G H RAISONI COLLEGE OF ENGINEERING

(An Autonomous Institute affiliated to RashtrasantTukadojiMaharaj Nagpur University, Nagpur)
Accredited by NAAC with 'A+' Grade
CRPF Gate No.3, Hingna Road, Digdoh Hills, Nagpur – 440 016. (INDIA)
Phone : +91 9604787184, 9689903286, 9921008391 Fax : +91 – 7104 – 232560
E-mail: principal.ghrce@raisoni.net Web: ghrce.raisoni.net

GHRCE/HoD/Dept./Scheme/UG/PG/02/01/02

Note: Applicable from 2018-19

Institute Vision and Mission

Programme: UG in Information Technology

Vision and Mission:

DEPARTMENT VISION

To achieve excellent standards of quality education by keeping pace with rapidly changing technologies to create technical manpower of global standards with capabilities of accepting new challenges in Information Technology.

DEPARTMENT MISSION

- To equip our graduates with knowledge and expertise to contribute significantly to the knowledge and information industry and continue to grow professionally.
- Promoting collaborative research through special interest groups, research laboratories and Industry Institute Interactions.
- To nurture our graduates interpersonal and entrepreneurial skills to provide leadership in the information industries

Program Education Objectives:

The programme educational objectives of the Information Technology programme are designed to produce competent engineers who are ready to contribute effectively to the advancement of information technology causes and to accommodate the needs of the profession. The graduates shall:

1. Practice Information Technology in the general disciplines of design, development & deployment of software and integration of existing technologies for e-governance nationwide.
2. Apply fundamental technical knowledge and skills to provide workable solutions to problems in various areas of IT.
3. Pursue higher education, research and development and deploy creative efforts in the area of Information Technology.
4. Use the acquired knowledge in societal and environmental sensitive manner with professional ethics in a team

Program Outcomes:

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Programme Specific Outcomes:

Graduate shall be able to:

PSO1 -Ability to develop and apply Engineering conceptual knowledge and practices inprogramming Web based technologies and information management.

PSO 2 - Apply core concepts of information technology in android/iOSApplication& Product Development**.**

PSO3 -Utilize the hands on experience of industry internship leading to take up challenging jobs in IT industries

B. E. FIRST YEAR SCHEME
(INFORMATION TECHNOLOGY)
SEMESTER- I

Subject Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme				
							Theory			Practical	Total Marks
		Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Cont.	
BFYL101	Matrices	1	1	-	2	2	10	15	25	--	50
BFYL102	Differential & Vector Calculus	1	1	-	2	2	10	15	25	--	50
BEEL101 BEEP101	AC & DC Circuits	1	-	2	3	2	10	15	25	25	75
BEEL102	AC & DC Machine	2	-	-	2	2	10	15	25	--	50
BEEL103	Energy Sources & Audit	1		-	1	1	10	15	--	--	25
BITL101 BITP101	Programming for Problem Solving	1	-	4	5	3	10	15	25	50	100
BECL104	Bio-System in Engg.	1	1	-	2	2	10	15	25	--	50
BCSP101	Data Analytics	-	-	2	2	1	--	--	--	25	25
BECL101 BECP101	Introduction to Digital System	1	1	2	4	3	10	15	25	25	75
BHUP103	Foreign Language	-	-	2	2	1	--	--	--	25	25
BHUP104	Liberal/ Creative Arts	-	-	1	1	0.5	--	--	--	25	25
BFYP131	Waste Management	-	-	2	2	1	--	--	--	25	25
BFYP132	Environmental Science	-	-	1	1	0.5	--	--	--	25	25
TOTAL		**9**	**4**	**16**	**29**	**21**	**90**	**135**	**175**	**200**	**600**

SEMESTER- II

BFYL103	Integral & Multiple Calculus	1	1	-	2	2	10	15	25	--	50
BFYL104	Ordinary & Partial Differential Equations	1	-	-	1	1	10	15	25	--	50
BCSP102	Data Structure	-	-	4	4	2	--	--	--	50	50
BFYP152	Internet of Things	-	-	2	2	1	--	--	--	25	25
BFYL121 BFYP121	Applied Physics	1	1	2	4	3	10	15	25	25	75
BECL102 BECP102	Analog Circuits	1	1	2	4	3	10	15	25	25	75
BECP103	Embedded Programming	-	-	2	2	1	--	--	--	25	25
BMEP102	Digital Fabrication	-	-	4	4	2	--	--	--	50	50
BFYP151	Mini Model through Innovation & Creativity	-	-	4	4	2	--	--	--	50	50
BHUL101 BHUP101	Communication Skills	-	2	2	4	3	10	15	25	50	100
BHUP102	Ethics & Professional Competencies	-	-	2	2	1	--	--	--	25	25
BMBP101	Entrepreneurship	-	-	2	2	1	--	--	--	25	25
TOTAL		**4**	**5**	**26**	**35**	**22**	**50**	**75**	**125**	**350**	**600**

SEMESTER III													
Course Code	**Name of the Course**	**Exam Mode**	**Teaching Scheme**				**Credits**	**Continuous Evaluation Scheme**					
								Theory			**Practical**		**Total**
			Th.	**Tu**	**Pr.**	**Total Hour**		**TAE**	**CAE**	**ESE**	**Int**	**Ext**	
BFYL141	Mathematics-V (Discrete Mathematics)	Offline	1	1	-	2	2	10	15	25	-	-	50
BCSL203/ BCSP203	Data Structures and Algorithms	Online Moodle	2	-	2	4	3	10	15	25	10	15	75
BECL320/ BECP320	Hardware Description Language	Offline	1	-	2	3	2	10	15	25	10	15	75
BCSP205	Object Oriented Programming	Online Moodle	-	-	4	4	2	-	-	-	25	25	50
BCSL207	Problem Identification & Design Thinking	Activity Based	1	-	-	1	1	10	15	-	-	-	25
BCSL208/ BCSP208	Database Management Systems	Online Moodle	2	-	2	4	3	10	15	25	10	15	75
BCSL209	Software Engineering & Project Management	Activity Based	1	1	-	2	2	10	15	25	-	-	50
BAIP201	Foundation Course In Machine Learning	Practical Based	-	-	2	2	1	-	-	-	25	25	50
BAIP202	Skill Development-1(Linear Algebra)	Practical Based	0	-	2	2	1	-	-	-	25	-	25
BHUP202	Reasoning	Online	-	-	1	1	0.5	-	-	-	25	-	25
BHUP203	Quant		-	-	1	1	0.5	-	-	-	25	-	25
BHUP204	Liberal arts	Offline	-	-	1	1	0.5	-	-	-	25	-	25
BHUP205	Business English Certification-1	Online	-	-	4	4	2	-	-	-	50	-	50
BHUP206	Aptitude 1	Online	-	-	1	1	0.5	-	-	-	25	-	25
Total			**8**	**2**	**22**	**32**	**21**	**60**	**90**	**125**	**255**	**95**	**625**
SEMESTER IV													
BFYL142	Mathematics-VI (Graph Theory and Number System)	Online	1	1	-	2	2	10	15	25	-	-	50
BCSL211/ BCSP211	Operating Systems	Activity Based	2	-	2	4	3	10	15	25	10	15	75
BCSL212	Formal languages and Automata	Offline	2	1	-	3	3	10	15	50		-	75
BCSP213	Java Programming	Online Moodle	-	-	4	4	2	-	-	-	25	25	50
BCSP214	Principles in Programming Languages	Online Moodle	-	-	2	2	1	-	-	-	25	25	50
BCSL215/ BCSP215	Big Data	Online	1	-	2	3	2	10	15	25	10	15	75
BCSL216	Software Architecture and Web Services	Activity Based	2	-	-	2	1	10	15	25	-	-	50
BAIL203	Machine Learning Algorithms	Activity Based	2	-	-	2	2	10	15	25			50
BCSLXXX	Open elective-1		2	-	-	2	2	10	15	25			50
BCSP219	Mini Project & Technical Report Writing	Online	-	-	2	2	2	-	-	-	50	-	50
BMBP102	Entrepreneurship Development	Offline	-	-	2	2	1	-	-	-	25	-	25
BHUP207	Soft Employability Skills	Viva-Voce	-	-	1	1	0.5	-	-	-	25	-	25
Total			**12**	**2**	**15**	**29**	**21.5**	**70**	**105**	**200**	**170**	**80**	**625**

SEMESTER V

Course Code	Name of the Course	Exam Mode	Teaching Scheme				Credits	Continuous Evaluation Scheme					
								Theory			Practical		Total
			Th.	Tu	Pr.	Total Hour		TAE	CAE	ESE	Int	Ext	
BFYL143	Mathematics-VII (Integral Transforms)	Online	1	-	-	1	1	10	15	25	-	-	50
BCSL316/ BCSP316	Design & Analysis of Algorithms	Online	2	-	2	4	3	10	15	25	10	15	75
BCSL309/ BCSP309	Compiler Design	Offline	2	-	2	4	3	10	15	25	10	15	75
BCSL317/ BCSP317	Data Communication and Networks	Offline	2	-	2	4	3	10	15	25	10	15	75
BCSL315/ BCSP315	Cloud Computing	Activity Based	1	-	2	3	2	10	15	25	10	15	75
MBP104	Advanced Communication Skills	Activity based	-	-	4	4	2	-	-	-	50	-	50
BCSP318	Skill Development-3	Online	-	-	2	2	1	-	-	-	25	-	25
BHUP302	Aptitude 2	online	-	-	1	1	0.5				25	-	25
BCSP319	Internship & Technical Report writing	Activity based	-	-	2	2	1	-	-	-	25	50	75
MBP301	Financial Management for Engineers	Activity based	-	-	1	1	0.5		-	-	25	-	25
BCSLXXX	Elective 1(Humanities)	Activity based	2	-		2	2	10	15	25	-	-	50
BCSLXXX	Elective 2(Science)	offline	2	-		2	2	10	15	25	-	-	50
Total			**12**	**0**	**18**	**30**	**21**	**70**	**105**	**175**	**190**	**110**	**650**

SEMESTER VI

BFYL144	Mathematics-VIII (Probability & Statistics)	Online/ Moodle	1	-	-	1	1	10	15	25	-	-	50
BECL218/ BECP218	Embedded Systems Design	Activity based	2	-	2	4	3	10	15	25	25	25	100
BCSL320/ BCSP320	Information Security & Cryptography	Offline Moodle	2	-	2	4	3	10	15	25	10	15	75
BCSL321/ BCSP321	Advanced Networks	Offline	1	-	4	5	3	10	15		10	15	50
BEMP319	Product Development & IPR		-	-	2	2	1	-	-	-	25	-	25
BHUP303	Aptitude 3	Online	-	-	1	1	0.5	-	-	-	25	-	25
BCSLXXX	Open Elective 2		2	-	-	2	2	10	15	25	-	-	50
BCSP322	Skill Development-4	Online	-	-	2	2	1	-	-	-	25	-	25
BHUP304	Career Development Practice	Activity Based	-	-	2	2	1	-	-	-	25	-	25
BCSLXXX	Elective 3		2	-	-	2	2	10	15	25	-	-	50
BCSLXXX	Elective 4		2	-	-	2	2	10	15	25	-		50
Total			**12**	**0**	**15**	**27**	**19.5**	**70**	**105**	**150**	**145**	**55**	**525**

SEMESTER VII

Course Code	Name of the Course	Teaching Scheme				Credits	Continuous Evaluation Scheme					
							Theory			Practical		Total
		Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	
XXXLXXX	Elective 5	2	-	-	2	2	10	15	25			50
XXXLXXX	Elective 6	2	-	-	2	2	10	15	25			50
XXXLXXX	Elective 7	2	-	-	2	2	10	15	25	-	-	50
XXXLXXX	Elective 8	2	-	-	2	2	10	15	25	-	-	50
XXXLXXX	Elective 9	2	-	-	2	2	10	15	25	-	-	50
BCSP428	Project Phase I	-	-	4	4	4	-	-	-	75	50	125
BCSP432	MOOCs-I	-	-	2	2	2	-	-	-	50	-	50
Total		**10**	**0**	**6**	**16**	**16**	**50**	**75**	**125**	**125**	**50**	**425**

SEMESTER VIII

BCSP430	6 Month Internship	-	-	12	12	12	-	-	-	150	150	300
BCSP433	Project Phase II	-	-	4	4	4	-	-	-	50	50	100
BCSP434	MOOCs-II	2	-		2	2	-	-	-	50	-	50
	Total	**2**	**-**	**16**	**18**	**18**	10	15	25	**250**	**200**	**450**

	First Year Credits	43	First Year Marks	1200
	Total Credits SE-BE	117	Total Marks SE-BE	3300
	Grand Total Credits	160	Grand Total Marks	4500

