform

5-4-3 Principles of Cloud computing: Five Essential Characteristics, Four Cloud Deployment Models, Three Service Offering Models

Cloud Ecosystem, Requirements for Cloud Services, Cloud Application, Benefits and Drawbacks

UNIT - II

Cloud Computing Architecture and Management

Cloud Architecture, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications on the Cloud, Managing the Cloud, Migrating Application to Cloud

Cloud Deployment Models

Private Cloud, Public Cloud, Community Cloud, Hybrid Cloud

Cloud Service Models

Infrastructure as a Service, Platform as a Service, Software as a Service, Other Cloud Service Models

UNIT - III

Technological Drivers for Cloud Computing

SOA and Cloud: SOA and SOC, Benefits of SOA, Technologies Used by SOA, Similarities and Differences between SOA and Cloud Computing.

Virtualization: Approaches in Virtualization, Hypervisor and Its Role, Types of Virtualization, Multicore Technology, Memory and Storage Technologies, Networking Technologies Web 2.0, Web 3.0

Operating Systems

Role of OS in Cloud Computing, Features of Cloud OS, Cloud OS Requirements, Cloud-Based OS Application Environment

UNIT –IV

Application Environment

Need for Effective ADE, Application Development Methodologies, Power of Cloud Computing in Application Development,

Cloud Computing APIs: Rackspace, IBM, Intel

Networking for Cloud Computing

Overview of Data Center Environment, Networking Issues in Data Centers

Security Aspects

Data Security, Virutalization Security, Network Security Platform-Related Security

Security Issues in Cloud Service Models, Software-as-a-Service Security Issues, Platform-as-a-Service Security Issues, Infrastructure-as-a-Service Security Issues

TEXT BOOKS

[1] K. Chandrasekaran, Essentials of Cloud Computing, CRC Press, 2015

REFERENCE BOOKS

- [1] Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2010
- [2] RajkumarBuyya, James Broberg, Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2011
- [3] Nikos Antonopoulos, Lee Gillam, Cloud Computing: Principles, Systems and Applications, Springer, 2012

E-RESOURCES & OTHER MATERIAL

[1] https://azure.microsoft.com/en-in/overview/ [Accessed: 20/02/2020]

- [2] https://www.ibm.com/cloud/learn/cloud-computing [Accessed: 20/02/2020]
- [3] https://aws.amazon.com/what-is-cloud-computing/ [Accessed: 20/02/2020]

19CSCS2003 CYBER SECURITY Course Category: Programme Core Credits: 3 **Course Type:** Theory 3 - 0 - 0 **Lecture - Tutorial-Practice:** Cryptography and **Prerequisites: Continuous Evaluation:** 40 Network Security **Semester end Evaluation:** 60 **Total Marks:** 100 **COURSE OUTCOMES** Upon successful completion of the course, the student will be able to: **CO1** Understand the classification of cyber crimes. Assess various security attacks. **CO2** Understand the process to counter the cyber crimes. **CO3** Analyze various tools and methods used in cyber crimes **CO4 Contribution of Course Outcomes towards achievement of Program** Outcomes (1 – Low, 2 - Medium, 3 – High)

	PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	3		2		
CO2	2		3		
CO3	3		3		
CO4	2		2		2

COURSE CONTENT

UNIT I

Introduction of Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, **Classifications of Cybercrimes**: E-Mail Spoofing, Spamming, Internet Time Theft, Salami Attack/Salami Technique, Data Diddling, Forgery, Web Jacking, Hacking, Online Frauds, Pornographic Offenses, Software Piracy, Computer Sabotage, E-Mail Bombing/Mail Bombs, Computer Network Intrusions, Password Sniffing, Credit Card Frauds, Identity Theft.

UNIT II

Cyber offenses: Criminals Plan: Categories of Cybercrime **Cyber Attacks:** Reconnaissance, Passive Attack, Active Attacks, Scanning/Scrutinizing gathered Information, Attack (Gaining and Maintaining the System Access), Social Engineering, and Classification of Social Engineering.

UNIT III

Cyberstalking: Types of Stalkers, Cases Reported on Cyberstalking, Working of Stalking, Real-Life Incident of Cyber stalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Botnet, Attack Vector, **Tools and Methods**: Proxy Servers and Anonymizers, Phishing and Identity Theft : Working of Phishing, Identity Theft (ID Theft).

UNIT IV

Password Cracking: Online Attacks, Offline Attacks, Strong, Weak and Random Passwords, Random Passwords, **Keyloggers and Spywares**: Software Keyloggers, Hardware Keyloggers, Antikeylogger, Spywares. Case Study : N-Map Tool, Nessus Vulnerability Tool

TEXT BOOKS

- [1] Nina Godbole, Sunit Belapur, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", 2nd edition, Wiley India Publications, April, 2011
- [2] William Stallings, Cryptography and Network Security: Principles and Practice. 7th Ed, Pearson Education, 2017

REFERENCE BOOKS

- [1] "Fundamental on Cyber Security", CISCO
- [2] "Cyber Security Essentials", CISCO
- [3] "Security Analyst", NASSCOM
- [4] Michael McPhee, "Mastering Khali Linux for Web Penetration testing",Pact Publishing, 2017

E-RESOURCES AND OTHER DIGITAL MATERIAL

https://www.cybrary.it/catalog/career-path/cyber-security-engineer/
 https://www.edx.org/course/cybersecurity-fundamentals-2

		19CS INTERNE	CS2014A Г OF THING	ïS		
Course Category:		Programme Elective		Credit		
Course Type:		Theory	Lecture -T	utorial-Practic	e: 3 - 0 - 0	
Prerequisites:		Computer Networks	Contin Semester	Continuous Evaluation Semester end Evaluation Total Marks		
COURS	E OUTCO	MES				
Upon suc	ccessful con	npletion of the co	urse, the stude	ent will be able t	0:	
CO1	Understand the basic principles and architecture of IoT.					
CO2	Illustrate Standards and Key Technologies in IoT					
CO3	Identify the structure of various physical devices used for IoT					
CO4	Analyze security threats and reliability issues of IoT Technologies					
Contribu Outcome	ution of Co es (1 – Low	ourse Outcomes to v, 2 - Medium, 3 -	owards achie - High)	vement of Prog	gram	
	PO 1	PO 2	PO 3	PSO 1	PSO 2	
CO1	2					
CO2			1	2		
CO3	3					

UNIT I

CO4

Introduction to Internet of Things –Definition and Characteristics of IoT **IoT Architectures**: SOA based architecture and API based architecture **Physical Design of IoT** – Things in IoT, IoT Protocols

1

2

Logical Design of IoT – IoT Functional Blocks, IoT communication models, IoT Communication APIs

IoT Enabling Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems,

Domain Specific IoTs – Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle

UNIT II

IoT and M2M – Introduction, M2M, Difference between IoT and M2M

SDN and NFV for IoT - Software Defined Networking, Network Function Virtualization

IoT Data Management and Analytics - IoT and the Cloud, Real-Time Analytics in IoT and Fog Computing

IoT Communication Protocols - Network Layer, Transport and Application Layer

UNIT III

IoT System Management with NETCONF- YANG- Need for IoT Systems Management, Simple Network Management Protocol (SNMP), Network Operator Requirements, NETCONF, YANG, NETOPEER

IoT Physical Devices and Endpoints – What is an IoT Device, Introduction to Raspberry Pi, Board, Raspberry Pi Interfaces (serial, SPI, I2C)

Programming Raspberry PI with Python – Controlling LED with Pi, Interfacing LED and Switch with Pi, Interfacing a light sensor with Pi.

