AMRITA VISHWA VIDYAPEETHAM
DEEMED TO BE UNIVERSITY
School of Engineering

COIMBATORE, BANGALORE , CHENNAI

B. Tech - Computer Science and Engineering (Cyber Security)

(BTC-CYS)

CURRICULUM AND SYLLABI

(2020)

GENERAL INFORMATION

ABBREVIATIONS USED IN THE CURRICULUM

Cat	-	Category
L	-	Lecture
T	-	Tutorial
P	-	Practical
Cr	-	Credits
ENGG	-	Engineering Sciences (including General, Core and Electives)
HUM	-	Humanities (including Languages and others)
SCI	-	Basic Sciences (including Mathematics)
PRJ	-	Project Work (including Seminars)
AES	-	Aerospace Engineering
AIE	-	Computer Science and Engineering - Artificial Intelligence
BIO	-	Biology
CCE	-	Computer and Communication Engineering
CHE	-	Chemical Engineering
CHY	-	Chemistry
CSE	-	Computer Science and Engineering
CVL	-	Civil Engineering
CUL	-	Cultural Education
EAC	-	Electronics and Computer Engineering
ECE	-	Electronics and Communication Engineering
EEE	-	Electrical and Electronics Engineering
ELC	-	Electrical and Computer Engineering
HUM	-	Humanities
MAT	-	Mathematics
MEE	-	Mechanical Engineering
PHY	-	Physics

Course Outcome (CO) – Statements that describe what students are expected to know and are able to do at the end of each course. These relate to the skills, knowledge and behaviour that students acquire in their progress through the course.

Program Outcomes (POs) – Program Outcomes are statements that describe what students are expected to know and be able to do upon graduating from the Program. These relate to the skills, knowledge, attitude and behaviour that students acquire through the program. NBA has defined the Program Outcomes for each discipline.

Program Objectives

The B. Tech program in CSE (Cyber Security) is intended to mould students into well prepared Cyber Security professionals and has been designed with a good balance between theoretical & practical aspects, analytical and architectural methods complemented by academic research and industry best practices.

Through this program students acquire necessary theoretical background, insights into general and technical aspects of Cyber Security, a good understanding of analytical methods and management practices in the field.

Program Educational Objectives (PEOs)

The PEOs outlined below describe the expectations of what graduates will accomplish in their careers, and how they perform during the first few years after graduation.

Areas or fields where graduates can find employment: Hundreds of Cyber Security career roles in pretty much every vertical market in the industry.

Preparedness of graduates to take up higher studies: There are various tracks with ample funding to take up master's and subsequently PhD programs around the world.

- Find employment in Computer Science & Engineering and/or Cyber Security field in a professional organization.
- Apply conceptual and practical knowledge of Cyber Security along with tools and technologies to avoid, identify, counter, and recover from cyber threats.
- Communicate Cyber Security risks, threats, and countermeasures to convince decision makers to apply this understanding to develop cyber defense strategies.
- Contribute to product development as individual contributors in corporations and/or entrepreneurs in inter disciplinary fields of computer engineering & technology and Cyber Security.
- Identify, analyze, and utilize professional and academic literature in the field of Cyber Security to help solve problems and stay up to date with the rapidly changing context of global security concerns.

Program Outcomes (PO):

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 and 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 modelling 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 teamwork:** 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.

Program Specific Outcomes (PSO):

1. Gain a thorough understanding of the Cyber Security landscape with its growing threats and vulnerabilities in the world of computing including software and hardware. Attain skills to comprehend and anticipate future challenges and devise methods to meet them and also, be articulate and skilled to convince all the stakeholders.
2. Acquire and demonstrate the ability to use standard tools, practices and technologies for the analysis, design, development and implementation of innovative and optimal Cyber Security solutions without compromising the privacy needs of individual and entities and the security concerns of law enforcement agencies

Curriculum

SEMESTER I

Cat	Code	Title	Credit
HUM	19ENG111	Technical Communication	3
ENGG	20CYS101	Classical Cryptography	2
MAT	20MAT102	Linear Algebra	4
SCI	19PHY101	Engineering Physics	3
ENGG	19CSE100	Problem Solving and Algorithmic Thinking	4
ENGG	20CYS102	Principles of Engineering	3
ENGG	20CYS103	Computer Hardware and System Essentials	3
HUM	19CUL101	Cultural Education – 1	2
			24