ELECTIVE : III BCSL312- COMPUTER GRAPHICS AND VISUALISATION BITL301- JAVA PROGRAMMING BITL408- DISTRIBUTED DATABASES AND OBJECT ORIENTED DATABASES **BCSL438 – Applications of AI in Bio Medical** **BCSL439 –Applications of AI in Civil Engineering**	**ELECTIVE IV:** BCSL416- MACHINE LEARNING BCSL420- Entrepreneurship BCSL421 -Blockchain Technology BECL428 -WIRELESS SENSOR NETWORK BITL307 - SCRIPTING LANGUAGES **BCSP432- Automation with AI** **BCSP434- Artificial Natural Network**
ELECTIVE V : BCSL403- AI AND EXPERT SYSTEMS BCSL407- ADVANCED COMPUTER ARCHITECTURE BECL405- DIGITAL SIGNAL PROCESSING BECL413 - WIRELESS COMMUNICATION BECL423 - PATTERN RECOGNITION **BCSL433- AI in AgriTech** **BCSL437- Applications of AI Financial Sector** **BCSL441- Applications of AI Embedded System**	**ELECTIVE-VI:** BITL309 - CYBER LAWS BCSL311 -E-COMMERCE BITL411 - ENTERPRISE RESOURCE PLANNING BCSL417 - BIO INFORMATICS BCSL423 - Artificial Intelligence and Machine Learning **BCSL435- AI in Video Processing** **BCSL440- Applications of AI in Industry 4.0**
ELECTIVE VII: BECL425 - REAL TIME OPERATING SYSTEM BECL409 - DIGITAL IMAGE PROCESSING BITL407 - ADVANCED WEB TECHNOLOGIES BITL410 - SOFTWARE TESTING BCSL310- MOBILE COMPUTING BCSL415 - CLOUD COMPUTING	**ELECTIVE-VIII** BCSL419- Digital Marketing BCSL427- Data Analytics BCSL422 - Big Data and Hadoop BCSL414- DATA MINING AND WAREHOUSING **BCSL436- AI in Speech Processing** Computer Forensics **Brain Machine Interface & Interaction** **Neuro Computing** **Virtual and Augmented Reality**
	ELECTIVE-IX BCSL410 - SOFT COMPUTING BCSL412- SOFTWARE ARCHITECTURE **Bio-Informatics: Algorithm and application** **Application of AI in HealthCare** **Predictive Analysis** **Gene Editing** **Reconfigurable Computing**

SEMESTER-III

BFYL141 MATHEMATICS-V (DISCRETE MATHEMATICS) (Offline)

Teaching Scheme				Credits			Evaluation Scheme				
					Theory					Practical	Total
Th.	Tu	Pr.	Total		TAE	CAE	ESE	Exam Mode	Int.	Ext.	
1	1	0	2	2	10	15	25				50

Course Objectives :

1.This course introduces size and kind of objects.
2.It also skills to analyze objects meeting the criteria, finding "largest", "smallest", or "optimal" objects.
3.It also introduces combinatorial structures and apply algebraic techniques to combinatorial problems.

Course Outcomes :

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

1. Apply concept of Set theory.
2. Understand and use concepts of Groups and Rings
3. Apply the concepts of Lattices and Boolean algebra in computer science engg.

Unit –I: Set Theory (10 hrs)

Operations on sets, Laws of algebra of sets, Representation of sets on computer in terms of 0's & 1's. Partition & covering of a set, ordered pair, Product set, Relation–Different types of relations, Graph of relation, Matrix of relation, Transitive closure of relation, Properties of relations, Compatible relation. Functions, Partial ordering & partially ordered set, Hasse diagram of Poset, Totally ordered set, Peano axioms & Mathematical Induction.

Unit –II:Group and Rings (12 hrs)

Algebra or Algebraic systems like semigroup, monoid, and examples. Homomorphism, Isomorphism of semigroup&monoid.Groups, properties of algebraic groups. Permutations groups, Subgroups, Cosets, Lagranges theorem, properties of cyclic groups, generator of group, Homorphism, quotient group. Rings , Fields and Integral domain

Unit -III: Lattices and Boolean algebra (8 hrs)

Lattice as Poset& as algebraic system, Types of lattices, Hasse diagrams, Sublattice, direct product of Lattices Lattice Homomorphism, complement of elements of lattices, Various lattices, composition tables, Lattice B_n. Boolean algebra; Boolean Expressions, Equivalence of Boolean Expression by tables, Simplification of circuit & equivalent circuit by truth tables.

Recommended Reference Books:

1. Discrete mathematical structure with application to computer science; Trembley&Manohar; Mc. Graw Hill,2011
2. Discrete Mathematical Structure ; Busby & Ross ; PHI, **2009**
3. Discrete Mathematics ; John Truss ; Addison Wesley

BECL207/BECP201 HARDWARE DESCRIPTION LANGUAGE(Offline)

Scheme of the Course:										
Teaching Scheme				Credits	Evaluation Scheme					
					Theory			Practical		Total Marks
Theory	Tutorial	Practical	Total Hours		TAE	CAE	ESE	Int.	Ext.	
1	-	2	3	2	10	15	25	10	15	75

Course Objectives:

Apply Boolean algebra and other techniques to express and simplify logic expressions.
Analyze and design combinational and sequential digital systems.
Use different techniques among them a hardware description language and a programming language, to design digital systems.

Course Outcomes

CO1 Student shall be able toConceptualize of digital systems and the use of Boolean algebra in logic analysis and design
CO2 Understanding of RTL design and verification techniques and methodologies
CO3 Understand the principles and methodology of digital logic design at the gate and switch level, including both combinational and sequential logic elements.
CO4 introduce basic tools of logic design and provide hands-on experience designing digital circuits
CO5 appreciate the uses and capabilities of a modern FPGA platform

Course Contents:

Unit 1. Introduction to Hardware Description Languages:

Combinational Logic, Structural Modeling, Sequential Logic, More Combinational Logic, Parameterized Modules, Test benches

Unit 2.

Sequential circuit Sequential circuit: Latches and flip-flops, counters, shift register, Finite state machine; representation and synthesis.

Unit 3.
FPGA architecture and synthesis Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI, Mask generation

Unit 4.
Semiconductor memories, PALs, PLAs and FPGAs; Pipelining and timing issues, PROMs (DRAMs, Flash memory etc.)

Text Books:

Sr. No.	Title	Author Name	Publisher	Year of Publication	Edition
1	HDL Chip Design: A Practical Guide for Designing, Synthesizing & Simulating ASICs & FPGAs Using VHDL or Verilog	Douglas Smith	Doone publications	1998	1st
2	Verilog HDL, A guide to Digital Design and Synthesis	Samir Palnitkar	Prentice Hall		1st

Reference Books:

Sr. No.	Title	Author Name	Publisher	Year of Publication	Edition
1	FPGA based Prototyping Methodology Manual	Doug Amos, Austin Lesea, Rene Richter	Synopsis Press		
2	Introduction to Reconfigurable Computing, Architectures, Algorithms	Christophe Bobda	Springer Netherlands.		
3	Writing Testbenches: Functional Verification of HDL Model	Janick Bergeron	Springer	2003	2nd

BCSP210 Artificial Intelligence Lab (Online)

Teaching Scheme				Credits	Continuous Evaluation Scheme					
					Theory			Practical		
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	Total
-	-	2	2	1	-	-	-	25	25	50

Course Objectives:

- Be able to formulate machine learning problems corresponding to different applications.
- Be able to apply machine learning algorithms to solve problems of moderate complexity.

Course Outcomes: Upon completion of the course students shall be able to:

- 1. Recall the basic concepts and techniques of artificial Intelligence
- 2. Classify machine learning algorithms to solve real time problems of moderate complexity.
- 3. Gain experience of doing independent study and research through case studies.

Sr. No	Title of Practical	Hrs	CO
1.	Write a program to implement of Linear Regression for the given dataset.	2	CO1, CO2
2.	Write a program to implement of Logistic Regression for the given dataset.	2	CO1, CO2
3.	Write a program to implement of Multiple Regression for the given dataset.		CO3, CO4
4.	Write a program to implement ANOVA and analysis of Co-Variance for the given dataset.	2	CO3, CO4
5.	Write a program to implement Chi-square test algorithm and Time Series analysis for the given dataset.	2	CO5, CO6
6.	*Open ended experiment: Clustering Algorithm Implementation for given dataset.	2	CO5, CO6

Text Books:

1. Introduction to machine learning,EthemAlpaydin. — 2nd ed., The MIT Press, Cambridge, Massachusetts, London, England.
2. Introduction to artificial neural systems, J. Zurada, St. Paul: West.
3. R in a Nutshell, 2nd Edition - O'Reilly Media.

Reference Books:

1. Machine Learning, Tom M Mitchell.
2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer

Resource Persons

Mr.VivekPatole,
Head Product Engineering &DEvelopment at Iknowlation ,Research Labs Pvt. Ltd,Pune

Prof. SudeshnaSarkar
Head of the Centre
Contact (Head)
Phone: +91-3222-282256
Email : sudeshna@cse.iitkgp.ac.in

AnupamBasu
Professor
PhD (IIT Kharagpur)
Joined Institute in 1984
Phone**:** 283462(o), 283463(r)
Email**:**anupam[at]cse.iitkgp.ernet.in

Free Courses:

Sr. No.	Artificial Intelligence course name	Offered by
1	Artificial Intelligence	EDX
2	Intro to Artificial Intelligence	Udacity's
3	Artificial Intelligence: Principles and Techniques	Standford university
4	Artificial Intelligence for Robotics by	Georgia Tech Udacity

BCSL208/BCSP208 Database Management System

Teaching Scheme				Credits	Continuous Evaluation Scheme						
					Theory				Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Exam Mode	Int	Ext	
2	-	2	4	3	10	15	25	Online	10	15	75

Course Objective:

1. This course introduces general idea of database management system.
2. It is aimed at developing skills to design databases using data modeling and design techniques.
3. It is also aimed to developing skills to implement real life applications which involve database handling.
4. This course also provide carrier opportunities in subject areas of designing, storage techniques and data handling and managing techniques

Course Outcome: Upon successful completion of the course, students shall be able to-

- CO1: Identify features of database management systems and Relational database. Understand functional dependencies and various normalization forms
- CO2: Demonstrate SQL queries to perform CRUD (Create, Retrieve, Update, Delete) operations on database and perform inferential analysis of data model
- CO3: Perform basic transaction processing and management and ensure database security, integrity and concurrency control
- CO4: Analyze the management of structured and unstructured data management with recent tools and technologies

Syllabus

Unit I - Introduction to DBMS, DBMS Architecture, Data Models, Relational Database design: Functional Dependency (FD) – Basic concepts, closure of set of FD, closure of attribute set, Decomposition, Normalization – 1NF, 2NF, 3NF, BCNF, 4NF

Unit II - SQL Concepts : Basics of SQL, DDL, DML, DCL, structure – creation, alteration, defining constraints, Functions - aggregate functions, Built-in functions –numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All , view and its types. Transaction control commands – Commit, Rollback, Save point. Cursors, Stored Procedures, Stored Function, Database Triggers

Unit III - Transaction Management: Transaction concepts, properties of transactions, serializability of transactions, Two- Phase Commit protocol, Deadlock, two-phase locking protocol

Unit IV -NoSQL Databases - Introduction, CRUD Operations, Data Mining

Text Books:

1 Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts 4th Ed, McGraw Hill, 2002.
2 Jeff Ullman, and Jennifer Widom, A First Course in Database systems, 2nd Ed.

Reference Books:

1 G. K. Gupta :"Database Management Systems", McGraw – Hill.
2 Regina Obe, Leo Hsu, PostgreSQL: Up and Running, 3rd Ed, O'Reilly Media 2017.
3 Kristina Chodorow, Shannon Bradshaw, MongoDB: The Definitive Guide, 3rd Ed, O'Reilly Media 2018.
4 RamezElmasri and ShamkantNavathe, Fundamentals of Database Systems 2nd Ed, Benjamin Cummings, 1994.