UNIT IV

Security and Privacy in the Internet of Things - Concepts, IoT Security overview, Security Frameworks for IoT, Privacy in IoT Networks

IoT- Robustness and Reliability- IoT Characteristics and Reliability Issues, Addressing Reliability

TEXT BOOKS

- [1] Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", 1st Edition, Morgan Kaufmann Publishing, 2016
- [2] Arshdeep Bahga, Vijay Madisetti "Internet of Things (A hands on approach)", 1ST edition, Universities Press, 2015

REFERENCE BOOKS

- [1] Matt Richardson & Shawn Wallace, "Getting Started with Raspberry Pi", O'Reilly (SPD), 2014
- [2] David Hanes, "IOT FUNDAMENTALS" 1ST Edition, CISCO PRESS, 2018
- [3] Perry Lea, "Internet of Things for Architects" Packt Publishing, 2018

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- [1] Prof. Sudip Misra, IIT Kharagpur "Introduction to Internet of things" [Web Content]. Available: http://nptel.ac.in/courses/106105166/ (Accessed on 14-5-19)
- [2] Review Article by Pallavi Sethi and Smruti R. Sarangi, "Internet of Things: Architectures, Protocols, and Applications" available at http://downloads.hindawi.com/journals/jece/2017/9324035.pdf

19CSCS2014B							
DIGITAL FORENSICS							
Course Ca	ategory: Pro	ogramme		Credi	its: 3		
	Ele	ective					
Course Ty	ype: Th	eory	Lecture -T	ture -Tutorial-Practice:			
Prerequis	ites: Co	mputer	Contin	Continuous Evaluation			
	Ne	tworks	Semester	end Evaluation	on: 60		
				Total Mar	ks: 100		
COURSI	E OUTCOM	ES					
Upon suc	cessful compl	etion of the co	urse, the stude	nt will be able	to:		
CO1	Understand the concepts of cyber forensics related Issues.						
CO2	Analyse the process of various forensic systems.						
CO3	Analyze Evidence capture mechanism and Recovery steps						
CO4	Evaluate and Report electronic communications evidences.						
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)							
	PO 1	PO 2	PO 3	PSO 1	PSO 2		
CO1	3		3				
CO2	3		3				
CO3	2		3				
CO4	2	2	2		2		

UNIT I

Forensic overview:

Introduction, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/ Employment Proceedings, Forensics

Services, Benefits of Professional Forensics Methodology, Steps Taken by Computer Forensics Specialists.

Types of Forensics Systems: Internet Security Systems, Intrusion Detection Systems, Firewall Security Systems, Storage Area Network Security Systems, Network Disaster Recovery Systems, Public Key Infrastructure Systems

UNIT II

Data Recovery: Defination, Data Backup and Recovery, The Role of Backup in Data Recovery, The Data-Recovery Solution, Hiding and Recovering Hidden Data

Evidence Collection and Data Seizure, Need of collection, Collection Options, Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps.

UNIT III

Duplication and Preservation of Digital Evidence, Preserving the Digital Crime Scene, Computer Evidence Processing Steps, Legal Aspects of Collecting and Preserving Computer Forensic Evidence, Special Needs of Evidential Authentication.

Computer Image Verification and Authentication: Special Needs of Evidential Authentication,

Practical Consideration, Practical Implementation, **Reconstructing Past Events**: Introduction, Useable File Formats, Unusable File Formats, Converting Files.

UNIT IV

Forensic Analysis: Computer Forensic Analysis, Discovery of Electronic Evidence,

Electronic Document Discovery: A Powerful New Litigation Tool, Identification of Data, Timekeeping, Forensic Identification and Analysis of Technical Surveillance Devices.

Network Forensics Scenario: A Technical Approach, Destruction of Email, Damaging Computer Evidence, Tools Needed for Intrusion Response to the Destruction of Data, System Testing

TEXT BOOKS

[1] Marjie T.Britz, "Computer Forensics and Cyber Crime": An Introduction",

REFERENCE BOOKS

[1] Nelson, Phillips Enfinger, Steuart "Computer Forensics and Investigations", CENGAGE, 2015

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] https://www.cybrary.it/glossary/d-the-glossary/digital-forensics/
- [2] https://www.udemy.com/topic/digital-forensics/

		19CS	CS2014C			
	GEO	GRAPHIC INF	FORMATION	N SYSTEM		
Course Category:		rogramme		Credi	its: 3	
		lective				
Course Type:		heory	Lecture -T	Lecture -Tutorial-Practice:		
Prerequis	ites: D	atabase	Contin	Continuous Evaluation:		
		lanagement	Semester	end Evaluation	on: 60	
	S	ystems		Total Mar	ks: 100	
COURSI	E OUTCOM	ES				
Upon suc	cessful comp	oletion of the co	urse, the stude	ent will be able	to:	
CO1	Understand the basic concepts of spatial and non spatial data.					
CO2	Analyze database issues in GIS.					
CO3	Create design principles for developing DEM and TIN					
CO4	Apply various real time problems in GIS					
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)						
	PO 1	PO 2	PO 3	PSO 1	PSO 2	
CO1	1					
CO2			2			
CO3		1		3		
CO4			3	2		

UNIT I

GIS: Definitions and Development – Computer Components of GIS (Hardware and Software) – General Data Base concepts of Spatial and Non Spatial data - Elements of Spatial data - Sources of Spatial data – Data quality for GIS – Errors

and Error variations in GIS

UNIT II

GIS Data Management: Data Base Management Systems (DBMS) Data Base Models. Data input methods – Spatial Data structures: Raster data and Vector data – Structures GIS Data Analysis: Spatial measurement methods Reclassification – Buffering – Overlay Analysis

UNIT III

Modeling Surfaces: Generation of DEM, DTM and TIN models – Spatial Interpolation – GIS output generation – Integration of Remote Sensing and GIS Principles of Global Positioning System (GPS).

UNIT IV

GIS applications: GIS as a Decision Support System – GIS as a Land Information System GIS as a Disaster Management and Emergency Response System -Resource management applications - Facility Management application – Urban Management application.

TEXT BOOKS

- [1] Aronoff S. Geographic Information System: A Management Perspective, DDL Publication, Ottawa. 1989.
- [2] Burrough P.A. Principles of Geographic Information Systems for Land Resource Assessment. Oxford University Press, New York, 1986.

REFERENCE BOOKS

- [1] Fraser Taylor D.R. Geographic Information System. Pergamon Press, Oxford, 1991.
- [2] Maquire D. J.M.F. Goodchild and D.W. Rhind (eds.) Geographic Information Systems : Principles and Application. Taylor & Francis, Washington, 1991.
- [3] Mark S. Monmonier. Computer assisted Cartography. Prentice Hall, Englewood Cliff, New Jersey, 1982.
- [4] Peuquet D.J. and D.F. Marble, Introductory Reading in Geographic Information Systems. Taylor & Francis, Washington, 1990.
- [5] Star J. and J. Estes. Geographic Information Systems: An Introduction. Prentice Hall, Englewood, Cliff, New Jersey, 1994.