SEMESTER II

Cat	Code	Title	Credit
MAT	19MAT115	Discrete Mathematics	4
MAT	20MAT112	Number Theory and Algebra	3
ENGG	20CYS111	Digital Signal Processing	3
ENGG	20CYS112	Computer Organisation and Architecture	4
ENGG	20CYS113	Computer Programming	3
ENGG	20CYS181	Computer Programming lab	1
ENGG	20CYS114	Cyber Security Essentials	3
HUM	19CUL111	Cultural Education – II	2
			23

SEMESTER III

Cat	Code	Title	Credit
MAT	20CYS201	Optimization Techniques	4
ENGG	20CYS202	User Interface Design	2
ENGG	20CYS203	Operating Systems	3
ENGG	20CYS281	Operating System Lab	1
ENGG	19CSE201	Advanced Programming	3
ENGG	20CYS204	Database Management System	3
ENGG	20CYS205	Modern Cryptography	4
HUM	19AVP201	Amrita Value Program I	1
			21

SEMESTER IV

Cat	Code	Title	Credit
MAT	20CYS211	Probability and Statistics	4
CYS	20CYS212	Multimedia Processing	3
CYS	20CYS213	System Security	3
CYS	20CYS282	System Security Lab	1
CYS	20CYS215	Machine Learning in Cyber Security	3
CYS	20CYS214	Data Structures and Algorithms	3
CYS	20CYS283	Data Structures and Algorithms Lab	1
CYS	20CYS383	Java Programming Lab	1
HUM	19AVP211	Amrita Value Program II	1
HUM	19SSK211	Soft Skills – 1	2
HUM	19MNG300	Disaster Management	P/F
			22

SEMESTER V

Cat	Code	Title	Credit
CYS	20CYS301	Digital Communication	3
CYS	20CYS302	Secure Coding	4
CYS	20CYS305	Algorithms: Design and Analysis	3
CYS	20CYS303	Computer Networks	3
CYS	20CYS382	Computer Networks Lab	1
CYS	20CYS304	Artificial Intelligence and Neural Networks	4
HUM		Humanities Elective	2
HUM	19SSK301	Soft Skills – 2	2
HUM	19ENV300	Environmental Science	P/F
ENGG	19LIV390	Live – in – Labs***	[3]
			22+[3]

SEMESTER VI

Cat	Code	Title	Credit
ENGG	20CYS311	Cyber Forensics	3
ENGG	20CYS312	Principles of Programming Languages	3
ENGG	20CYS384	Advanced Protocol Engineering and Security Lab	1
ENGG	20CYS313	Network Security	3
ENGG	20CYS314	Applied Cryptography	4
ENGG	20CYS315	Automata Theory and Compiler Design	3
ENGG		Professional Elective – 1	3
HUM	19SSK311	Soft Skills – 3	2
ENGG	19LIV490	Live-in-Labs	[3]
			22+[3]

SEMESTER VII

Cat	Code	Title	Credit
ENGG	20CYS401	Secure Software Engineering	3
ENGG	20CYS402	Distributed Systems and Cloud Computing	3
ENGG	20CYS403	Web Application Security	3
ENGG	20CYS404	Android Application Development	1
ENGG		Professional Elective – 2	3
ENGG		Professional Elective – 3	3
ENGG		Free Elective – 1 (Management Elective)	3
PRJ	2OCYS495	Project - Phase – 1 / Seminar	2
HUM	19LAW300	Indian Constitution	P/F
			21

SEMESTER VIII

Cat	Code	Title	Credit
PRJ	20CYS499	Project - Phase – 2	10
Total (30hrs)			10
Total Credits			165

***Professional Elective - Electives categorised under Engineering, Science, Mathematics, Live-in-Labs, and NPTEL Courses. Student can opt for such electives across departments/campuses. Students with CGPA of 7.0 and above can opt for a maximum of 2 NPTEL courses with the credits not exceeding 8.**