Certification Courses available:

1. http://infolab.stanford.edu/~ullman/fcdb.html
2. https://www.cse.iitb.ac.in/~sudarsha/db-book/slide-dir/

Free Courses available:

1. Database Systems Concepts & Design - [Udacity, edx] - Free Course (https://in.udacity.com/course/database-systems-concepts-design--ud150)
2. https://www.edx.org/course/database-systems-concepts-and-design
3. Database Management System - Swayam (https://swayam.gov.in/course/220-database-management-system)
4. Database Management System - NPTEL (https://onlinecourses.nptel.ac.in/noc18_cs15/preview)

Expert Faculty:

1. P. Sreenivasa Kumar, IIT Madras
2. S. Sudarshan, IIT Bombay (Email: sudarsha@cse.iitb.ac.inURL: http://www.cse.iitb.ac.in/~sudarshaTel: +91.22 2576 7714 (Dept. Office: 2576 7700))
3. David G. Sullivan PhD, Senior Lecturer on Computer Science, Boston University Location: Maxwell-Dworkin G125

BCSL207 PROBLEM IDENTIFICATION & DESIGN THINKING (Offline)

Teaching Scheme				Credits	Continuous Evaluation Scheme					
					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	
1	-	-	1	1	10	15	-	-	-	25

Course Objective:

1. Introduce students to a discipline—designthinking—that enhances innovation activities interms of value creation, speed, and sustainability. Be exposed to architectural styles and views
2. Strengthen students' individual and collaborativecapabilities to identify problems/issues/needs,develop sound hypotheses, collect and analyzeappropriate data, and develop ways to collectmeaningful feedback in a real-world environment
3. Teach students to translate broadly definedopportunities into actionable innovationpossibilities and recommendations for keystakeholders and their organizations

Course Outcome: Upon successful completion of the course, students shall be able to:

- Have an awareness of how design thinking can be applied in a wide range of contexts, from the personal to the global
- Initiate an attitude of playfulness to aid design thinking
- Use computing tools and online environments to aid design thinking.

Syllabus

UNIT 1:CO1: Why Design Thinking, The Design Process, Stages of Design Thinking, **Research-** Identifying drivers, Information gathering, Target groups, Samples and feedback

UNIT 2 :CO2: Idea generation- Basic design, Themes of thinking, Inspiration and References, Brainstorming ,Value, Inclusion, Sketching, Presenting ideas , **Refinement -** Thinking in images, Thinking in signs, Appropriation , Humour, Personification, Visual metaphors, Modification, Thinking in words,Words and language , Type 'faces', Thinking in shapes, Thinking in proportions, Thinking in color,

UNIT3: CO3: Prototyping -Developing designs, 'Types' of prototype, Vocabulary, **Implementation-** Format, Materials, Finishing, Media, Scale, Series/Continuity

Text Books:

1. Gavin Ambrise, Pall Harris *Design Thinking* (AVA Publication SA- 2010)

Reference Books:

1. Tom Kelly, The Art of Innovation: Lessons in Creativity From IDEO, America's Leading Design Firm (Profile Books, 2002)
2. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation(Harper Business, 2009)
3. Roger Martin, *The Design of Business: Why Design Thinking Is The Next CompetitiveAdvantage*(Harvard Business Review Press, 2009)
4. Alexander Osterwalder and Yves Pigneur, *Business Model Generation: A Handbook forVisionaries, Game Changers, and Challengers* (John Wiley and Sons, 2010)
5. Nigel Cross, *Design Thinking: Understanding How Designers Think and Work*(Bloomsbury Academic, 2011)

Certification Courses available:

1. https://www.coursera.org/learn/uva-darden-design-thinking-innovation
2. https://www.edx.org/course/introduction-to-design-thinking-1/
3. https://in.udacity.com/course/intro-to-the-design-of-everyday-things--design101

Expert Faculty:

1. Tim Zak, Associate Teaching Professor, Heinz College, Director—Institute for Social Innovation
2. Dr Deepak John Mathew of IIT Hyderabad

BCSL 203/BCSP203Data Structure and Algorithms (Online)

Teaching Scheme				Credits	Continuous Evaluation Scheme						
					Theory				Practical		
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Exam Mode	Int	Ext	Total
2	-	2	4	3	10	15	25	Online	10	15	75

Course Objective:

1. This course introduces basic idea of data structure while making aware of methods and structure used to organize large amount of data.
2. It's also aimed at developing skill to implement methods to solve specific problems using basic data structures.
3. The course also provides career opportunities in design of data, implementation of data, technique to sort and searching the data.

Course Outcome: Upon successful completion of the course, students

CO1:Acquire and Apply basic concepts of data type and their types.

CO2:Implementnon linear data structure to find solution for given engineering applications.

CO3:Implement Graph data structure to solve various computing problems

CO4:Design and analyze different algorithms techniques.

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes			Programme Specific Outcomes	
	PO2	PO3	PO4	PSO1	PSO2
CO1	3	2	3	1	
CO2	2	3	3	2	
CO3	3	3	3	2	1
CO4	3	3	3	3	2
CO5	3	3	3	2	3
CO6	2	3	3	3	3

Syllabus

Unit 1 Introduction –Common operations on data structures, Types of data structures, Data structures & Programming, Program Design, Complexities, Time Complexity, order of Growth, Asymptotic Notation.

Unit 2Trees and Binary Trees -Binary Trees • Representation, Operations: Insert, Delete , Traversal: Preorder, Inorder, Postorder,Traversal Algorithms Using Stacks,Header Nodes; Threads ,Threaded Binary Trees ,Binary Search Trees ,Searching and Inserting in Binary Search Trees ,Deleting in a Binary Search Tree,Balanced Binary Trees,AVL Search Trees,Insertion in an AVL Search Tree ,Deletion in an AVL Search Tree,m-way Search Trees ,Searching, Insertion and Deletion in an m-way Search tree,B-Trees ,Searching, Insertion and Deletion in a B-tree,B+-Trees Graph Algorithms

Unit 3: Graphs and their Applications -) Introduction, Graph Theory Terminology, Sequential Representation of Graphs, Adjacency Matrix; Path Matrix, Linked Representation of a Graph, Operations on Graphs, Traversing a Graph , Posets; Topological Sorting ,Spanning Trees.

Unit 4: Advanced Data structure:

Segment tree, advanced lists, Binary index tree, Splay tree

Text Books:

1.AVAho, J Hopcroft, JD Ullman, Data Structures and Algorithms, Addison- Wesley, 1983.

2.THCormen, CF Leiserson, RL Rivest, C Stein, Introduction to Algorithms, 3rd Ed., MIT Press, 2009.

Reference Books:

1. Data Structures & Algorithms, 1e, Alfred V.Aho, Jeffery D. Ullman , Person.

2. MT Goodrich, R Tamassia, DM Mount, Data Structures and Algorithms in Java, 5th Ed., Wiley, 2010. (Equivalent book in C also exists.)

Certification Courses available:

Sr.No.	Name of the course	MOOC's/ SWAYAM/NPTEL	Link	Duration of Course	Name of Expert	Affiliation
1	Programming Data Structure and Algorithm	SWAYAM	https://swayam.gov.in/course/4422-programming-data-structures-and-algorithms	8 weeks (certification Course)	SudarshanIyengar	IIT Madras

Free Courses available:

Sr. No.	Name of the course	MOOC's/ SWAYAM /NPTEL	Link	Duration of Course	Name of Expert	Affiliation
1	Programming, Data Structures	NPTEL	https://nptel.ac.in/courses/106106145/	8 weeks(from 28 January 2019 to	Prof.MadhavanMukund	Chennai Mathematic

Sr. No.	Name of the course	MOOC's/ SWAYAM /NPTEL	Link	Duration of Course	Name of Expert	Affiliation
	and Algorithms using Python		https://onlinecourses.nptel.ac.in/noc18_cs34	22 March 2019)		al Institute
2	Data Structure and Algorithm	NPTEL	https://nptel.ac.in/courses/106102064/	8 weeks(Video Lectures)	Dr. Naveen Garg	IIT DELHI
3	Programming Data Structure and Algorithm	NPTEL	https://nptel.ac.in/courses/106106133/	8 weeks(Video)	Dr. N S. Narayanaswamy Prof. Shankar Balachandran Prof.Hema A Murthy ,IIT Madras	IIT Madras

Expert Faculty:
1. Dr. Naveen Garg,Department of Computer Science and Engineering Indian Institute of Technology, Delhi.
2.YogeshSimmhan, Assistant Professor,Department of Computational and Data Sciences (CDS), Indian Institute of Science (IISc), Bangalore.

BCSP205 OBJECT ORIENTED PROGRAMMING
(Online)

Teaching Scheme				Credits	Continuous Evaluation Scheme					
					Theory			Practical		
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	Total
-	-	4	4	2	-	-	-	25	25	50

Course Objective:
1. This course introduced features of object oriented programming.
2. The course provide carrier opportunities in implementation of various applications as object oriented concepts plays dominant role in software development.

Course Outcome: Upon successful completion of the course, students shall be able to–
CO 1: Articulate the principles of object oriented programming using C++
CO 2: Understand function overloading, constructor overloading, operator overloading, polymorphism & its uses in programming.
CO3: Implement inheritance concepts and its use for application development
CO4: Analyze of dynamic memory allocation and its use for software development
CO5: Implement concept of file handling in real life problems
CO6: Implement a project for real world problems

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes						Programme Specific Outcomes	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 11	PSO1	PSO2
CO1	1	2	2	3		-	-	-
CO2	-	3	3	2	-	2	1	2
CO3	-	3	3	2	1	2	2	3
CO4	-	3	1	3	3	2	3	3
CO5	-	3	3	2	2	2	1	3
CO6	-	3	3	3	3	3	3	3

Syllabus

Unit-I: Principles of Object Oriented Programming -
Introduction to OOPS: Differences between C and C++.A look at procedure Oriented programming, object oriented programming paradigm, basic concepts of OOP, Headers & Name Spaces

Unit-II: Functions & Polymorphism -
Functions, Types of Functions, Constructor, Destructor, Function overloading & Ambiguity, Operator Overloading, Function Overriding, Friend Function

Unit-III: Inheritance & Virtual Functions -
Inheritance and the access specifies, Types of Inheritance, Pointers and references to derived types, Virtual Functions

Unit-IV: Pointers & Dynamic allocations -
Static & Dynamic allocation using new and delete,* and ->* operators, Creating conversion functions, this pointer.

Text Books:
1. Object Oriented Programming in C++ -Robert Lafore, edition, Galgotia publications
2. The Complete Reference C++, Herbert Schildt, 4th Edition, TMH

Reference Books:
1. Let's C++ by Y. Kanetkar, BPB publications
2. Object oriented programming with C++, E Balagurusamy, 4th edition, TMH
3. Object-Oriented Programming with C++, SouravSahay, Oxford University Pres

Certification Courses Available:
Name of Course: Programming In C++ (NPTEL)

Link: https://nptel.ac.in/courses/106105151/
https://onlinecourses.nptel.ac.in/noc18_cs32

Duration of Course:8 Weeks (from 28 January 2019 to 22 March 2019)
Name of Expert:Prof. ParthaPratim Das
Affiliation:IITKharagpur

Expert Faculty:
Name of Expert:Prof. ParthaPratim Das
Affiliation:IITKharagpur

BCSL209 SOFTWARE ENGINEERING AND PROJECT MANAGEMENT(Offline)

Teaching Scheme				Credits	Continuous Evaluation Scheme					
					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	
1	1	-	2	2	10	15	25	-	-	50

Course Objectives:
The student should be made to:

- Understand the phases in a software project
- Understand fundamental concepts of requirements engineering and Analysis Modelling.
- Understand the major considerations for enterprise integration and deployment.
- Learn various testing and maintenance measures

Course Outcomes: At the end of the course, the student should be able to

- Identify the key activities in managing a software project.
- Compare different process models.
- Concepts of requirements engineering and Analysis Modeling.
- Apply systematic procedure for software design and deployment.
- Compare and contrast the various testing and maintenance

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes						Programme Specific Outcomes	
	PO1	PO2	PO3	PO5	PO8	PO11	PSO1	PSO2
CO1	3	2	3	-	-	3	-	-
CO2	3	2	3	-	-	3	-	-
CO3	2	3	3	2	1	3	3	2
CO4	2	3	3	-	-	3	3	3
CO5	3	-	3	1	-	3	-	3
CO6	3	2	3	3	-	3	3	3

Syllabus

UNIT I: SOFTWAREPROCESS
Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Software Project Management: Estimation – LOC and FP Based Estimation, COCOMO Model – Project Scheduling – Scheduling, Earned Value Analysis – Risk Management.

UNIT II: REQUIREMENTS ANALYSIS AND SPECIFICATION
Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary.

UNIT III: SOFTWARE DESIGN
Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design – Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT IV: TESTING AND PROJECT MANAGEMENT
Software testing fundamentals-Internal and external views of Testing-white box testing – basis path testing-control structure testing-black box testing Debugging
Estimation – FP Based, LOC Based, Make/Buy Decision, COCOMO II – Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection, RMMM – Scheduling and Tracking –

Text Books:

- Roger S. Pressman, "Software Engineering – A Practitioner"s Approach", Seventh Edition, McGraw-Hill International Edition, 2010.