		19CS	CS2014D				
	ALGO	DRITHMS FO	R BIOINFO	RMATICS			
Course Ca	ategory: Pro	ogramme		Credi	ts: 3		
Course T	Ele Ele	ective	Lootuno T	utorial Drastic			
Course I	it age Di	eory	Lecture - I	Lecture - I utorial-Practice:			
Prerequis	nes: Di	Bioinformatics	Contin	uous Evaluatio	n: 60		
			Semester	Total Marl	s • 100		
					100		
COURSI	E OUTCOMI	ES					
Upon suc	cessful compl	etion of the co	urse. the stude	nt will be able t	0:		
-1							
CO1	sequences.	Dynamic pr	ogramming	algorithing for	biblogical		
CO2	I have a small algorithms and their anglications						
02	Understand graph algorithms and their applications						
CO3	Apply pattern matching and clustering with reference to						
	Bioinformatics						
CO4	Analyze evolutionary trees and phylogeny related algorithms.						
Contribu	ition of Cours	se Outcomes t	owards achie	vement of Prog	gram		
Outcome	es (1 – Low, 2	- Medium, 3 -	- High)				
	PO 1	PO 2	PO 3	PSO 1	PSO 2		
CO1	3		1				
CO2	3		1	2			
CO3	3		1	2			
CO4	3	1	1				

UNIT I

Algorithms and Complexity: Algorithms and Complexity of an Algorithm, Biological Algorithms versus Computer Algorithms, The Change Problem Correct versus Incorrect Algorithms Recursive Algorithms, Iterative versus Recursive Algorithms, Fast versus Slow Algorithms, Big-O Notation, Algorithm Design Techniques, Exhaustive Search Branch-and-Bound Algorithms, Greedy Algorithms, Dynamic Programming, Divide-and-Conquer Algorithms, Machine Learning, Randomized Algorithms, Tractable versus Intractable

Exhaustive Search: Exhaustive Search, Restriction Mapping Impractical Restriction Mapping Algorithms, A Practical Restriction Mapping Algorithm, Regulatory Motifs in DNA Sequences, The Motif Finding Problem Search Trees indexing Motifs Finding a Median String

UNIT II

Greedy Algorithms: Genome Rearrangements Sorting by Reversals. Approximation Algorithms Breakpoints, A Different Face of Greed A Greedy Approach to Motif Finding. Dynamic Programming, Algorithms, The Power of DNA Sequence Comparison, The Change Problem, Revisited The Manhattan Tourist Problem, Edit Distance and Alignments Longest Common subsequences, Global Sequence Alignment Scoring Alignments, Local Sequence Alignment, Alignment with Gap Penalties, Multiple Alignment, Gene Prediction, Statistical Approaches to Gene Prediction, Similarity-Based Approaches to Gene Prediction Spliced Alignment .

UNIT III

Graph Algorithms: Graphs and Genetics, DNA Sequencing Shortest Superstring Problem DNA Arrays as an Alternative Sequencing Technique Sequencing by Hybridization, SBH as a Hamiltonian Path Problem SBH as an Eulerian Path Problem, Fragment Assembly in DNA Sequencing, Protein Sequencing and Identification, The Peptide Sequencing Problem, Spectrum Graphs Protein Identification via Database Search Spectral Convolution, Spectral Alignment

UNIT IV

Combinatorial Pattern Matching : Repeat Finding , Hash Tables , Exact Pattern Matching , Keyword Trees, Suffix Trees, Heuristic Similarity Search Algorithms Approximate Pattern Matching, BLAST: Comparing a Sequence against a Database.

Clustering and Trees: Gene Expression Analysis, Hierarchical Clustering, k-Means Clustering and Corrupted Cliques, Evolutionary Trees, Distance-Based Tree Reconstruction, Reconstructing Trees from Additive Matrices, Evolutionary Trees and Hierarchical Clustering, Character-Based Tree Reconstruction, Small Parsimony Problem, Large Parsimony Problem

TEXT BOOKS

- [1] Neil C. Jones and Pavel A. Pevzner, "An Introduction to Bioinformatics Algorithms", MIT Press, 2005.
- [2] Gusfields D, "Algorithms on strings, trees and sequences: Computer Science and Computational Biology", Cambridge University Press, 1997.

REFERENCE BOOKS

- [1] Steffen Schulze-Kremer, "Molecular Bioinformatics: Algorithms and Applications", Walter de Gruyter, 1996.
- [2] Gary Benson, Roderic Page (Eds.), "Algorithms in Bioinformatics", Springer International Edition, 2004.
- [3] Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison. "Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acid", Cambridge University Press, 1999.
| | | 19CSC | S2015A | | |
|---------------------|----------------------------|---|----------------------|----------------------|-----------|
| | | BLOCKCHAIN | FECHNOL | OGIES | |
| Course C | ategory: | Programme | | Credits | 3 |
| | | Elective | | | |
| Course T | ype: | Theory | Lecture -T | utorial-Practice: | 3 - 0 - 0 |
| Prerequis | sites: | Cryptography and | Contin | uous Evaluation | 40 |
| | | Network Security | Semester | end Evaluation: | 60 |
| | | | | Total Marks | 100 |
| | | | | | |
| COURS | E OUTCO | OMES | | | |
| Upon suc | ccessful co | mpletion of the cour | se, the stude | ent will be able to: | |
| CO1 | Understa | nd the block chain a | rchitecture a | nd design | |
| CO2 | Analyze | the consensus protoc | cols Role in | Block chain | |
| CO3 | Understa | nd functioning of Bi | itcoins | | |
| CO4 | Analyze | security and privacy | aspects of E | Bitcoin | |
| Contribu
Outcome | ution of Co
es (1 – Lov | ourse Outcomes to
w, 2 - Medium, 3 – 1 | wards achie
High) | vement of Progra | am |
| | PO 1 | PO 2 | PO 3 | PSO 1 | PSO 2 |
| CO1 | 2 | | 3 | | |
| CO2 | 2 | | 2 | | |
| CO3 | 2 | | 1 | | |
| CO4 | 2 | | 1 | | 2 |

UNIT I

Blockchain: Introduction, Structure of a Block, Block Header, Block Identifiers -Block Header Hash and Block Height, The Genesis Block, Linking Blocks in the Blockchain, Merkle Trees, Merkle Trees and Simplified Payment Verification (SPV).

Mining and Consensus I: Introduction, Bitcoin Economics and Currency Creation, De-centralized Consensus, Independent Verification of Transactions, Mining Nodes, Aggregating Transactions into Blocks, Transaction Age, Fees, and Priority

UNIT II

Mining and Consensus II: The Generation Transaction, Coin base Reward and Fees, Structure of the Generation Transaction, Coin base Data, Constructing the Block Header, Mining the Block, Proof-of-Work Algorithm, Difficulty Representation, Difficulty Target and Re-Targeting, Successfully Mining the Block, validating a New Block, Assembling and Selecting Chains of Blocks, Block chain Forks, Mining and the Hashing Race, The Extra Nonce Solution, Mining Pools, Consensus Attacks.