**** Free Electives - This will include courses offered by Faculty of Humanities and Social Sciences/ Faculty Arts, Commerce and Media / Faculty of Management/Amrita Darshanam -(International Centre for Spiritual Studies).**

***** Live-in-Labs - Students undertaking and registering for a Live-in-Labs project, can be exempted from registering for an Elective course in the higher semester.**

PROFESSIONAL ELECTIVES

Cat	Code	Title	Credit
Professional Elective-1			
CYS	20CYS331	Wireless Sensor Network Security	3
CSE	19CSE436	Mobile and Wireless Security	3
CSE	19CSE446	Internet of Things	3
Professional Elective-2			
CYS	20CYS431	Program Obfuscation	3
CYS	20CYS432	Vulnerability Assessment and Penetration Testing	3
CYS	20CYS433	Blockchain Technology	3
Professional Elective-3			
CYS	20CYS441	Formal Methods for Security	3
CYS	20CYS442	Hardware Security	3
CYS	20CYS443	Biometrics and Security	3

Electives in Business Systems			
Cat	Code	Title	Credit
CSE	19CSE358	Software Project Management	3
HUM	19CSE359	Financial Engineering	3
HUM	19MNG331	Financial Management	3
CYS	20MNG331	Information Security Risk Management	3

FREE ELECTIVES

FREE ELECTIVES OFFERED UNDER MANAGEMENT STREAM			
Cat.	**Code**	**Title**	**Credit**
HUM	**19MNG331**	**Financial Management**	**3**
HUM	**19MNG332**	**Supply Chain Management**	**3**
HUM	**19MNG333**	**Marketing Management**	**3**
HUM	**19MNG334**	**Project Management**	**3**
HUM	**19MNG335**	**Enterprise Management**	**3**
HUM	**19MNG338**	**Operations Research**	**3**
HUM	**19MEE401**	**Industrial Engineering**	**3**
HUM	**19MEE346**	**Managerial Statistics**	**3**
HUM	**19MEE347**	**Total Quality Management**	**3**
HUM	**19MEE342**	**Lean Manufacturing**	**3**
HUM	**19CSE358**	**Software Project Management**	**3**
HUM	**19CSE359**	**Financial Engineering**	**3**
HUM	**19CSE360**	**Engineering Economic Analysis**	**3**
HUM	**19MNG331**	**Financial Management**	**3**
HUM	**19CSE362**	**Information Systems**	**3**

FREE ELECTIVES OFFERED UNDER HUMANITIES / SOCIAL SCIENCE STREAMS			
Cat.	**Code**	**Title**	**Credit**
HUM	**19CUL230**	**Achieving Excellence in Life - An Indian Perspective**	**2**
HUM	**19CUL231**	**Excellence in Daily Life**	**2**
HUM	**19CUL232**	**Exploring Science and Technology in Ancient India**	**2**
HUM	**19CUL233**	**Yoga Psychology**	**2**
HUM	**19ENG230**	**Business Communication**	**2**
HUM	**19ENG231**	**Indian Thought through English**	**2**
HUM	**19ENG232**	**Insights into Life through English Literature**	**2**
HUM	**19ENG233**	**Technical Communication**	**2**
HUM	**19ENG234**	**Indian Short Stories in English**	**2**
HUM	**19FRE230**	**Proficiency in French Language (Lower)**	**2**
HUM	**19FRE231**	**Proficiency in French Language (Higher)**	**2**
HUM	**19GER230**	**German for Beginners I**	**2**
HUM	**19GER231**	**German for Beginners II**	**2**
HUM	**19GER232**	**Proficiency in German Language (Lower)**	**2**
HUM	**19GER233**	**Proficiency in German Language (Higher)**	**2**
HUM	**19HIN101**	**Hindi I**	**2**
HUM	**19HIN111**	**Hindi II**	**2**
HUM	**19HUM230**	**Emotional Intelligence**	**2**
HUM	**19HUM231**	**Glimpses into the Indian Mind - the Growth of Modern India**	**2**
HUM	**19HUM232**	**Glimpses of Eternal India**	**2**
HUM	**19HUM233**	**Glimpses of Indian Economy and Polity**	**2**
HUM	**19HUM234**	**Health and Lifestyle**	**2**
HUM	**19HUM235**	**Indian Classics for the Twenty-first Century**	**2**
HUM	**19HUM236**	**Introduction to India Studies**	**2**