Reference Books:

- Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011.
- Rajib Mall, "Fundamentals of Software Engineering", Third Edition, PHI Learning Private Limited, 2009.
- PankajJalote, "Software Engineering, A Precise Approach", Wiley India, 2010.
- Kelkar S.A., "Software Engineering", Prentice Hall of India Pvt Ltd, 2007.
- Stephen R.Schach, "Software Engineering", Tata McGraw-Hill Publishing Company Limited, 2007.
- http://nptel.ac.in/.

Certification Courses available:
https://nptel.ac.in/downloads/106105087/

Free Courses available:
https://swayam.gov.in/course/236-software-enginnering

Expert Faculty:

Dr. MadhuriBhavsar
Nirma University

Total Experience	25 Year
Educational Qualification	Ph.D.
Research Area	High Performance Computing, Software Engineering,Networking , Cloud Computing and Software Engineering

General information

Designation	Professor and Head of Department
Office Phone	07930642213
Cabin No	B Block - 100
Email	madhuri.bhavsar@nirmauni.ac.in

SEMSTER-IV

BFYL142 **COURSE NAME: MATHEMATICS-VI(GRAPH THEORY AND NUMBER SYSTEM) (Online)**

Teaching Scheme				Credits	Evaluation Scheme						Duration of Paper
					Theory			Practical		Total	
Th.	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.		
1	1	0	2	2	10	15	25			50	2

Course Objectives :

1.This course introduces size and kind of objects.
2.It also skills to analyze objects meeting the criteria, finding "largest", "smallest", or "optimal" objects.
3.It also introduces combinatorial structures and apply algebraic techniques to combinatorial problems.

Course Outcomes :

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

1. Know data structure used to represent different kinds of objects viz Graph, Trees
2. Know the basics of combinatorial structure and develop algebraic technique to solve combinatorial problems.
3. Programming application of group, ring and number theory.

Unit -I: Graph Theory

Graphs and its types, subgraph, Quotient graph, Euler path, Complete path, indegreeoutdegree, reachability, cycle, matrix representation of graph. Transitive closure of graph, Adjacency matrix, Trees, Venn diagram, Representation of trees, binary trees, spanning trees, Prims algorithm.

Unit –II: Combinatorics

Definition of generating functions and examples, proof of simple combinatorial identities, Probab.**G.F.** $p(t) = \sum p_n t^n$, $E(x) = p'(t)$, examples. Recursive relations: definitions & examples, explicitly formula for sequence, back tracking to find explicit formula of sequence, solving recurrence relations. Counting Theorem Principle of counting, Permutation & Combination with examples. Pigeon hole principle.

Unit -III: Number Theory:

The study of continued fractions .alpha has Infinite continued fraction if alpha is irrational. Alpha has periodic continued fractions if alpha is quadratic irrational. Application to approximation of irrationals by rationals. Hurwitz's theorem, Advanced topic on Combinatorial Theory

Recommended Reference Books:

1. Discrete mathematical structure with application to computer science; Trembley&Manohar; Mc. Graw Hill,2011
2. Discrete Mathematical Structure ; Busby & Ross ; PHI, **2009**
3. Discrete Mathematics ; John Truss ; Addison Wesley

BCSL211/BCSP211 OPERATING SYSTEM (Online)

Teaching Scheme					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours	Credits	TAE	CAE	ESE	Int	Ext	
2	-	2	4	3	10	15	25	10	15	75

Course Objective:

1. Introduces general idea, structure and functions of operating system
2. Making students aware of basic mechanisms used to handle processes, memory, storage devices and files.

Course Outcome: Upon successful completion of the course, students shall be able to-

1.Identify basic structure and purpose of operating system.
2. Interpret the concepts of process and illustrate various CPU scheduling algorithms.
3. Interpret the concepts of inter process communication.
4. Schematize Deadlock & security mechanisms in operating systems.
5. Analyze different memory management techniques with advantages and disadvantages.

CO Mapping with PO and PSO:

Course Outcomes	Program Outcomes				Program Specific Outcomes	
	P02	P03	P04	P05	PSO1	PSO2
CO1	2	-	1	3	-	1
CO2	2	-	3	-	2	2
CO3	3	3	-	-	2	3
CO4	3	-	2	-	2	2
CO5	3	-	3	2	3	2
CO6	-	-	2	3	2	2

Syllabus

Unit-I

Evolution of OS, Types of OS, Basic h/w support necessary for modern operating systems, services provided by OS, system programs and system calls, system design and implementation.

Unit-II

Process & Its Scheduling

Process concept, process control block, Types of scheduler, context switch, threads, multithreading model, goals of scheduling and different scheduling algorithms,

Unit-III

Process management and synchronization: Concurrency conditions, Critical section problem, software and hardware solution, semaphores, conditional critical regions and monitors, classical inter process communication problems

Unit-IV

Deadlock definitions, Prevention, Avoidance, detection and Recovery, Goals of Protection, access matrix, Deadlock implementation

Unit-V

File systems: File concept, Access methods space allocation strategies, disk arm scheduling strategies. Contiguous allocation, Relocation, Paging, Segmentation, Segmentation with paging, demand paging , Virtual Memory Concepts, page faults and instruction restart , page replacement algorithms , working sets , Locality of reference, Thrashing, Garbage Collection.

TEXT BOOKS :

1. Operating System concepts – Silberchatz& Galvin, Addison Wesley, 6 thEdn.
2. Modern Operating Systems – Tanenbaum, Pearson Edn. 2 ndedn.

REFERENCE BOOKS :

1. Operating Systems – S R Sathe, Macmillan Publishers, India, 2008
2. Operating System –Milan Milenkovik, McGraw-Hill, 1987
3. Operating Systems - 3 rd Edition by Gary Nutt, Pearson Education.

Certification Courses available:

By Edureka

1. Linux Administration
2. UNIX Shell Scripting
3. Linux Fundamentals

Free Courses available:

UDACITY: Introduction to Operating Systems by Georgia Institute of Technology

Expert Faculty:

1. **Debadatta Mishra**
   Assistant Professor
   Computer Science and Engineering
   Indian Institute of Technology Kanpur
   email: deba@cse.iitk.ac.in

2. **MythiliVutukuru**
   Department of Computer Science and Engineering
   Indian Institute of Technology, Bombay
   mythili@cse.iitb.ac.in

3. **SoravBansal**
   Department of Computer Science and Engineering
   Indian Institute of Technology, Delhi
   sbansal@cse.iitd.ac.in

BCSL212 FORMAL LANGUAGE AND AUTOMATA(Offline)

Teaching Scheme					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours	Credits	TAE	CAE	ESE	Int	Ext	
2	1	-	3	3	10	15	50		-	75

Course Objectives:

- To provide introduction to some of the central ideas of theoretical computer science from the perspective of formal languages.
- To introduce the fundamental concepts of formal languages, grammars and automata theory.
- Classify machines by their power to recognize languages.
- Employ finite state machines to solve problems in computing.
- To understand deterministic and non-deterministic machines.
- To understand the differences between decidability and un-decidability.

Course Outcomes:

- Able to understand the concept of abstract machines and their power to recognize the languages.
- Able to employ finite state machines for modeling and solving computing problems.
- Able to design context free grammars for formal languages.
- Able to distinguish between decidability and un-decidability.
- Able to gain proficiency with mathematical tools and formal methods.

Syllabus

Unit-I: Introduction- Basic Mathematical Notation and techniques- Finite State systems – Basic Definitions – Finite Automaton – DFA & NDFA – Finite Automaton with €- moves – Regular Languages- Regular Expression – Equivalence of NFA and DFA – Equivalence of NDFA"s with and

without €-moves – Equivalence of finite Automaton.

UNIT–II: Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Properties of Regular Languages Pumping Lemma for Regular Languages, Applications of the Pumping Lemma, Closure Properties of Regular Languages, Decision Properties of Regular Languages.

UNIT–III: Context-Free Grammars: Chomsky hierarchy of languages.Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Sentential Forms, Parse Tress, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages. Push Down Automata,: Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata.

UNIT-IV: Definitions of Turing machines – Models – Computable languages and functions –Techniques for Turing machine construction – Multi head and Multi tape Turing Machines – The Halting problem – Partial Solvability – Problems about Turing machine

UNIT-V: Un-decidability: A Language that is Not Recursively Enumerable, An Undecidable Problem That is RE, Undecidable Problems about Turing Machines, Post's Correspondence Problem, Other Undecidable Problems, Intractable Problems: The Classes P and NP, An NP-Complete Problem.

TEXT BOOKS:

- Introduction to Automata Theory, Languages, and Computation, 3nd Edition, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
- Introduction to the Theory of Computation, Michael Sipser, 3rd edition, Cengage Learning.

REFERENCE BOOKS:

- Introduction to Languages and The Theory of Computation, John C Martin, TMH.

Course Outcomes	Program Outcomes					Program Specific Outcomes	
	P02	P03	P05	PO8	PO11	PSO1	PSO2
CO1	2	3	-	-	2	-	2
CO2	2	3	-	-	3	-	3
CO3	2	3	-	-	3	3	3
CO4	2	3	2	-	3	-	3
CO5	2	3	2	2	3	3	3
CO6	2	3	2	-	3	3	3

- Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
- A Text book on Automata Theory, P. K. Srimani, Nasir S. F. B, Cambridge University Press.
- Introduction to Formal languages Automata Theory and Computation Kamala Krithivasan, Rama R, Pearson.
- Theory of Computer Science – Automata languages and computation, Mishra and Chandrashekaran, 2nd edition, PHI.

Certification Courses available:
https://nptel.ac.in/courses/111103016/

Free Courses available:

Expert Faculty:
Prof. DigantaGoswami
Departmentof Computer Science and Engineering
Indian Institute of Technology, Guwahati

Prof. Kamala Krithivasan
Departmentof Computer Science and Engineering
Indian Institute of Technology, Madras

BCSP213 JAVA PROGRAMMING (Online)

Teaching Scheme					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours	Credits	TAE	CAE	ESE	Int	Ext	
-	-	4	4	2	-	-	-	25	25	50

Course Objective:
1. This course introduces fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
2. It is aimed at building software development skills using java programming for creating real world applications.
3. Use a development environment to design, code, test, and debug simple programs, including multi-file source projects, in an object-oriented programming language

Course Outcome: Upon successful completion of the course, students shall be able to–

- **CO 1:** Explain the basic data types and control flow constructs using J2SE.
- **CO 2:** Make use of Integrated Development Environments (IDEs) such as Eclipse, NetBeans, and JDeveloper for program development.
- **CO3:** Design object oriented class structures with parameters, constructors, and utility.
- **CO4:** Implement a final project selected from an approved project chosen by the student.

CO Mapping with PO and PSO

Syllabus

Unit I: Introduction to JAVA, Class and Object
Introduction to data types, operators and control statements, Classes: fundamentals of classes, declaring objects, Assigning objects, reference variables, methods, constructor, variable handling. Methods and classes: Overloading methods, understanding static and final.

Unit II: Array, Packages, Interface Introduction to Array, Vectors, Wrapper class & Inheritance, Packages and interface: Packages, access protection, importing packages, interfaces.

Unit III: Exception Handling &Multithreaded Programming
Exception handling: Fundamentals exception types, uncaught exception, try-catch, displaying description of an exception, multiple catch clauses, nested try statements, throw, finally, built in exceptions, creating own exception subclasses, JAVA thread model, creating thread, creating multiple thread.

Unit IV: Applet, Graphics Programming and Database Connectivity
Introduction to applet, The Five Stages of an Applet's Life Cycle, Methods for Adding UI Components, Methods for Drawing and Event Handling.
Database Connectivity: JDBC (Java Data Base Connection), Introduction to JDBC, Databases and Drivers, Types of Driver, Loading a driver class file, establishing the Connection to Database with different Driver. Executing SQL queries by result Set using Statements

Text Books:
1. The Complete Reference by Herbert Schild, TMH Publication
2. Programming with Java- A Primer by E. Balagurusamy, 3rd Edition, TMH Publication

Reference Books:
1. The Complete Reference- JAVA 2- 3rd Edition By Patrick Naughton, TMH Publication.
2. Java 6 Programming Black Book by Kogent Solution Inc., Dreamtech Press Publication.
3. Java 2 Black Book by Steve Holzner, Paraglyph Press, 2nd Ed.

Certification Courses available:
Name of Course: Java Programming (NPTEL)
Link:https://nptel.ac.in/courses/106106147/5
Duration of Course:2 Weeks
Name of Expert: Prof. Pushpedra Singh
Affiliation: Indraprasth Institute of Information Technology Delhi
Name of Course: Java Programming (SWAYAM)
Link:https://swayam.gov.in/courses/4104-spoken-tutorial-java-oriya
Duration of Course:16 Weeks
Name of Expert: Prof. KannanMoudgalya
Affiliation:IIT Bombay

Expert Faculty:
Expert 1:
Name of Expert: Prof. Pushpedra Singh
Affiliation: Indraprasth Institute of Information Technology Delhi

Expert 2:
Name of Expert: Prof. KannanMoudgalya
Affiliation:IIT Bombay

BCSP214 PRINCIPLES OF PROGRAMMING LANGUAGE(Online)

Teaching Scheme					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours	Credits	TAE	CAE	ESE	Int	Ext	
-	-	2	2	1	-	-	-	25	25	50

Course Objective:
1. This course introduces the general ideas of programming concepts.
2. Making students aware of basic programming paradigms, the principles and techniques involved in design and implementation of it.
3. It is aimed at developing skills to provide frameworks specifying and reasoning about programming languages.