UNIT III

Bitcoin: Introduction, History, Bitcoin Uses, Users and Their Stories, Getting Started, Quick Start, getting your first bitcoins, Sending and receiving bitcoins,

Bitcoin Functioning: Transactions, Blocks, Mining, and the Block chain, Bitcoin Overview, buying a cup of coffee, Bitcoin Transactions, Common Transaction Forms, constructing a Transaction, Getting the right inputs, Creating the outputs, Adding the transaction to the ledger, Bitcoin Mining, mining transactions in blocks, Spending the transaction

UNIT IV

Bitcoin Transactions: Bitcoin Transactions, Common Transaction Forms, constructing a Transaction, Getting the right inputs, Creating the outputs, Adding the transaction to the ledger, Bitcoin Mining, mining transactions in blocks, Spending the transaction

Bitcoin Network: Peer-to-Peer Network Architecture, Nodes Types and Roles, The Extended Bitcoin Network, Network Discovery, Full Nodes, Simplified Payment Verification (SPV) Nodes.

Alert Messages Alt-Coins: CryptoNote, Bytecoin, Monero, Zerocash/Zerocoin,

Darkcoin, Namecoin, Bitmessage, Ethereum

TEXT BOOKS

[1] Andreas M. Antonopoulos, "Mastering Bitcoin", 2nd Edition, O'Reilly, 2017

REFERENCE BOOKS

- [1] Melanie Swan, "Blockchain –Blueprint For a New economy", 1st Edition, O'Reilly, 2018
- [2] Don TapScott, Alex Tapscott, "Block chain Revolution". 2nd Edition, Penguin publisher, 2018

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] https://onlinecourses.nptel.ac.in/noc18_cs47/announcements?force=true
- [2] Marco Iansiti, Karim R. Lakhani, "Truth About Blockchain", Harvard Bsiness Review, Harward University, Jan 2017

		19CSC	CS2015B						
		SOFTWARE DEF	INED NET	WORKS					
Course C	ategory:	Programme		Credits:	3				
		Elective							
Course T	ype:	Theory	Lecture -T	utorial-Practice:	3 - 0 - 0				
Prerequis	sites:	Wireless &	Contin	uous Evaluation:	40				
		Mobile Networks	Semester	r end Evaluation:	60				
				Total Marks:	100				
COURS	E OUTCO	OMES							
Upon suc	ccessful co	mpletion of the cour	rse, the stude	ent will be able to:					
CO1	Understa	nd the concepts of v	vireless com	munication.					
CO2	Analyze	Analyze WPAN, WMAN and WWAN technologies							
CO3	Compare	3G and 4G technol	ogies of com	munications.					
CO4	Familiari	ze with concepts of	Wireless Ad	hoc Networks					
Contribu Outcom	ution of Co es (1 – Lov	ourse Outcomes to w, 2 - Medium, 3 –	wards achie High)	vement of Progra	m				
	PO 1	PO 2	PO 3	PSO 1	PSO 2				
CO1	1								
CO2		2							
CO3		2							
CO4			1						

UNIT I

INTRODUCING SDN

SDN Origins and Evolution – Introduction – Why SDN? - Centralized and Distributed Control and Data Planes - The Genesis of SDN

UNIT II

SDN ABSTRACTIONS

How SDN Works - The Openflow Protocol - SDN Controllers: Introduction -General Concepts - VMware - Nicira - VMware/Nicira - OpenFlow-Related -Mininet - NOX/POX - Trema - Ryu - Big Switch Networks/Floodlight - Layer 3 Centric - Plexxi - Cisco OnePK

UNIT III

PROGRAMMING SDN'S

Network Programmability - Network Function Virtualization - NetApp Development, Network Slicing

UNIT IV

SDN APPLICATIONS AND USE CASES

SDN in the Data Center - SDN in Other Environments - SDN Applications - SDN Use Cases - The Open Network Operating System 3

SDN'S FUTURE AND PERSPECTIVES

SDN Open Source - SDN Futures - Final Thoughts and Conclusions

TEXT BOOKS

[1] Software Defined Networks: A Comprehensive Approach by Paul Goransson and Chuck Black, Morgan Kaufmann Publications, 2014

REFERENCE BOOKS

 [1] SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013

[2] Software Defined Networking with OpenFlow By SiamakAzodolmolky, Packt

Publishing, 2013

[3] Monsanto, Christopher, et al. "Composing software defined networks." Presented as part of the 10th USENIX Symposium on Networked Systems Design and Implementation (NSDI 13). 2013

		1908	SCS2015C		
		OPEN SOURC	E PROGRAM	IMING	
Course C	ategory:	Programme Elective		Credi	ts: 3
Course T	ype:	Theory	Lecture -T	utorial-Practio	ee: 3 - 0 - 0
Prerequis	sites:		Contin	uous Evaluatio	on: 40
			Semester	end Evaluatio	on: 60
				Total Mar	ks: 100
Γ					
COURS	E OUTCO	MES			
Upon suc	ccessful cor	npletion of the co	ourse, the stude	ent will be able	20:
CO1	Understar	d the fundamenta	als of Open sou	ırce Programmi	ng.
CO2	Develop c	odes in open sou	rce web applic	ations	
CO3	Understar	d the risks assoc	iated with the o	open source cod	es
CO4	Write sect	ure CGI scripts			
Contribu Outcome	ution of Co es (1 – Low	urse Outcomes 7, 2 - Medium, 3	towards achie – High)	vement of Prog	gram
	PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	3	2			
CO2		3	3	1	
CO3	3	2			
CO4	1		2		

1

UNIT I

INTRODUCTION: Introduction to open source programming languages, advantages and drawbacks of open source programming, threats and vulnerabilities in open source languages, Operating System - Ubuntu Linux - Introduction to

2

shell programming.

UNIT II

PHP: PHP Language Basics, Functions - calling a function, variable function, and anonymous function, Strings - cleaning, encoding and escaping, and comparing strings, Arrays – storing data in arrays, extracting multiple values, traversing, and sorting arrays, Objects – creation, introspection, and serialization, Web Techniques – processing forms and maintaining state.

UNIT III

WEB DATABASE APPLICATIONS:Three-tier architecture, Introduction to Object oriented programming with PHP 5, Database basics, MYSQL - querying web databases, writing to web databases, validation with Javascript, Form based authentication, protecting data on the web.

UNIT IV

PERL, TCL: Numbers and Strings, Control Statements, Lists and Arrays, Files, Pattern matching, Hashes, Functions. Introduction to TCL/TK

SECURITY IN WEB APPLICATIONS:Recognizing web application security threats, Code Grinder, Building functional and secure web applications, Security problems with Javascript, vulnerable GCI scripts, Code Auditing and Reverse Engineering, types of security used in applications

TEXT BOOKS

- [1] Kevin Tatroe, Peter MacIntyre, Rasmus Lerdorf, "Programming PHP", O'Reilly Media, 2012.
- [2] Michael Cross, "Developer's Guide to Web Application Security", Syngress Publishers, 2007.
- [3] Hugh E. Williams, David Lane, "Web Database applications with PHP and MYSQL", Second Edition, O'Reilly Media, 2004.