HUM	**19HUM237**	**Introduction to Sanskrit Language and Literature**	**2**
HUM	**19HUM238**	**National Service Scheme**	**2**
HUM	**19HUM239**	**Psychology for Effective Living**	**2**
HUM	**19HUM240**	**Psychology for Engineers**	**2**
HUM	**19HUM241**	**Science and Society - An Indian Perspective**	**2**
HUM	**19HUM242**	**The Message of Bhagwad Gita**	**2**
HUM	**19HUM243**	**The Message of the Upanishads**	**2**
HUM	**19HUM244**	**Understanding Science of Food and Nutrition**	**2**
HUM	**19JAP230**	**Proficiency in Japanese Language (Lower)**	**2**
HUM	**19JAP2313**	**Proficiency in Japanese Language (Higher)**	**2**
HUM	**19KAN101**	**Kannada I**	**2**
HUM	**19KAN111**	**Kannada II**	**2**
HUM	**19MAL101**	**Malayalam I**	**2**
HUM	**19MAL111**	**Malayalam II**	**2**
HUM	**19SAN101**	**Sanskrit I**	**2**
HUM	**19SAN111**	**Sanskrit II**	**2**
HUM	**19SWK230**	**Corporate Social Responsibility**	**2**
HUM	**19SWK231**	**Workplace Mental Health**	**2**
HUM	**19TAM101**	**Tamil I**	**2**
HUM	**19TAM111**	**Tamil II**	**2**

SYLLABUS

SEMESTER I

19ENG111	TECHNICAL COMMUNICATION	L-T-P-C: 2-0-3-3

Course Objectives

- To introduce the students to the fundamentals of mechanics of writing
- To facilitate them with the style of documentation and specific formal written communication
- To initiate in them the art of critical thinking and analysis
- To help them develop techniques of scanning for specific information, comprehension and organization of ideas
- To enhance their technical presentation skills.

Course Outcomes

CO1: To gain knowledge about the mechanics of writing and the elements of formal correspondence.
CO2: To understand and summarize technical documents.
CO3: To apply the basic elements of language in formal correspondence.
CO4: To interpret and analyze information and to organize ideas in a logical and coherent manner.
CO5: To compose project reports/ documents, revise them for language accuracy and make technical presentations.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										3				
CO2				1						2				
CO3										3				
CO4				1						2				
CO5									2	1				

Syllabus

Unit 1

Mechanics of Writing: Grammar rules -articles, tenses, auxiliary verbs (primary & modal) prepositions, subject-verb agreement, pronoun-antecedent agreement, discourse markers and sentence linkers.
General Reading and Listening comprehension - rearrangement & organization of sentences.

Unit 2

Different kinds of written documents: Definitions- descriptions- instructions- recommendations- user manuals - reports – proposals
Formal Correspondence: Writing formal Letters.
Mechanics of Writing: impersonal passive & punctuation
Scientific Reading & Listening Comprehension.

Unit 3

Technical paper writing: documentation style - document editing – proof reading - Organizing and formatting.
Mechanics of Writing: Modifiers, phrasal verbs, tone and style, graphical representation.
Reading and listening comprehension of technical documents.
Mini Technical project (10 -12 pages). Technical presentations

Textbook

Hirsh Herbert L. Essential Communication Strategies for Scientists, Engineers and Technology Professionals. Second Edition, New York: IEEE press; 2002.