Course Outcome: Upon successful completion of the course, students shall be able to-
1.Recognize programming paradigm anddesign principles.
2.Demonstrate different data types and theirspecification.
3.Illustrate the generic subprograms and itsstructure.

CO Mapping with PO and PSO

Course Outcomes	Program Outcomes			Program Specific Outcomes	
	PO2	PO3	PO5	PSO1	PSO2
CO1	3	3		2	3
CO2	3	2		2	2
CO3	3	2		3	2

Syllabus

Unit I: Introduction to Programming language
Definition of Programming language, Implementation of high-level languages, Data elements,
binding time. Concept of r-value and l-value and their implementation.Language paradigms.

Unit II: Data Types and Object
Data type, Type checking and type conversion, elements of specification and implementation of data type. arrays Files and i/o, Genericfunctions, Objects.Inheritance and Encapsulation
Abstract data type, Inheritance and type of Inheritance, encapsulation, Implementation of newdata types,

UnitIII: Exception Handling and sequence control
Exception Handling in Various Languages, Programming Events, Handling Large Databases, Special Languages, Sequence control, Implicit and explicit sequence control, implementation of case statement, recursive and non-recursive subprogram.

Text Books:

1. Programming Languages, 1st edition byT.W. Pratt and M .V. Zelkowitz& T. V.Gopal by Pearson Education, 2008
2. Programming Languages, Ravi Sethi,Addison Wesley.
3. Programming Languages: Paradigm and Practices by Doris Appleby and J. J. Vandekopple, McGraw Hill.
4. Concepts of Programming Languages by Robert W. Sebesta, Pearson Education.

Reference Books:

1. Principles of programming languages by Gilles Dowe, Springer-verlag,LondonLimited 2009
2. Concepts in programming languages by John C. Mitchell copyright, Cambridge University press 2003
3. Principles of Programming Languages:Design, Evaluation, and Implementationby Bruce J. MacLennan third Edition, 1999 by oxford universitypress.Inc.
4. Programming Languages: Application and Interpretation, 2003-07, ShriramKrishnamurthi, United StatesLicense

Certification Courses available:

1. https://www.udemy.com/fundamentals-of-programming/

Free Courses available:

1. https://nptel.ac.in/courses/106106145/26
2. https://nptel.ac.in/courses/106106145/28
3. https://nptel.ac.in/courses/106106145/37
4. https://nptel.ac.in/courses/106106145/38
5. https://nptel.ac.in/courses/106106145/35

Expert Faculty:

1. Prof. MadhavanMukund, Department of Computer Science and Engineering, Indian Institute of Technology, Madras.
2.Prof: S. ArunKumar,DepartmentofComputer Science and Engineering,Indian institute of Technology, Delhi.
3. Prof: S. Arun Kumar, Department of Computer Science and Engineering, Indian institute of Technology, Delhi

BCSL215/BCSP215 BIG DATA(Online)

Teaching Scheme					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours	Credits	TAE	CAE	ESE	Int	Ext	
1	-	2	3	2	10	15	25	10	15	75

Course Outcome:

Upon successful completion of the course, students shall be able to-

- **CO1:** Understand basic concepts and techniques of Hadoop ecosystem and Big data.
- **CO2:** Design different component of Hadoop ecosystem.
- **CO3:** Understand the domain of data science and analysis of big data.

Syllabus

UNIT 01: Big data, challenges for processing big data, technologies support big data, History of Hadoop, Use cases of Hadoop, The Data Scientist, Big Data Analytics in Industry Verticals, Data Analytics Lifecycle,Hadoop Distributed File System, Significance of HDFS in Hadoop, Features of HDFS,Data Storage in HDFS**(07Hrs.)**

UNIT 02: Map Reduce: Map Reduce Story, Map Reduce Architecture, How Map Reduce works, Developing Map Reduce, Map Reduce Programming Model, Data Flow Engines and other memory databases.**(06Hrs.)**

UNIT 03: Introduction to Apache Pig, Map Reduce Vs. Apache Pig, Modes of Execution in Pig, Loading data, Exploring Pig Latin commands, Hive introduction, Hive architecture. Data types and schemas, Partitions and buckets, Spark Shell, Spark Application, Flume,SQOOP introduction and application. **(06Hrs.)**

Text Books:
1. Tom White, "Hadoop: The Definitive Guide", 3rd edition, O'Reilly Media.
2. Big Data (Black Book), Wiley
3. V. Prajapati, "Big Data Analytics with R and Hadoop", PacktPub.

Reference Books:
1. V. Ankam, Big Data Analytics, Packt Pub Ltd.
2. N. Dasgupta, Practical Big Data Analytics, Packt Pub Ltd.

Certification Courses available:
1 https://www.udemy.com/big-data-hadoop-the-complete-course/
2.https://www.cloudera.com/more/training/certification.html
3.https://www.edureka.co/big-data-and-hadoop
https://www.simplilearn.com/big-data-and-analytics/big-data-and-hadoop-training

Free Courses available:
1. https://nptel.ac.in/courses/106106142/ ------ Algorithm for Big data
2. https://nptel.ac.in/courses/106104135/48 ---- Big data
3. https://nptel.ac.in/courses/106106168/22 ----- HDFS

Expert Faculty:
1. Dr. R.B.V. Subramaanyam, National Institute of Technology, Warangal.
2. Animesh Mukherjee, Indian Institute of Technology, Kharagpur.
3. Mr. ValaAfshar, Boston, MA, USA. Area of interest: Digital Marketing, Social Business, Link: https://www.cmswire.com/author/vala-afshar/

BCSL216SOFTWARE ARCHITECTURE & WEB SERVICES(Online)

Teaching Scheme					Theory			Practical		
Th.	Tu	Pr.	Total Hours	Credits	TAE	CAE	ESE	Int	Ext	Total
2	-	-	2	1	10	15	25	-	-	50

Course Objective:
4. Understand software architectural requirements
5. Be exposed to architectural styles and views
6. Be familiar with architectures for emerging technologies

Course Outcome: Upon successful completion of the course, students shall be able to:
1. Design software architecture for large scale software systems.
2. Describe a software architecture using various documentation approaches and architectural description languages.
3. Use well-understood paradigms for designing new systems.

Syllabus

UNIT I: Introduction to Software Architecture
Introduction: What is software architecture?, Standard Definitions, Architectural structures, Influence of software architecture on organizatio n both business and technical, Architecture Business Cycle: Introduction, Functional requirements, Technical constraints, Quality Attributes: Quality Attribute Workshop, Documenting Quality attributes, Six part scenarios.

UNIT II: UML Modelling
UML diagrams and UML analysis modeling, analysis case studies, analysis tools, analysis patterns, documenting software architecture, reconstructing software architecture, Issues in Software Architecture: Scalability and interoperability issues, web application architectures.

UNIT III: Introduction to Web Services & XML
Web Service Architecture, Web Services VS other Technologies, Web Services Benefits, DTD VS XSD, What is XML Parsing?, Various other XML Binding API's, JAX-P API based XML parsing using (SAX, DOM),Validating XML Documents using JAX-Vp, XML Binding using JAX-B (Marshalling, Un-Marshalling and In-Memory Validation)

Text Books:
1. Len Bass, Paul Clements, and Rick Kazman, "Software Architectures Principles and Practices",2nd Edition, Addison-Wesley, 2003.
2. Anthony J Lattanze, "Architecting Software Intensive System. A Practitioner's Guide",Auerbach Publications, 2010.

Reference Books:
1. Mary Shaw, David Garlan, Software architecture: perspectives on an emerging discipline. Prentice-Hall, 1996.
2. Frank Buschmann, RegineMeunier, Hans Rohnert, Peter Sommerlad, Michael Stal, Pattern-oriented software architecture, Volume 1: A system of patterns, Wiley, 1996.
3. Douglas Schmidt, Michael Stal, Hans Rohnert, Frank Buschmann, Pattern-Oriented Software Architecture, Volume 2; Patterns for Concurrent and Networked Objects, Wiley, 2000.
4. Martin Fowler, Patterns of Enterprise Application Architecture, Addison-Wesley, 2000.
5. Selected research papers, and Articles related to state-of-the-art technologies and standards.

Certification Courses available:

4. https://www.coursera.org/learn/software-architecture
5. https://www.udemy.com/basics-of-software-architecture-design-in-java/
6. https://in.udacity.com/course/software-architecture-design--ud821

Free Courses available:

1. https://www.coursera.org/learn/software-architecture
2. https://www.udemy.com/basics-of-software-architecture-design-in-java/
3. https://in.udacity.com/course/software-architecture-design--ud821

Expert Faculty:

1. Prof. Rajib Mall is Professor, Department of Computer Science and Engineering, Indian Institute of Technology Kharagpur, West Bengal.
2. Prof. N.L. Sardais Professor, Department of Computer Science and Engineering, Indian Institute of Technology Bombay.

BCSP217MACHINE LEARNING(Online)

Teaching Scheme					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours	Credits	TAE	CAE	ESE	Int	Ext	
-	-	2	2	1	-	-	-	25	25	50

Course Objectives:

- Be able to formulate machine learning problems corresponding to different applications.
- Be able to apply machine learning algorithms to solve problems of moderate complexity.

Course Outcomes: Upon completion of the course students shall be able to:

- CO1. Recall the basic concepts and techniques of Machine Learning.
- CO2. Summarize and compare a range of machine learning algorithms along with their strengths and weaknesses
- CO3. Develop skills of using recent machine learning software for solving practical problems.

Unit I: Understanding Machine Learning

Introduction, What Is Machine Learning?, Examples of Machine Learning Applications, Learning Associations, Supervised & Unsupervised Learning, Reinforcement Learning, Classification, Regression

Unit II: Applying R-Programming

R - Basic Syntax, Data Types, Variables, Operators, Decision Making, Loops, Functions, Strings, Vectors, Lists, Matrices, Arrays, Factors, Data Frames, Packages-chart & graphs

UNIT III: Clustering & Application of ML

Introduction to clustering, k-Means Clustering, Hierarchical clustering, Introduction to Chat Bot, creation of Chat Bot

Text Books:

1. Introduction to machine*learning,EthemAlpaydin*. *— 2nd ed*., The MIT Press, Cambridge, Massachusetts, London, England.
2. Introduction to artificial neural systems, J. Zurada, St. Paul: West.
3. R in a Nutshell, 2nd Edition - O'Reilly Media.

Reference Books:

1. Machine Learning, Tom M Mitchell.
2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer

Resource Persons

Mr.VivekPatole,
Head Product Engineering &DEvelopment at Iknowlation ,Research Labs Pvt. Ltd,Pune

Prof. SudeshnaSarkar
Head of the Centre
Contact (Head)
Phone: +91-3222-282256
Email : sudeshna@cse.iitkgp.ac.in

AnupamBasu
Professor
PhD (IIT Kharagpur)
Joined Institute in 1984
Phone**:** 283462(o), 283463(r)
Email**:**anupam[at]cse.iitkgp.ernet.in

Free Courses:

Sr. No.	Machine Learning course name	Offered by
1	Machine Learning by Andrew Ng	Stanford COURSERA
2	Intro to Machine Learning	Udacity's
3	Learning from Data(Introductory Machine Learning)	EDX
4	Statistical Machine Learning	Carneggie Melon University
5	Neural Networks for Machine Learning	**Coursera**
6	Google's Deep Learning	Udacity's
7	R Tutorial on Machine Learning	Kaggle
8	Principles of Machine Learning	EDX
9	Machine Learning Specialization	Coursera

SEMSTER-V

BFYL143 Mathematics-VII (Integral Transforms) (online)

Teaching Scheme				Credits	Evaluation Scheme					
					Theory			Practical		Total
Th.	Tu	Pr.	Total		TAE	CAE	ESE	Int.	Ext.	
1	0	0	1	1	10	15	25			50

1. Analyze problems, recognize appropriate methods of solution, solve the problems and find the solutions.
2. Apply principles from mathematics to solve applied problems in engineering.