- [1] Tom Christiansen, Brian D Foy, Larry Wall, Jon Orwant, "Programming Perl", Fourth Edition, O'Reilly Media, 2012.
- [2] Mark Lutz, "Programming Python", Fourth Edition, O'Reilly Media, 2010.
- [3] Online Tutorials and Recent IEEE/ACM Journal Papers

		19CSC	S2015D				
Commo		Dra granne a	KE ENGIN	EERING	2		
Course	alegory:	Floctive		Creans:	3		
Course T	vne•	Theory	Lecture -T	utorial-Practice.	3 - 0 - 0		
Prerequis	ites:	Object Oriented	Contin	uous Evaluation:	40		
1 i ei equis		Programming	Semester	end Evaluation:	60		
		rundamental, UML		Total Marks:	100		
COURSI	E OUTCO	OMES					
Upon suc	cessful co	mpletion of the cour	rse, the stude	ent will be able to:			
C01	Apply M Architect	odern Agile Develop cure Concept of Indu	oment and S stry.	ervice Oriented			
CO2	Apply the Approach	e concept of Functio n for Software Desig	nal Oriented	and Object-Orient	ted		
CO3	Recogniz quality st	Recognize how to ensure the quality of software product, different quality standards and software review techniques.					
CO4	Apply va	rious testing techniq	ues and test	planning.			
CO5	Create SI SPMP (S	RS (Software Requir oftware Project Mar	ement Speci agement Pla	ification) document an) document.	t and		
Contribu Outcome	ition of Co es (1 – Lov	ourse Outcomes tow w, 2 - Medium, 3 –]	wards achie High)	vement of Program	m		
	PO 1	PO 2	PO 3	PSO 1	PSO 2		
CO1	3			3			
CO2	3			3			
CO3	3 3						
CO4	3	3 3					
CO5	3			3			

UNIT I

Introduction to Software and Software Engineering

The Evolving Role of Software, Software: A Crisis on the Horizon and Software Myths, Software Engineering: A Layered Technology, Software Process Models, The Linear Sequential Model, The Prototyping Model, The RAD Model, Evolutionary Process Models, Agile Process Model, Component-Based Development, Process, Product and Process.

Agile Development

Agility and Agile Process model, Extreme Programming, Other process models of Agile Development and Tools.

Managing Software Project

Software Metrics (Process, Product and Project Metrics), Software Project Estimations, Software Project Planning (MS Project Tool), Project Scheduling & Tracking, Risk Analysis & Management (Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation).

UNIT II

Requirement Analysis and Specification

Understanding the Requirement, Requirement Modelling, Requirement Specification (SRS), Requirement Analysis and Requirement Elicitation, Requirement Engineering.

Software Design

Design Concepts and Design Principal, Architectural Design, Component Level Design (Function Oriented Design, Object Oriented Design) (MS Visio Tool), User Interface Design, Web Application Design.

Software Coding & Testing

Coding Standard and coding Guidelines, Code Review, Software Documentation, Testing Strategies, Testing Techniques and Test Case, Test Suites Design, Testing Conventional Applications, Testing Object Oriented Applications, Testing Web and Mobile Applications, Testing Tools (Win runner, Load runner).

UNIT III

Quality Assurance and Management

Quality Concepts and Software Quality Assurance, Software Reviews (Formal Technical Reviews), Software Reliability, The Quality Standards: ISO 9000, CMM, Six Sigma for SE, SQA Plan.

Software Maintenance and Configuration Management

Types of Software Maintenance, Re-Engineering, Reverse Engineering, Forward Engineering, The SCM Process, Identification of Objects in the Software Configuration, Version Control and Change Control

UNIT IV

Software Engineering and Software as a Service

Product Lifetime: Independent Product Vs. Continues, Improvement, Software as a Service, SaaS Architecture.

Advanced Topics in Software Engineering:

Component-Based Software Engineering, Client/Server Software Engineering, Web Engineering, Reengineering, Computer-Aided Software Engineering, Software Process Improvement, Emerging Trends in software Engineering.

TEXT BOOKS

- [1] Roger S.Pressman, Software engineering- A practitioner's Approach, McGraw-Hill International Editions
- [2] Ian Sommerville, Software engineering, Pearson education Asia

- [1] Pankaj Jalote, Software Engineering A Precise Approach Wiley
- [2] Software Engineering Fundamentals by Ali Behhforoz & Frederick Hudson OXFORD
- [3] Rajib Mall, Fundamentals of software Engineering, Prentice Hall of India.
- [4] Engineering Software as a Service An Agile Software Approach, Armando Fox and David Patterson
- [5] John M Nicolas, Project Management for Business, Engineering and Technology, Elsevier

E-RESOURCES AND OTHER DIGITAL MATERIAL

- [1] PROF. RAJIB MALL Dept. of Computer Science and Engineering IIT Kharagpur, Software Engineering https://nptel.ac.in/courses/106/105/106105182/
- [2] PROF. RAJIB MALL PROF. DURGA PRASAD Computer Science and Engineering IIT Kharagpur Software Project Management https://nptel.ac.in/courses/106/105/106105218/
- [3] PROF. MEENAKSHI D'SOUZA Dept. of Computer Science and Engineering IIIT Bangalore, Software Testing,

https://nptel.ac.in/courses/106/101/106101163/

		19M7	TAC2036				
		TECHNICAL R	EPORT WR	ITING			
Course Category:Audit CourseCredits:							
Course T	ype:	Theory	Lecture -T	utorial-Practic	:e: 2 - 0 - 0		
Prerequis	sites:	Basic English Language	e Contin	uous Evaluatio	n: 0		
			Semester	r end Evaluatio	n: 0		
				Total Marl	ks: 0		
COURSI	E OUTCO	OMES					
Upon suc	cessful co	mpletion of the cou	urse, the stude	ent will be able t	0:		
CO1	Understa	nd the significance	of Technical	Report writing.			
CO2	Develop	Proficiency in writ	ing technical	reports.			
CO3	Apply the	e basic principles to	o prepare doc	umentation usin	g LATEX.		
CO4	Understa report wr	nding the need of iting	Bibliography	and references	s for quality		
Contribu Outcome	ition of Co es (1 – Lov	ourse Outcomes to w, 2 - Medium, 3 –	owards achie - High)	vement of Prog	gram		
	PO 1	PO 2	PO 3	PSO 1	PSO 2		
CO1	1	2			1		
CO2		3	1	2	3		
CO3		3 1 2					
CO4	1	3			3		

UNIT I

Writing scientific and engineering papers: Title, Abstract, Introduction, Materials And Methods, Result, Discussion, Conclusion, References, Acknowledgements, Appendices, Hedging and Criticizing, Paraphrasing and

Plagiarism.

UNIT II

Effective use of charts, graphs and tables-Bar Chart, Line Chart, Pie Chart, Area Chart, Cylindrical Chart, Column Bars, Bubble Chart, Flow Diagram, Screen Capture, Tables

Writing Technical Reports-Objectives Of Technical Report, Types Of Reports, Steps In Writing A Technical Report, Guidelines For Writing A Technical Report.

UNIT III

LATEX- Introduction, Document Structure- Creating a Title, Sections, Labeling, Table of Contents

Typesetting Text- Font Effects, Colored Text, Font Sizes, Lists, Comments & Spacing, Special Characters

UNIT IV

Tables, Figures, Equations- Inserting Equations, Mathematical Symbols, Practical.

Inserting References- Introduction, The BibTeX file, Inserting the bibliography, Citing references, Styles, Practical.

TEXT BOOKS

- [1] Barun K Mitra, Effective Technical Communication-A Guide for Scientists and Engineers,Oxford University Press,2006, ISBN:978019568291.
- [2] LATEX for Beginners, Workbook Edition 5, March 2014 Document Reference: 3722-2014.