Reference(s)

1. *Anderson Paul V. Technical Communication: A Reader-Centred Approach. Fifth Edition, Harcourt Brace College Publication; 2003.*
2. *Strunk, William Jr., White. EB. The Elements of Style. New York, Alliyan & Bacon; 1999.*
3. *Riordan G Daniel, Pauley E Steven. Technical Report Writing Today, Eighth Edition (Indian Adaptation), New Delhi: Biztantra; 2004.*
4. *Michael Swan. Practical English Usage. Oxford University Press; 2000.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	20	
Periodical 2	20	
Continuous Assessment (Lab) (CAL)	40	
End Semester		20

20CYS101	CLASSICAL CRYPTOGRAPHY	L-T-P-C: 2-0-0-2

Prerequisite(s): Nil

Course Objectives

- To introduce different classical cryptographic techniques and its theoretical security analysis.
- To provide and demonstrate different cryptanalysis attacks against the cryptographic techniques, and their attack models.
- To show the impact of these ciphers on society during the time of their use.

Course Outcomes

CO1: Identify the basic language & terminologies of cryptography.

CO2: Demonstrate Encryption and Decryption methods using various ciphers of classical cryptography.

CO3: Perform cryptanalysis of classical cryptography.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2											3	1
CO2	3	2	3	2	2	1							2	2
CO3	2	2	2	3	3	1							2	2

Syllabus

Transposition Ciphers, Columnar Transposition, Keyword Columnar Transposition, Double Transposition Ciphers, Substitution Ciphers, Simple Substitution Ciphers, Poly-alphabetic Ciphers, Affine Ciphers, Simple Substitution Cryptanalysis, Vigenere Cipher, Index of Coincidence, Hill Cipher, One Time Pad, Code Book Ciphers, Enigma Machine, Rotors, Enigma attack, Purple – Machine - Decrypting Purple, SIGABA Cipher Machine, LFSR based shift registers, Berlekamp-Massey Algorithm

Textbook(s)

Mark Stamp and Richard M. Low: Applied cryptanalysis: Breaking Ciphers in the Real World, Wiley-Interscience, 2007.

Reference(s)

Stinson, Douglas Robert, and Maura Paterson, Cryptography: Theory and Practice, CRC press, Fourth Edition, 2019.

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
Continuous Assessment (CAL)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports

20MAT102	LINEAR ALGEBRA	L-T-P-C: 3-1-0-4

Prerequisites: Nil

Course Objectives

- Understand the basic concepts of vector space, subspace, basis and dimension.
- Familiar the inner product space. Finding the orthogonal vectors using inner product.
- Understand and apply linear transform for various matrix decompositions.

Course Outcomes

CO1: Understand the basic concepts of vector space, subspace, basis and dimension.
CO2: Understand the basic concepts of inner product space, norm, angle, Orthogonality and projection and implementing the Gram-Schmidt process, to obtain least square solution.
CO3: Understand the concept of linear transformations, the relation between matrices and linear transformations, kernel, range and apply it to change the basis, to get the QR decomposition, and to transform the given matrix to diagonal/Jordan canonical form.
CO4: Understand the concept of positive definiteness, matrix norm and condition number for a given square matrix.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1											1
CO2	3	3	2											2
CO3	3	3	2											1
CO4	3	2	1											1

Syllabus

Unit 1

Review: System of linear Equations, linear independence.
Eigen values and Eigen vectors: Definitions and properties. Positive definite, negative definite and indefinite. Diagonalization and Orthogonal Diagonalization. Properties of Matrices. Symmetric and Skew Symmetric Matrices, Hermitian and Skew Hermitian Matrices and Orthogonal matrices.

Unit 2

Vector spaces - Sub spaces - Linear independence - Basis - Dimension - Inner products - Orthogonality - Orthogonal basis - Gram Schmidt Process - Change of basis.
Orthogonal complements - Projection on subspace - Least Square Principle

Unit 3

Linear Transformations: Positive definite matrices - Matrix norm and condition number - QR-Decomposition - Linear transformation - Relation between matrices and linear transformations - Kernel and range of a linear transformation. Change of basis, Similarity of linear transformations, Diagonalization and its applications, Jordan form and rational canonical form, SVD.

Textbook

Howard Anton and Chris Rorrs,"Elementary Linear Algebra", Ninth Edition, John Wiley & Sons, 2000.