Course Outcomes
Upon successful completion of the course, students will be able to:
1. Understand and use Laplace- transform to solve engineering problems.
2. Apply the concept of z-Transform to solve difference equations
3. Apply the concepts of Numerical methods to solve engineering problems

Unit -I: Laplace Transforms: (10 hrs)
Laplace transform: definition and their simple properties, transform of derivatives and integrals, evaluation of integrals by L.T. ,inverse L.T. &its properties , convolution theorem, Laplace transforms of periodic function & unit step function,

Unit -II: Z-Transforms:
The Z transform- definition & properties, inverse & relation with Laplace Transform.Application to z-transform to solve difference equations with constant coefficients.

Unit-III: Application :
applications of Laplace and Z-Transform transforms Recommended

Reference Books:

1. Kreyszig, E.: Advanced Engineeing Mathematics (Eighth Edition); John Wiley & Sons; 2000.
Jain, R.K. and Iyengar, S.R.K.; Advanced Engineering Mathematics; Narosa Publishers; 2003.

BCSL316/BCSP316DESIGN AND ANALYSIS OF ALGORITHMS(online)

Teaching Scheme				Credits	Continuous Evalation Scheme					
					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	
2	-	2	4	3	10	15	25	10	15	75

Course Objective:
1. This course introduces students the general idea of analysis and design of algorithms while making them aware of basic methods of algorithm analysis and design.
2. It is also aimed at developing skills to solve real life applications which involve algorithm development.
3. The course also provides career opportunities in analysis, design and optimization technique in algorithms.

Course Outcome: Upon successful completion of the course, students shall be able to-
Upon successful completion of the course, students will be able to
1. Apply basic concepts of algorithm in analysis and Design of algorithms.
2. Identify and apply methods used for analysis and Design of Algorithm
3. Develop an appropriate mathematical formulations in designing algorithm
4. Use advanced techniques and tools available for algorithm analysis and development

CO Mapping with PO and PSO

Course Outcomes	Program Outcomes					Program Specific Outcomes	
	P01:	PO2	PO3	P04:	PO5	PSO1	PSO2
CO1	2	3	3	-	-	2	3
CO2	-	3	3	3	-	2	3
CO3	-	-	3	3	-	3	2
CO4	-	-	2	2	-	2	3

Syllabus

Unit – I: Mathematical foundations
summation of arithmetic and geometric series, n, n2, bounding summations using integration, recurrence relations, solutions of recurrence relations using technique of characteristic equation and generating functions, Complexity calculation of various standard functions, Principles of designing algorithms

Unit – II: Asymptotic notations
Asymptotic notations of analysis of algorithms, analyzing control structures, worst case and average case analysis, amortized analysis, application of amotorized analysis, Sorting networks, comparison networks, biotonic sorting network.

Unit – III :Advanced data structures
Advanced data structures like Fibonacci heap, Binomial heap, disjoint set representation, red and black trees and their applications. Divide and conquer basic strategy, matrix operation, binary search, quick sort, merge sort, fast fourier transform.

Unit – IV :Greedy Method & Dynamic Programming

Greedy method – basic strategy, application to job sequencing with deadlines problem, minimum cost spanning trees, single source shortest path etc. Dynamic Programming basic strategy, multistage graphs, all pairs shortest path, single source shortest paths, optimal binary search trees, traveling salesman problem, Maximum flow networks.

Unit V: Traversal And Search Techniques

Basic Traversal and Search Techniques, breadth first search and depth first search, connected components. Backtracking basic strategy, 8-Queen's problem, graph coloring, Hamiltonian cycles etc

Unit VI: Completeness Problems And Applications

NP-hard and NP-complete problems, basic concepts, non-deterministic algorithms, NP-hard and NP-complete, decision and optimization problems, Computational Geometry, Approximation algorithm and concepts based on approximation algorithms. Recent trends in Design and analysis of algorithms, advanced topics & its Application.

Text Books:

1. Thomas H. Cormenet. al. "Introduction to Algorithms", Prentice Hall of India.
2. Design & Analysis of Computer Algorithms by Aho,. Horowitz, Sahani, Rajsekharam, Pearson education

Reference Books:

1. "Computer Algorithms", Galgotia Publications Pvt. Ltd. Brassard, Bratley, "Fundamentals of Algorithms", Prentice Hall
2. Computer Algorithms: Introduction to Design and analysis, 3rd Edition, By Sara Baase& A. V. Gelder Pearson Education.

Certification Courses available:

1) Design and Analysis of Algorithms CS161, Stanford School of Engineering
https://online.stanford.edu/courses/cs161-design-and-analysis-algorithms
2) EdX course on Algorithm Design and Analysis, University of Pennsylvania
https://www.edx.org/course/algorithm-design-analysis-pennx-sd3x

Free Courses available:

1) MOOCs Free Online Courses in Algorithm Design:
https://www.class-central.com/tag/algorithm-design
2) NPTEL course on Design and Analysis of Algorithms**:**
https://www.class-central.com/course/nptel-design-and-analysis-of-algorithms-3984

Expert Faculty:

1) Prof.AbhiramRanade, Department of Computer Science Engineering,IIT Bombay
2) Prof.MadhavanMukund, Chennai Mathematical Institute
3) Prof.MadhavanMukund, Chennai Mathematical Institute

BCSL309/BCSP309 COMPILER DESIGN

(offline)

Teaching Scheme				Credits	Continuous Evalation Scheme					
					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	
2	-	2	4	3	10	15	25	10	15	75

Course Objective:

1. This course introduces student general ideas of compiler.
2.This course introduces to use regular languages to describe the lexical elements of a programming language and understand syntax analysis.
3. Aimed to develop skills to understand optimization technique

Course Outcome: Upon successful completion of the course, students shall be able to-

1. Understand basic concepts of compiler and different phases of compiler.
2. Explain the role of a semantic analyzer and describe the purpose of a syntax tree.
3. Apply context free grammars, compiler parsing techniques, construction of abstract syntax trees, symbol tables.
4. Demonstrate lexical analysis using a finite automata along with error recovery.
5. Apply optimization techniques to intermediate code and generate machine code for high level language program.
6. Implement the knowledge and skills necessary to develop a language translator or compiler covering a broad range of engineering and scientific applications.

CO Mapping with PO and PSO

Course Outcomes	Program Outcomes							Program Specific Outcomes	
	PO2	PO3	P04:	PO5	P06	PO11	PO12:	PSO1	PSO2
CO1	3	-	-	3	-	1	2	3	1
CO2	3	3	-	3	1	1	2	3	1
CO3	3	2	-	2	-	-	1	3	-
CO4	2	-	3	2	-	-	-	2	-
CO5	3	3	1	2	-	-	-	2	-
CO6	2	-	3	2	-	-	-	2	-

SYLLABUS

UNIT I INTRODUCTION TO COMPILERS
Overview of compilerand translator, types of Compiler, Analysis of the Source Program, The Phases of a compiler, grouping of phases, Cousins of the Compiler, design of lexical Analysis.compiler writing tools – bootstrapping

UNIT II SYNTAX ANALYSIS
Review of Context-Free Grammars – Derivation trees and Parse Trees, Ambiguity. Top-Down Parsing: Recursive Descent parsing, Predictive parsing, LL(1) Grammars.Bottom-Up Parsing: Shift Reduce parsing – Operator precedence parsing (Concepts only)LR parsing – Constructing SLR parsing tables, Constructing, Canonical LR parsing tables and Constructing LALR parsing tables.

UNIT IIISemantic Analysis
Need of semantic analysis, Abstract Parse trees for Expressions, variables, statements, functions and classdeclarations, Syntax directed definitions, Syntax directed translation schemes for declarationprocessing, type analysis, scope analysis , Symbol Tables (ST),Organization of ST for block structure and non block structured languages, Symbol Table management.

UNIT IV Intermediate code generation and error recovery
Intermediate code generation: Intermediate languages, Design issues, Translation of different language features, different types of intermediate forms.Error Handling and Recovery in Syntax Analyzer-YACC-Design of a syntax Analyzer for a Sample Language.

UNIT V CODE OPTIMIZATION
Principal Sources of Optimization-DAG-Optimization of Basic Blocks-Global Data Flow Analysis-Efficient Data Flow Algorithms-Issues in Design of a Code Generator - A Simple Code Generator Algorithm.

UNIT VIRecent Trends
Recent trends and Compiler tools, advanced topics & its Application.
Virtual Machines and Interpretation Techniques, Just-In-Time (JIT) and Adaptive Compilation, Runtime System Architectures and Automatic Memory Management Techniques.

Text Books:

1. Alfred V. Aho, Monica S.Lam, R. Sethi and J.D. Ullman “Compilers: principles, techniques and tools” Pearson Education.
2. "Modern Compiler Implementaton in ML" by Andrew W. Appel, Cambridge University Press, 1998.

Reference Books:

- Kenneth C Louden, “Compiler Construction Principle and Practice”, PWS publishing Company, 1997
- Dhamdhere D.M., “Compiler Construction Principle and Practice”, Mac. Millan India, New Delhi, 1983
- Holub, A.J., “Compiler design in C” –Prentice Hall,1982
- John Levine, Tony Mason & Doug Brown, “Lex and Yacc”, O’Reilly.1995

Certification Courses available:

1. https://nptel.ac.in/courses/106108052/9
2. https://nptel.ac.in/courses/106104123/10

Free Courses available:
1. The lex and Yaccpagehttp://dinosaur.compilertools.net/
2.http://www.personal.kent.edu/~rmuhamma/Compilers/compiler.html
3. http://www.cs.sjsu.edu/~louden/cmptext/
4.http://www.gtoal.com/software/CompilersOneOhOne/
5.http://lambda.uta.edu/cse5317/notes/node4.html

Expert Faculty:

1. Prof. Y. N. Srikant, Department of Computer Science and Automation, Indian Institute of Science, Bangalore.
2. Prof. S. K. Aggarwal,Dept. of Computer Science and Engineering. Indian institute of Technology,Kanpur

BCL317/BCSP317 DATA COMMUNICATION AND NETWORKS (Offline)

Teaching Scheme				Credits	Continuous Evalation Scheme					
					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	
2	-	2	4	3	10	15	25	10	15	75

Course Objective:
1. This course introduces student’s basics of data communication and networking while making them aware of functions of each layer in architecture.
2. The course provide career opportunities in design, implement, operate & manage enterprise work.
3. Understand advanced technique such as Data encoding and Compression.

Course Outcomes:
Upon successful completion of the course, students will be able to
1. Understand Basics of data communications and Computer Networks

2. Identify the techniques involved in the data transfer process
3. Understand advanced technique such as Data encoding and Compression
4. Recognize the need for OSI reference Model in computer networking
5. Use different elementary protocols for communication and identify IEEE standards employed in Computer networking
6. Design techniques involved in developing transport and application layer of Computer Networking

CO Mapping with PO and PSO:

Course Outcomes	Programme Outcomes					Programme Specific Outcomes	
	PO1	PO2	PO4	PO5	PO11	PSO1	PSO2
CO1	1	3	3	-	-	3	2
CO2	-	3	2	-	-	2	-
CO3	-	-	3	-	2	3	2
CO4	1	3	2	2	2	3	2
CO5	1	3	3	-	-	2	-
CO6	-	-	2	2	2	3	2

SYLLABUS

Course Content:

UNIT I: Introduction

Introduction: Data Communications, Networks, The Internet, Protocols and Standards, Network Models, Layered Tasks, The OSI Model, Layers in the OSI Model, TCP/IP Protocol Suite, Addressing, Physical Layer and Media, Data and Signals, Analog and Digital, Periodic Analog Signals, Digital Signals, Transmission impairment, Data Rate Limits, Performance, Digital Transmission, Digital-to-Digital Conversion, Analog-to-Digital Conversion, Analog Transmission, Digital-to-analog Conversion, Analog-to-analog Conversion

UNIT II: II Physical Layer

Bandwidth utilization: Multiplexing and Spreading, Multiplexing, Spread Spectrum, Transmission Media, Guided Media, Unguided Media: Wireless, Switching, Circuit-Switched Networks, Datagram Networks, Virtual-Circuit Networks, Structure of a Switch, Using Telephone and Cable Networks for Data Transmission, Telephone Networks, Dial-up Modems, Digital Subscriber Line, Cable TV Networks, Cable TV for Data Transfer

UNIT III: Data Link Layer

Error Detection and Correction, Introduction, Block Coding, Liner Block Codes, Cyclic Codes, Checksum, Data Link Control, Framing, Flow and Error Control, Protocols, Noiseless Channels, HDLC, Point-to-Point Protocol, Multiple Access, Random Access, Aloha, Controlled Access, Channelization, IEEE Standards, Standard Ethernet, Changes in the Standard, Fast Ethernet, Gigabit Ethernet, IEEE 802.11, Bluetooth, Backbone Networks, and Virtual LANs, Connecting Devices, Backbone Networks, Virtual LANs, Cellular Telephony, Satellite Networks, Sonet/SDH, Architecture, Sonet Layers, Sonet Frames, STS Multiplexing, Sonet Networks, Virtual Tributaries, Virtual-Circuit Networks: Frame Relay and ATM, Frame Relay, ATM, ATM LANs