- [1] Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
- [2] Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] https://www.futurelearn.com/courses/technical-report-writing-for-engineers

		19C TER	SCS2063 M PAPER		
Course C	Category:	Term Paper		Credits	: 1
Course T	ype:		Lecture -7	Sutorial-Practice	: 0 - 0 - 2
Prerequi	sites:		Contin	uous Evaluation	: 40
			Semeste	r end Evaluation Total Marks	: 100
COURS	E OUTCO	MES		ut	
Opon su			· · · · · · ·		
CO1	Identify a	real world proble	em in specific	domain	
CO2	Understan	d requirements a	nd specificatio	ons of the problem	L
CO3	Explore the	ne existing techno	ologies/ Metho	dologies	
CO4	Formulate	a real world pro	blem and deve	lop its requirement	nts
CO5	Express te	echnical ideas stra	ategies and me	thodologies in wr	itten form
CO6	Prepare an	nd conduct oral pr	resentations		
Contrib Outcom	ution of Co es (1 – Low	urse Outcomes (7, 2 - Medium, 3	towards achie – High)	evement of Progra	am
	PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	2		2	1	1
CO2	2		2	2	
CO3	2		2	2	
CO 4	2		2	2	
CO5		2			1

CO6		2		1
VR	SEC			80

19CSCS2051							
]	HIGH PER	FORMANCE (COMPUTING	G LABORATO	DRY		
Course Ca	se Category: Programme Core Credits: 1.5						
Course Ty	ype: L	aboratory	Lecture -T	'utorial-Practi	ce: 0 - 0 - 3		
Prerequis	ites: D	ata Structures,	Contin	uous Evaluatio	on: 40		
	С	omputer	Semester	end Evaluation	on: 60		
	0	rganization &		Total Mar	ks: 100		
	Architecture						
COURSI	E OUTCOM	IES					
Upon suc	cessful comp	oletion of the co	urse, the stude	ent will be able	to:		
	Understand	parallel program	mming platfor	ms and parallel	algorithms		
CO1	on parallel	computer system	ns.	-	-		
CO2	Analyze the	working group	communicatio	on operations o	f MPI.		
	Understand	the accelerator	technologies of	of GPGPU's wi	th CUDA,		
CO3	OpenCL.						
	Implement	algorithms for N	Jotrix Sorting	and Graphs us	ing		
CO4	OpenMP P	threads MPI an	nd CLIDA lang	, and Oraphs us uage/library	Sing		
	Openivir, i	uncaus, wii i an		uage/norary.			
Contribu	tion of Cou	rse Outcomes t	owards achie	vement of Pro	gram		
Outcome	s (1 – Low,	2 - Medium, 3 -	– High)				
	DO 1	BO 2	DO 2	DCO 1			
	PUT	PO 2	PO 3	PSU 1	PSU 2		
CO1			3	2			
CO2	1		3	2			
CO3	1		3				
CO4	1		3	2			
CO3 CO4	1		3	2			

Task 1: Implement Basic of MPI Programs.

- Task 2: Implement a Program for Communication between MPI processes.
- Task 3: Implement advance communication between MPI processes

Task 4: Implement MPI collective operations using 'Synchronization'

Task 5: Implement MPI collective operations using 'Data Movement'

Task 6: Implement MPI collective operations using 'Collective Computation'

Task 7: Write a program for MPI Non-Blocking operation

Task 8: Implement Matrix-Matrix multiplication - Cannon's.

Task9: Implement Sorting using MPI- Shell sort, Quick sort, Bucket.

Task10: Implement Problems using OpenMP.

Task11: Implement Problems using Pthreads.

Task12: Implement Problems using CUDA.

Task13: Implement problems using OpenCL.

TEXT BOOKS

- [1] AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar: Introduction to Parallel Computing, Second Edition Pearson Education, 2016.(Chapters:1-10)
- [2] Jason Sanders, Edward Kandrot, CUDA By Example An Introduction to General-Purpose GPU Programming, Addison Wesley, 2011. (Chapters:1-4)
- [3] Benedict R Gaster, Lee Howes, David R KaeliPerhaad Mistry Dana Schaa, *Heterogeneous Computing* with OpenCL McGraw-Hill, Inc. Newyork , 2012(Chapters-2)

REFERENCE BOOKS

- [1] Michael J. Quinn, Parallel Programming in C with MPI and OpenMP McGraw-Hill International Editions, Computer Science Series, 2004.
- [2]. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors – A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] nptel.ac.in/courses/106108055/

- [2] http://www.nvidia.com/object/cuda_home_new.html
- [3]http://www.icrar.org/research/postgraduuate/igh-performance-computinghonours-course
- [4] http://www.openCL.org

		19CS	CS2052			
Course	C	LOUD COMPUT	ING LABO	RATORY	15	
Course C	ategory:	Programme Core	Locturo	Crealis:	1.3	
Course I Prerequi	ype: sites·	Laboratory	Contir	utorial-relactice.	40	
1 I CI CYUI	51105.		Semeste	r end Evaluation.	40 60	
			Semeste	Total Marks:	100	
]	
COURS	E OUTCO	OMES				
Upon su	ccessful co	mpletion of the cou	rse, the stude	ent will be able to:		
CO 1	Understa architectu	nd the evolution oure	of cloud co	omputing paradigm	and its	
CO2	Explain service m	and characterize d	ifferent clou	ud deployment mo	odels and	
CO3	Identify paradigm	the various techn	ological dr	ivers of cloud co	omputing	
CO4	Identify t	the security issues in	n cloud com	outing.		
Contrib Outcom	ution of Co es (1 – Lov	ourse Outcomes to w, 2 - Medium, 3 –	wards achie High)	evement of Program	m	
	PO 1	PO 2	PO 3	PSO 1	PSO 2	
CO1			2			
CO2			2	1		
CO3			3	2		
CO 4	1 2					

Task 1:Create a cloud based google app engine project and deploy using any cloud based IDEs like codenvy, cloud9 or codeanywhere.

Task 2:Install and configure guest Operating System in another host OS using virtual box to implement para-virtualization.

Task 3:Develop and deploy a Node.js app using IBM BlueMix PAAS services.

Task 4:Create sample battle station Application in <u>salesforce.com</u> developer interface.

Task 5:Simulate the cloud environment of three data centers in different geographical locations and add virtual machines to them along with resources like storage, compute and bandwidth using Cloud Analyst.

Task 6: Create and launch windows server virtual machine using YELLOW CIRCLE cloud platform.

Task7: Create Node.js sample application using redhatopenshift cloud application platform.

Task 8: Create a virtual machine and install guest OS in Amazon AWS cloud platform.

Task 9: Using Cloudsim simulate a datacenter with one host and run one cloudlet on it.

Task 10: Using Cloudsim simulate two datacenters with one host and a network topology each and run two cloudlets on them.