UNIT IV: Network layer

Network Layer: Logical Addressing, IPv4 Addresses, IPv6 Addresses, Network Layer: Internet Protocol, Internetworking, IPv4, IPv6, Transition from IPv4 to IPv6, Network Layer: Adress Mapping, Error Reporting and Multicasting, Address Mapping, ICMP, IGMP, ICMPv6, Network Layer: Delivery, Forwarding and Routing, Delivery, Forwarding, Unicast Routing Protocols, Multicast Routing Protocols

UNIT V: Transport Layer

Transport Layer: Process-Process Delivery: UDP, TCP and SCTP, Process-to-Process Delivery, User Datagram Protocol (UDP), TCP, SCTP, Congestion Control and Quality of Service, Data Traffic, Congestion, Congestion Control, Two Examples, Quality Service, Techniques to improve QoS, Integrated Services, Differentiated Services, QoS in Switched Networks

UNIT VI: Application Layer

Application Layer: Domain Name System, Name Space, Domain Name Space, Distribution of Name Space, DNS in the Internet, Resolution, DNS Messages, Types of Records, Registrars, Dynamic Domain Name System (DDNS), Encapsulation, Remote Logging, Electronic Mail and File Transfer, Remote Logging, Telnet, Electronic Mail, File Transfer, WWW and HTTP: Architecture, Web Documents, HTTP, Network Management: SNMP, Network Management System, Simple Network Management Protocol (SNMP), Multimedia, Digitizing Audio and Video, Audio and Video Compression, Streaming Stored Audio/Video, Streaming Live Audio/Video, Real-Time Interactive Audio/Video, RTP, RTCP, Voice over IP

TEXT BOOKS:

1. Data Communications and Networking, Fourth Edition by Behrouza A. Forouzan,TMH.
2. Computer Networks, A.S.Tanenbaum, 4th Edition, Pearson education.

REFERENCE BOOKS:

1.Introduction to Data communications and Networking, W.Tomasi, Pearson education.
2. Data and Computer Communications, G.S.Hura and M.Singhal, CRC Press, Taylor and Francis Group.
3. An Engineering Approach to Computer

Networks-S.Keshav, 2nd Edition, Pearson Education.
4. Understanding communications and Networks,3rd Edition, W.A.Shay, Cengage Learning.

Free Certification Courses available:
Coursera – "Data communication Network Services" by Cisco
NPTEL – "Data Communication" by IIT Kharagpur
Swayam – "Computer Networks" by Anand More, Devi AhilyaVishwavidyalaya, Indore
Expert Faculty:
Dr. VershaApte, IIT Bombay
Dr. S. Selvakumar, NIT Tiruchirappalli
Dr. T. Kishore Kumar, NIT Warangal
Mr. Jack Lange, University of Pittsburgh, Pennsylvania

BCSL315/BCSP315 CLOUD COMPUTING
(online)

Teaching Scheme				Credits	Continuous Evalation Scheme					
					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	
1	-	2	3	2	10	15	25	10	15	75

Course Objective:
1. Understand the new technologies for resources sharing
2. Explain classification of Cloud deployment
3. Discuss capacity planning for cloud configuration
4. Understand Cloud service model
5. Cloud Security and privacy issue
6. Cloud business model for cost effectiveness

Course Outcome: Upon successful completion of the course, students shall be able to-
CO1: State the basics of distributed computing and cloud computing.
CO2: Summarize the technical capabilities and business benefits cloud technology.
CO3: Develop cloud-based application demonstrating its implications
CO4: Develop cost effective solution using cloud technology
CO5 : Develop solution for Society with minimized resources
CO Mapping with PO and PSO:

Course Outcomes	Program Outcomes					Program Specific Outcomes
	P01	PO2	PO3	P04	PO5	PSO1
CO1	1	3	3	3	3	-
CO2	-	3	3	3	3	2
CO3	2	3	3	3	3	3
CO4	1	3	2	3	3	3
CO5	1	2	3	2	3	3
CO6	1	3	2	3	3	3

Syllabus

Unit- I: Introduction to Cloud Computing

Virtualization Concepts, Cloud Computing Fundamental: Overview of Computing Paradigm,Evolution of cloud computing, Defining cloud computing, Components of a computing cloud,Essential Characteristics of Cloud Computing, Cloud Taxonomy. Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), Hardware-as-a-service: (HaaS), Oriented Architecture (SOA)

Unit – II: Cloud Computing Architectural Framework
Cloud architectural principles, Role of Web services, Benefitsand challenges to Cloud architecture, Cloud Service Models, cloud computing vendors. Cloud Services, Management, Performance and scalability of services, tools and technologies used to managecloud services deployment.

Unit – III: Cloud Application Development
Role of business analyst, Technical architecture considerations, Service creation environments to develop cloud based applications, Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages, Cloud Economics,

Unit – IV: Cloud Security and Risk Management
Cloud Security: Understanding cloud based security issues and threats, Data security and Storage,Identity& Access Management, Risk Management in cloud, Governance and Enterprise Risk
Management.

Text Books:

3. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier – 2012
4. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010

5. Cloud Computing: Principles and Paradigms, Editors: RajkumarBuyya, James Broberg,
6. Andrzej M. Goscinski, Wile, 2011
7. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos,Lee Gillam, Springer, 2012

Reference Books:

1 Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010
2 GautamShroff, Enterprise Cloud Computing Technology Architecture Applications [ISBN:978-0521137355]
3. Dimitris N. Chorafas, Cloud Computing Strategies [ISBN: 1439834539]
4. Barrie Sosinsky, " Cloud Computing Bible" John Wiley & Sons, 2010
5. Tim Mather, SubraKumaraswamy, and ShahedLatif, Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, O'Reilly 2009

Certification Courses available:

Sr No	Name	Affiliation	Expertise	Courses
1	Prof SoumyaKantiGhosh	IIT Kaharagpur	Cloud Computing	SWAYAM
2	Dr. Rajiv Mishra	IIT Patna	Cloud Computing and Distributed Systems	NPTEL
3		https://www.udemy.com/topic/Cloud-Computing(66 online courses of cloud)	Cloud Computing	Udemy

Free Courses available: on UDEMY, NPTEL, CourseEra, MOOC
https://pages.awscloud.com/TC-Global-Campaign-2019
https://www.coursera.org/courses?query=cloud%20computing
https://www.udemy.com/introduction-to-cloud-computing/

Expert Faculty:

Sr. No.	Name	Affiliation	Expertise	Contact Details
1	Prof C. L. Wang	BS *Nat. Taiwan*; MS, PhD *S. Calif* BEng(CE) Programme Coordinator; Professor University of Hong Kong	Cloud Computing and Virtualization	Tel: (+852) 2857 8458 Fax: (+852) 2559 8447 Email: clwang@cs.hku.hk Homepage: http://www.cs.hku.hk/~clwang
2	Prof Debadatta Mishra https://www.cse.iitk.ac.in/users/deba/	Professor,Department of CSE,IIT Kanpur	Cloud Computing	+91(512)259/333/679-2004 deba@cse.iitk.ac.in
3	Prof PurushottamKulkarni	Associate Professor IIT Bombay	Virtualization and Cloud Computing	puru@cse.iitb.ac.in
4	Prof D. JanaKiram	Professor IIT Madras	Cloud, Cluster and Grid Computing	djram@cse.iitm.ac.in

SEMSTER-VI

BFYL144 Mathematics-VIII
(Probability & Statistics) (online)

Teaching Scheme				Credits	Evaluation Scheme					
					Theory			Practical		Total Marks
Th	Tu	Pr	Total Hours		TAE	CAE	ESE	Int	Ext	
2	0	0	2		10	15	25			50

Course Objectives :
1. This course introduces a general mathematical concepts and objects.
2. It skill the students to understand important mathematical models used in computer science branch

Course Outcomes :
Upon successful completion of the course, students will be able to:
1.Understand the concepts of Random variables.
2. Understand and use special probability distributions

Unit -I Random Variables :
Random Variables, Distribution functions of continuous & discrete random variables, Joint distributions, mathematical
expectations, moment, Moment generating function &characteristic function

Unit –II : Special probability distribution:
Binomial, Poisson's, Geometric, Uniform, Exponential, Normal.

Unit-III : Hypothesis testing.

Recommended Reference Books:

1. Kreyszig, E.: Advanced Engineeing Mathematics (Eighth Edition); John Wiley & Sons; 2000.
2. Jain, R.K. and Iyengar, S.R.K.; Advanced Engineering Mathematics; Narosa Publishers; 2003.

BCSL321/BCSP321 ADVANCED NETWORKS(offine)

Teaching Scheme				Credits	Continuous Evalation Scheme					
					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	
1	-	4	5	3	10	15		10	15	50

Course Objectives:
1. To learn about Software Defined Networking.
2. To understand an emerging Internet architectural framework, including the main concepts, architectures, algorithms, protocols and applications
3. To be able to implement Network virtualization framework.

Course Outcomes:
Upon completion of course students will be able to:
1. Design a network with appropriate protocols selected according to requirement.
2. Analyze different routing protocols and traffic engineering methods deployed in networking.
3. Understand the concept of SDN (i.e. abstracting and centralizing the control plane).
4. Analyze the implications of shifting from traditional network architectures to software defined networks.
5. Apply and analyze network functions virtualization.
6. Implement a network service using the knowledge acquired throughout the lectures.

Syllabus

UNIT 1: Routing in Packet Networks
Circuit Switching and Packet Switching, Types of Routing Protocols: Interior and Exterior Gateway protocols, Adaptive and Non-adaptive Routing Algorithms, Traffic Management at packet level, Traffic management at flow level.

UNIT2: Introduction to Software Defined Networking (SDN)
Evolution of Switches and Control Planes, Centralized and Distributed Control and Data Planes Concepts, Advantages and Disadvantages, OpenFlowprotocol.SDNController: GeneralConcepts,Layer 3 Centric, Plexxi ,CiscoOnePK ,Network Programmability

UNIT 3: Data Center Concepts and Constructs
Technologies for the Data Center, The Multitenant Data Center ,The Virtualized Multitenant Data Center ,SDN Solutions for the Data Center Network ,VLANs, EVPN ,VxLan,NVGRENetwork Topology and Topological Information Abstraction: Introduction,Network Topology ,Traditional Methods ,LLDP ,BGP-TE/LS ,ALTO ,I2RS Topology

UNIT 4: Building an SDN Framework
Introduction The Juniper SDN Framework IETF SDN Framework(s) Open Daylight Controller/Framework Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring, Use Cases for Input Traffic Monitoring, Classification, and Triggered Actions, Firewalls as a Service ,Network Access Control Replacement ,Extending

the Use Case with a Virtual Firewall ,Feedback and Optimization ,Intrusion Detection/Threat Mitigation

UNIT 5: **Network Function Virtualization**
Introduction, Existing Network Virtualization Framework (VMWare and others), Virtualization and Data Plane I/O, Services Engineered Path, Service Locations and Chaining, NFV at ETSI, Non-ETSI NFV Work

Textbook(s):

1. SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media, August 2013, ISBN: 978-1-4493-4230-2, ISBN 10: 1-4493-4230-2.
2. Software Defined Networks: A Comprehensive Approach, by PaulGoransson and Chuck Black, Morgan Kaufmann, June 2014, Print BookISBN: 9780124166752, eBook ISBN : 9780124166844

References:

1. SDN and OpenFlow for Beginners by VivekTiwari, Sold by: Amazon Digital Services, Inc., ASIN: , 2013.
2. Network Innovation through Open Flow and SDN: Principles and Design, Edited by Fei Hu, CRC Press, ISBN-10: 1466572094, 2014.
3. Open Networking Foundation (ONF) Documents, https://www.opennetworking.org, 2015.
4. Open Flow standards, http://www.openflow.org, 2015.
5. Online Reading Lists, including: http://www.nec-labs.com/~lume/sdn-reading-list.html, 2015.

Certification Courses available:

1. CompTIA A+ Technician
This entry-level certification is a starting point for a career in IT. Certified A+ techs handle PC maintenance, operating systems, printers, mobile devices and laptops. The CompTIAA+ validates skills hiring managers need from entry-level technicians and often provides entry-level employment opportunities for aspiring IT practitioners without work-related experience.

2. CompTIA Network+
Interested in a networking career? CompTIA Network+ verifies the ability to design, manage and troubleshoot wired and wireless networks. This is another in-demand certification ideal for beginning a career in IT, and serves as a recommended prerequisite for more advanced network training.