TEXT BOOKS

[1] K. Chandrasekaran, Essentials of Cloud Computing, CRC Press, 2015

- [1] Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2010
- [2] RajkumarBuyya, James Broberg, Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2011
- [3] Nikos Antonopoulos, Lee Gillam, Cloud Computing: Principles, Systems and Applications, Springer, 2012

SEMESTER III

	Ic	19CSC	S3011A	PVTHON				
Course C	Ourse Category: Programme Credits: 3							
Course T		Elective	Lootuno T	utarial Drastian	0 0 0			
Course I Duonoqui	ype:	Dete Structures	Lecture - I	utorial-Practice:	0-0-0			
Prerequis	sites:	Data Structures,	Contin	uous Evaluation:	-			
		Organization &	Semester	Total Marks	100			
		A rehitecture		Total Marks:	100			
		AICIIIICCIUIC						
COURS	E OUTCO	OMES						
Upon suc	ccessful co	mpletion of the cour	rse, the stude	ent will be able to:				
CO1	Understa	nd python lexical fe	atures and sy	ntax.				
CO2	Understa	nd basic data structu	res with pyt	hon.				
CO3	Impleme	nt Exception Handli	ng and files.					
CO4	Create G	UI Applications usin	ng Python.					
Contribu Outcome	ution of Co es (1 – Lov	ourse Outcomes to w, 2 - Medium, 3 –	wards achie High)	vement of Progra	ım			
	PO 1	PO 2	PO 3	PSO 1	PSO 2			
CO1	2							
CO2				3	2			
CO3				3	2			
CO4				3	2			

Motivation for Computing | Welcome to Programming.

Variables and Expressions, Design your own calculator | Loops and Conditionals, Hopscotch once again.

Lists, Tuples and Conditionals, Lets go on a trip | Abstraction Everywhere : Apps in your phone.

Counting Candies: Crowd to the rescue | Birthday Paradox : Find your twin.

Google Translate: Speak in any Language | Currency Converter : Count your foreign trip expenses.

Monte Hall: 3 doors and a twist | Sorting : Arrange the books.

Searching: Find in seconds | Substitution Cipher : What's the secret !!

Sentiment Analysis: Analyse your Facebook data | I can read your mind.

Permutations: Jumbled Words | Spot the similarities : Dobble game.

Count the words: Hundreds, Thousands or Millions | Rock, Paper and Scissor : Cheating not allowed !!

Lie detector: No lies, only TRUTH | Calculation of the Area : Don't measure. | Six degrees of separation: Meet your favourites | Image Processing : Fun with images.

Tic tac toe: Let's play | Snakes and Ladders : Down the memory lane | Recursion : Tower of Hanoi | Page Rank : How Google Works !!

TEXT BOOKS

- [1] Allen B.Downey, "Think Python", 2rd Edition, O'Reilly Publications, 2012
- [2] Python Programming, Michael Dawson, 3rd Edition, Course technology PTR, 2010.

- [1] Michael Dawson "Python Programming for the Absolute Beginner", 3rd Edition, Course technology PTR.
- [2] Taneja Sheetal , Kumar Naveen "Python Programming: A modular approach", Pearson Publications, 2017.

[3]	Mark Lutz "Learning Python", 5th Edition, O'Reilly Publications, 2013
E-F	RESOURCES AND OTHER DIGITAL MATERIAL
[1]	NOC: The Joy of Computing using Python by Prof. Sudarshan Iyengar, IIT
	Madras in www.nptel.ac.in
	URL: https://nptel.ac.in/courses/106/106/106106182/#
	Accessed on : 22-08-2019
[2]	Programming for Everybody(Python) by Prof. Charles Severance, University
	of Michigan in www.coursera.com
	URL: https://www.coursera.org/course/pythonlearn
	Course Schedule (coursera): May 2019
[3]	An Introduction to Interactive Programming in Python by Prof. Scott
	Rixner,Rice University in www.coursera.com
	URL: https://www.coursera.org/learn/interactive-python-1
	Course Schedule (coursera): Starts May 2nd 2019, 5 weeks

[4] The Python Tutorial available at http://docs.python.org/3.3/tutorial/

		19CS	CS3011B				
		USER INTE	RFACE DES	IGN			
Course Ca	ategory: P	rogramme		Credi	its: 3		
	E	lective					
Course Ty	ype: T	heory	Lecture -1	utorial-Praction	ce: $0 - 0 - 0$		
Prerequis	ites:		Contin	uous Evaluatio	on: -		
			Semestel	r end Evaluatio	on: 100		
				I otal Mar	KS: 100		
COURSI	E OUTCON	IES					
Upon quo	acceful com	lation of the app	man the stude	nt will be able	ta		
Opon suc		pletion of the cot	urse, the stude	ent will be able			
CO1	Understan	d the key terms	s of User int	erface			
CO2	Use appro UI and UX	priate prototyp K.	es for preser	nting informat	ion using		
CO3	Apply des interfaces.	ign principles f	for developi	ng sophisticate	ed User		
CO4	Identify fa	ults and test ca designs.	ises in the in	terfaces and s	uggest		
Contribu Outcome	ition of Cou es (1 – Low,	rse Outcomes te 2 - Medium, 3 -	owards achie - High)	vement of Prog	gram		
	PO 1	PO 2	PO 3	PSO 1	PSO 2		
CO1	1						
CO2	2	1		2	2		
CO3	2	2 2 2 2					
CO 4		3		2	2		

Introduction to User Interface Design

Introduction to UI Design

Brief History of UI Design

UI Design Methodology

User Experience design component in Interface Design

User Research and Design

Prototyping and Design

Evaluating User Interfaces

Human Factor in Interaction Design

Visual Communication design component in Interface Design

Visual Cognition

Contemporary Visual Language in Design

Usage of Typography in User Interface Design

Testing User interfaces

TEXT BOOKS

[1] Wilbert O Galitz, "The Essential Guide to User Interface Design- An Introduction to GUI Design Principles and Techniques", 3rd Edition, Wiley DreamaTech, 2017.

REFERENCE BOOKS

- [1] Steven Jacobs, Ben Shneiderman, Catherine Plaisant, Maxine Cohen, "Designing the User Interface: Strategies for Effective Human -Computer Interaction" 6th Edition, Pearson Education Asia, 2017.
- [2] Alan Dix, Janet Fincay, Gre Goryd, Abowd and Russell Bealg, "Human Computer Interaction", 2nd Edition, Pearson Education.
- [3] Scott Mackenzie, "Human-Computer Interaction: An Empirical Research Perspective" 2016, Elsevier Publications.
- [4] Rogers, "Interaction Design: Beyond Human Computer Interaction", Third Edition, Wiley Publications, 2013.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Dr. Samit Battacharya IIT Guwahati , Department of Computer Science & Engineering, NPTEL Videos, Available:https://nptel.ac.in/courses/106103115/ Last accessed on

[2] Prof. Pradeep Yammiyavar IIT Guwahati , Department of Design, NPTEL Videos

Available:https://nptel.ac.in/courses/106103115/ Last accessed on August 2019.

19CSCS3011C DEEP LEARNING							
Course Category:		rogramme lective		Credits			
Course Type:		heory	Lecture -T	Lecture -Tutorial-Practice:			
Prerequisites:		lachine learning	Contin	Continuous Evaluation:			
•			Semester end Evaluation		n: 100		
			Total Mar		s: 100		
COURSE OUTCOMES							
Upon successful completion of the course, the student will be able to:							
CO1	Understand the Linear Classifiers and Optimization Techniques						
CO2	Understand various types of Neural networks						
CO3	Apply Classical Supervised Tasks with Deep Learning						
CO4	Understand LSTM Networks						
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)							
	PO 1	PO 2	PO 3	PSO 1	PSO 2		
CO1	2		2	2			
CO2	1		1	1			
CO3	2		2	2			
CO4	1		1	1			

Introduction to Deep Learning, Bayesian Learning, Decision Surfaces Linear Classifiers, Linear Machines with Hinge Loss Optimization Techniques, Gradient Descent, Batch Optimization Introduction to Neural Network, Multilayer Perceptron, Back Propagation Learning.

Unsupervised Learning with Deep Network, Autoencoders

Convolutional Neural Network, Building blocks of CNN, Transfer Learning

Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam

Effective training in Deep Net- early stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization

Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network Fully Connected CNN etc.

Classical Supervised Tasks with Deep Learning, Image Denoising, Semantic segmentation Object Detection etc.

LSTM Networks

Generative Modeling with DL, Variational Autoencoder, Generative Adversarial Network.

TEXT BOOKS

- [1] Deep Learning- Ian Goodfelllow, Yoshua Benjio, Aaron Courville, The MIT Press
- [2] Pattern Classification- Richard O. Duda, Peter E. Hart, David G. Stork, John Wiley & Sons Inc.

REFERENCE BOOKS

- [1] Antonio Gulli, Sujit Pal, Deep Learning with Keras, Packt Publishing, 2017
- [2] Tom Hope, Yehezkel S. Resheff, Itay Lieder, Learning Tensor Flow: A Guide to Building Deep Learning Systems, OReilly 2017

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Prof. Prabir Kumar Biswas, IITKGP, https://swayam.gov.in/nd1_noc19_cs54/preview, Accessed on 22-08-2019

19CSCS3011C								
DATA VISUALISATION								
Course Category:		Programme	Credits		3			
		Elective						
Course Type:		Theory	Lecture - Tutorial-Practice:		0 - 0 - 0			
Prerequisites:		Computer	Continuous Evaluation:		-			
		Graphics,	Semester	end Evaluation:	100			
		Image Processing		Total Marks:	100			
COURSI	E OUTCO	MES						
Upon suc	cessful con	npletion of the cou	rse, the stude	ent will be able to:				
CO1	Understand Visualization stages for different types of data							
CO2	Apply Visualization algorithms for good visualization							
CO3	Analyze various visualization and modelling techniques							
CO4	Use Visualization relationships for correlation, distribution and to Identify Outliers							
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)								
	PO 1	PO 2	PO 3	PSO 1	PSO 2			
CO1	1		1	1				
CO2	2		2	2				
CO3	2		2	2				
CO4	2		2	2				

The minimum content to be covered

Foundations for an applied science of data visualization, Gibson's Affordance theory

A Model of Perceptual Processing, Visual working memory, Costs and Benefits of Visualization

Types of Data: entities, relationships, attributes of entities or relationships, data dimensions, types of numbers, uncertainty, and operations considered as data.

The Visualization Pipeline: Conceptual Perspective, Implementation Perspective.

Algorithm Classification, Scalar Visualization: Color Mapping, Designing Effective Color maps, Contouring, Height Plots

Vector Visualization: Vector Glyphs, Vector Color Coding, Displacement Plots, Texture-Based Vector Visualization

Domain- Modeling Techniques: Cutting, Selection, Grid Construction from Scattered Points

Image Visualization: Image Data Representation, Image Processing and Visualization

Information Visualization: What Is Infovis Table Visualization, Visualization of Relations, Multivariate Data Visualization, Text Visualization

Visualizing Proportions: what to look for in proportions, parts of a whole, proportions over a time

visualizing relationships: what relationships to look for, correlation, distribution, comparison

Spotting Differences: comparing across multiple variables, reducing dimensions, searching for outliers

Visualizing spatial relationships: specific locations, regions, over space and time

TEXT BOOKS

[1] Colin Ware "Information Visualization Perception for Design", 3 rd edition, Morgan Kaufman 2012.

[2] Alexandru C. Telea, "Data Visualization: Principles and Practice," A. K. Peters Ltd, 2008

[3] Nathan Yau's Visualize This: The FlowingData Guide to Design, Visualization, and Statistics 2011 wiley Publisher

REFERENCE BOOKS

[1] Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.

[2] Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001. E-resources and other digital material.

E-RESOURCES AND OTHER DIGITAL MATERIAL

[1] Prof. Han-Wei Shen Introduction to Data Visualization, http://web.cse.ohio-state.edu/~shen.94/5544/

[2]University of Illinois at Urbana-Champaign

https://www.coursera.org/learn/datavisualization

SEMESTER – III

19CSCS3061								
Course C	ategory. Pr	oject	\mathbf{A} - PARIA	Cred	its. 3			
Course Type:			Lecture -T	utorial-Practi	ce: 0 - 0 - 20			
Prerequisites:			Contin Semester	uous Evaluati c end Evaluati Total Mar	on: 40 on: 100 ks: 100			
COURS	E OUTCOM	ES						
Upon suc	Upon successful completion of the course, the student will be able to:							
CO1	D1 Identify a real world problem in specific domain and its feasibility							
CO2	Explore the existing technologies/ Methodologies							
CO3	Apply the techniques for data preparation and formulization							
CO4	Design a prototype							
CO5	Prepare the technical Report							
CO6	Prepare and conduct oral presentations							
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)								
	PO 1	PO 2	PO 3	PSO 1	PSO 2			
CO1	2		2	1	1			
CO2	2		2	1				
CO3	2		2	2				
CO4	2		2	2	1			
CO5		2			1			

CO6	2		1				
		19CS INTE	SCS3052 CRNSHIP				
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Course Category: Int		ernship		Credits	02		
Course Type:			Lecture -T	utorial-Practice:	0 - 0 - 4		
Prerequis	sites:		Continuous Evaluation		-		
			Semester	end Evaluation	100		
				Total Marks	100		
COURS	E OUTCOM	ES					
Upon suc	cessful comp	letion of the co	urse, the stude	nt will be able to:			
CO1	Understand the practices of the particular company and industry in which they are working						
CO2	Apply their knowledge and skills acquired in the classroom to a professional context						
CO3	Identify, write and carry out performance objectives related to their job assignment						
CO4	Successfully reflect on the quality of the contribution they have made to the organization						
Contribu Outcome	ition of Cour es (1 – Low, 2	se Outcomes t - Medium, 3 -	owards achie – High)	vement of Progra	ım		
	PO 1	PO 2	PO 3	PSO 1	PSO 2		
CO1			1		3		
CO2			2	2			
CO3		3					
CO4			3				

SEMESTER – IV

		19CS	SCS4061					
~ ~		PROJEC	T – PART B	~	1.6			
Course Category:		Project		Credits	: 16			
Course Type:			Lecture -7	Sutorial-Practice	: 0 - 0 - 32			
Prerequisites:			Contin	uous Evaluation	: 40			
			Semeste	r end Evaluation	: 100			
				Total Marks	: 100			
COURS	E OUTCO	OMES						
Upon successful completion of the course, the student will be able to:								
CO1	Develop and implement proposed methodologies							
CO2	Validate the methodology with the requirements of the problem							
CO3	Compare proposed methodology with existing technologies to do performance analysis.							
CO4	Prepare the quality technical Report with professional ethics							
CO5	Prepare and conduct oral presentations							
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)								
	PO 1	PO 2	PO 3	PSO 1	PSO 2			
CO1	2		2	2	2			
CO2	3		3	3	1			
CO3	3		3	3				
CO4		3			3			
CO5		3						