3. Cisco Certified Network Associate (CCNA)
Routing and Switching
The CCNA: Routing and Switching is an associate-level certification and assures employers that you're able to install, operate and configure enterprise-level networks. CCNA-certified pros can also detect and solve common network problems. This is a fantastic certification for anyone building a career in networking. With this certification, you also have the options of specializing in security, voice or wireless networking.

4. Microsoft Certified Solutions Expert (MCSE)
Cloud Platform and Infrastructure
The MCSE: Cloud Platform and Infrastructure is an ideal certification for advanced-level practitioners responsible for managing modern data centers. MCSE certification is offered in specializations that include server infrastructure, desktop infrastructure, private cloud, enterprise devices and apps, data platform, business intelligence, messaging, communications and SharePoint.

5. Certified Information Systems Auditor (CISA)
The CISA validates a high-level of audit skills and knowledge, and certifies the ability to identify vulnerabilities, report on compliance and institute controls within an enterprise system. Earn this certification and enjoy an amazing career in IT auditing.

6. Certified Information Systems Security Professional (CISSP)
The CISSP validates skills required to protect large enterprise systems from a host of modern cyber threats. With less than 112,000 practitioners in existence, those with this in-demand certification find lucrative employment opportunities all over the world.

7. AWS Certified Solutions Architect – Associate
The AWS Certified Solutions Architect – Associate validates skills for designing distributed applications and systems on the AWS platform. This is an ideal certification for anyone wanting to ride the bleeding edge of the IT industry. Get certified in cloud computing and meet the business demands of today and tomorrow.

8. Certified Information Security Manager (CISM)
The CISM is another in-demand certification from ISACA, and validates skills required to design, build and manage enterprise-level security programs. Candidates for this certification will have many years of experience in managing enterprise systems and will fully understand the many enterprise-level risks and vulnerabilities that are involved. Achieve this expert-level certification and become the defender of your enterprise system.

9. Certified in Risk and Information Systems Control (CRISC)
This ISACA certification validates skills required to provide enterprise-level risk management and is arguably the top IT certification in the world.

With less than 21,000 current practitioners, job security is essentially guaranteed for those willing to achieve this expert-level credential. Achieve this world-class certification and enjoy all that comes with a rewarding career in risk management.

Free Courses available:

- **Massachusetts Institute of Technology (MIT)**
  - MIT offers a free online course in network optimization. The course addresses problems in network flow, like minimum cost and maximum flow.
  - Network Optimization
- **Open University**
  - Open University offers students an intro to network security course which is designed for advanced-level students. The course takes 25 hours to complete.
  - The protocols in multi-service networks course explores communication protocols. Class topics include packet-switched and circuit-switched networks, the OSI (Open Systems Interconnection) reference model, TCP/IP (Transmission Control Protocol/Internet Protocol) architecture and protocol software. This networking course takes 30 hours to complete.
  - Network Security
  - Protocols in Multi-Service Networks

Expert Faculty:

- **Brad Hedlund**
  https://www.linkedin.com/in/bradhedlund/
  @BradHedlund
  Brad is the Technical Account Manager for AWS and before that an engineering Architect for VMWare. Brad has extensive hands-on experience and specializes in Cloud networking, data center infrastructure, and network security. Check out an interview with Brad on VMWorld TV.
- **Greg Ferro**
  https://www.linkedin.com/in/etherealmind/
  @etherealmind
  Greg is one of the co-founders of Packet Pushers which is a weekly podcast about data networking by networking architects. Greg is a veteran of networking and a prolific writer. Sign up for his networking newsletter which gives the latest news on networking infrastructure and great hands-on advice too. Greg stated recently on Twitter: "Gonna talk about SD-WAN in 2018. It will be kind of ranty. Ok, maybe a lot ranty."
- **Prof. C P Katti,**
  Dean
  Tel.: + 91-11-26704767 (O)
  Fax: + 91-11-26742526
  Email: jnu_scss@mail.jnu.ac.in
  School of Computer & Systems Sciences,
  Jawaharlal Nehru University, New Delhi
  (www.jnu.ac.in/SCSS/default.html)

BCSL320/BCSP320 INFORMATION SECURITY AND CRYPTOGRAPHY
(Offline)

Teaching Scheme				Credits	Continuous Evalation Scheme					
					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	
2	-	2	4	3	10	15	25	10	15	75

Course Objectives:

- This course covers the fundamentals of computer systems security.
- It introduces many different areas of security such as encryption, malicious code, authentication and access control, trusted computer systems, operating system and network security.
- The objective of this course is to provide students with a comprehensive overview of the threats to computer security, technologies for security assurance, and engineering approaches to security solutions.
- Create an ability to understand and use various open source security tools to improve personal information security & network security.

Course Outcomes:

Upon successful completion of the course, students will be able to
CO1: Use the fundamentals of Cryptography and standard algorithms to provide confidentiality, integrity and authenticity.
CO2: Use symmetric and asymmetric key encryption systems
CO3: Analyze various message authentication codes and hash functions.
CO4: Analyze detection and prevention of various attacks
CO5: Use open source tools like wireshark, keyloggeretc to protect important data.
CO6: Design secure applications

Course Contents:

Unit-I: Introduction

Introduction to information and network security, Attacks, services, mechanisms, security attacks, security services, a model for internet work security, encryption model, steganography, classical encryption techniques, modern techniques - simplified DES, block cipher principles, data encryption standard, strength of DES, block cipher design principles, block cipher modes of operation.

Unit-lI: Confidentiality and Key Management

Confidentiality using conventional encryption: placement of encryption function, random number

generation. Public key cryptography: principles, RSA algorithm, key management, diffie-heliman key exchange, elliptic curve cryptography, Chinese remainder theorem, Euclidean algorithm, extended Euclidean algorithm, discrete logarithms, primality testing, Chinese remainder theorem, finite fields.

Unit-lII: Message Authentication and Hash Functions

Authentication requirements, functions, codes**,** security of hash function &MACs.Hash& Mac algorithms.Messages digest, Properties of hash functions, MD2, MD5 and SHA-1, keyed hash functions, attacks on hash functions. Digital signatures & authentication protocols, Elgamal digital signature algorithm, digital signature standard.

Unit-IV: Network Security

Network security: Firewalls, Proxy-Servers, Network intrusion detection. Transport security: Mechanisms of TLS, SSL, IPSec. Biometric authentication, Secure E-Commerce (ex. SET), Smart Cards, Security in Wireless Communication.

Unit-V: Open Source Tools

Hans-on sessions on open source network & information security tools such as Wireshark, Nmap&Zenmap, CryptoForge, VaraCrypt, Quick Checksum Verifier, KeePass, CrypTool, Metasploit.

Unit-VI: Trends and Applications of Network Security

Recent trends in Computer System & Security, Advanced topics & its Application

Books:

- Cryptography and networks security principles & practice by William Stalings (Pearson Education prentice Hall).
- Networks security Essentials Applications & standards by William Stalings (Pearson Education, LPF).
- Cryptography in C and C++ by Michael Welschenbach (A press IDG Books India).
- Introduction to Data Compression by Khalid Sayood (Morgan kaufmann/Harcourt India).

Reference Book

- Information Security: The Complete Reference, Second Edition2nd Edition by Mark Rhodes-OusleyISBN-13:978-0071784351 ,ISBN-10:0071784357
- Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
- Cryptography and Network Security : ForouzanMukhopadhyay, McGraw Hill, 3rd Edition
- Information Security, Principles, and Practice: Mark Stamp, Wiley India.
- Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH
- Introduction to Network Security: Neal Krawetz, CENGAGE Learning
- Network Security and Cryptography: Bernard Menezes, CENGAGE Learning

MOOCS Courses:

- **NPTEL LINKS:**
  - **nptel.ac.in/courses/106105031 (IIT K)**
  - **https://nptel.ac.in/courses/106105031/39**
  - **https://nptel.ac.in/courses/106106129**
  - **https://onlinecourses.nptel.ac.in/noc18_cs24**
- **MIT Courseware**
  - **https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-858-computer-systems-security-fall-2014/exams/**
- **Swayam Courses:**
  - **https://swayam.gov.in/course/1303-introduction-to-information-security-i**
  - **https://swayam.gov.in/courses/4957-information-security**
- **MOOCS Link**
  - **https://www.khanacademy.org/computing/computer-science/cryptography/modarithmetic/a/the-euclidean-algorithm**
  - **https://www.khanacademy.org/computing/computer-science/cryptography/crypt/v/intro-to-cryptography**

Open Source Tools:

- **Nmap**
- **OpenVAS**
- **OSSEC**
- **Security Onion**
- **Metasploit Framework**
- **OpenSSH**
- **Wireshark**
- **Kali Linux.**
- **Snort**
- **SalesForce**
- **CiscoPacketTracer**
- **OpenNMS**
- **Nikto.**
- **Truecrypt**
- **Moloch**
- **Bro IDS**
- **Snort**

- **OSQuery**
- **GRR - Google Rapid Response**
- **Omnet++**
- **Cacti**
- **NetDisco**
- **Experts:**

1. Bhaskar Raman, IIT Bombay
2. SachinDhedia - Professor - SGA EDUCATION INSTITUTE, Mumbai
3. Dr. Abhijeet Das, IIT KGP, abhij@cse.iitkgp.ac.in, +91-3222-282350

BECL204/BECP204 MICROCONTROLLER AND EMBEDDED SYSTEMS(online)

Teaching Scheme				Credits	Continuous Evalation Scheme					
					Theory			Practical		Total
Th.	Tu	Pr.	Total Hours		TAE	CAE	ESE	Int	Ext	
2	-	2	4	3	10	15	25	10	15	75

Course Objectives:

1. To study and understand various microcontrollers and embedded systems.
2. To understand the design parameters ofembedded systems applications.
3. To study and impart different tools for embedded system and IoT application design.

COURSE OUTCOMES:

On successful completion of the course, Students shall be able to:

CO1: Understanding principle of embedded systems and Microcontroller
CO2: Develop programming for applicationsdevelop real time applications
CO3: Perform interfacing of devices and peripherals
CO4: Make Use Of ARM7 Controller for Designing of Embedded Applications
CO5: Understand different IoT platform for Embedded applications
CO6: Design and Develop different embedded system and IoTapplications.

Syllabus

Unit 1: Embedded Systems: Introduction to embedded Systems, Requirements /Components of Embedded Systems, Design Process in Embedded System
Microcontrollers: Introduction to microcontrollers, 8051 architecture, Addressing modes and instruction set, 8051 programming in Assembly language and Embedded C.

Unit 2:Programming: Timer,Interrupts and serial communications, Serial I/O, Programming Tools
Interfacing with 8051: ADC and DAC interfaces for microcontrollers, Real time interfacing with LED, Keypad, LCD display, Sensors interfacing (LDR, IR, PIR etc.)

Unit 3: Advanced devices and peripheral interfacing with ATmega16: GSM, GPS, GPRS, Bluetooth

Unit 4: Introduction of 32-bit Microcontroller:ARM7 Processors, ARM Architecture, Register and Memory organization, Addressing modes, Arm Thumb and instruction sets, Basic Assembly Programming

Unit 5: Advance Microcontroller and Programming: Introduction to Raspberry PI and Intel Galileo Board, Python Programming, OOP's and Modules in Python Programming.

Unit 6: Design and perform differentembedded system and IoT Applications: Robotic, Industrial Automations,

TEXT BOOKS:

Sr. No.	Title	Author Name	Publisher	Year of Publication	Edition
1	Muhammad Ali Mazidi	The 8051 Micro-controller & Embedded System using assembly & C	Pearson Education	2008	Second
2	Muhammad Ali Mazidi	ARM Assembly language programming and Architecture			Second
3	RajKamal	Microcontrollers: Architecture, Programming, Interfacing and System Design	Pearson Education India	2009	Second

REFERENCE BOOKS:

Sr. No.	Title	Author Name	Publisher	Year of Publication	Edition
1	Shibu K. V.	Introduction to Embedded System,	The McGraw Hill,	2011	
2	Ajay V. Deshmukh	Micro-controllers - Theory and Applications,	Tata McGraw Hill		
3	Kenneth J. Ayala	The 8051 Micro-controller – Architecture, Programming & Applications,	Penram International & Thomson Asia,	1996	Second

ONLINE CERTIFICATION AVAILABLE:

Sr. No.	Course Name	Faculty Name	Institute Name	Link
1.	NPTEL video Course on Embedded Systems	Dr. SantanuChaudhury	IIT-Delhi	https://nptel.ac.in/courses/108102045/#

BEST FACULTY MEMBERS FROM IIT/CENTRALLY FUNDED INSTITUTES:

Sr No.	Faculty Name	Institute Name	Contact Details
1.	Dr. SantanuChaudhury	IIT-Delhi	santanuc@ee.iitd.ernet.in