Reference(s)

1. *D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.*
2. *Gilbert Strang, "Linear Algebra and its Applications", Third Edition, Harcourt College Publishers, 1988.*
3. *Kenneth Hoffman and Ray Kunze, Linear Algebra, Pearsons, 2015.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19PHY101	ENGINEERING PHYSICS	L-T-P-C: 2-1-0-3

Pre-Requisite(s): Nil

Course Objective

- To learn fundamental concepts of electricity and magnetism for applications in engineering and technology.
- To familiarize the principles of interference, diffraction and polarization and apply in engineering context.
- To gain knowledge of basic quantum mechanics, crystal structure and classification of solids based on their properties and applications.

Course Outcomes

CO1: Be able to apply the concepts of electric and magnetic field including Maxwell's equations to engineering application and problem solving.

CO2: Understand the principles of interference, diffraction and polarization and apply it in engineering context and to solve numerical problems.

CO3: Understand the principles and applications of solid state and gas lasers.

CO4: Be exposed to basic principles of Quantum mechanics with elementary applications in one dimensional potential well.

CO5: Be familiar with crystals structure, free electron theory and basic semiconductor theory.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3								2		
CO2	3	3	2	3								2		
CO3	3	3	2	3								2		
CO4	3	3	2	3								2		
CO5	3	3	2	3								2		

Syllabus

Unit 1

Electrostatics, Magnetostatics and Electrodynamics
Electric field and electrostatic potential for a charge distribution, divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential, Biot-Savart law, divergence and curl of static magnetic field, vector potential, Stoke's theorem, Lorentz force, Faraday's law and Lenz's law, Maxwell's equations.

Unit 2
Waves and Optics
Huygens' Principle, superposition of waves and interference of light by wave front splitting and amplitude splitting, Young's double slit experiment, Newton's Rings, Michelson interferometer. Fraunhofer diffraction from single slit and circular aperture, Rayleigh criterion for limit of resolution and its application to vision, diffraction gratings and their resolving power. Polarization: Unpolarized, polarized and partially polarized lights, polarization by reflection, double refraction by uniaxial crystals, Polaroid, half wave and quarter wave plates.

Unit 3

Lasers
Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers (Ruby, Neodymium), dye lasers.

Unit 4

Quantum Mechanics
De Broglie waves, wave functions, wave equation, Schrodinger wave equation: time dependent and time independent form, operators – Eigenfunctions and Eigenvalues, uncertainty principle, particle in a finite potential one -dimensional box, tunnelling effect (Qualitative).

Unit 5

Introduction to Solids
Crystal systems: Miller indices, crystal planes and directions, packing fraction, Classification of solids: Metals, semiconductors, and insulators (qualitative), free electron theory of metals, Fermi level, Density of states, Kronig- Penney model and origin of energy bands.

Textbook

David J Griffiths, Introduction to Electrodynamics, Fourth Edition, Pearson; 2015.

Reference Books

1. *Ajay Ghatak, Optics, Sixth Edition, McGraw Hill Education India Private Limited; 2017.*
2. *Eugene Hecht, A R Ganesan, Optics, Fourth Edition, Pearson Education; 2008.*
3. *Arthur Beiser, ShobhitMahajan, S. RaiChoudhury, Concepts of Modern Physics, McGraw Hill Education India Private Limited; 2017.*
4. *Charles Kittel, Introduction to Solid State Physics, Eight Edition, Wiley; 2012.*
5. *Halliday, Resnick, Jearl Walker, Principles of Physics, Tenth Edition, Wiley;2015.*
6. *John David Jackson, Classical Electrodynamics, Third Edition, Wiley;2007.*
7. *F A Jenkins, H E White, Fundamental of Optics, Fourth Edition, McGraw Hill Education India Private Limited; 2017.*
8. *David J Griffiths, Introduction to Quantum Mechanics, Second Edition, Pearson Education; 2015.*
9. *M A Wahab, Solid State Physics, Third Edition, Narosa Publishing House Pvt. Ltd.; 2015.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CSE100	PROBLEM SOLVING AND ALGORITHMIC THINKING	L-T-P-C: 2-1-3-4

Prerequisites: Nil

Course Objectives

- This course provides the foundations of computational problem solving.
- The course focuses on principles and methods thereby providing transferable skills to any other domain.
- The course also provides foundation for developing computational perspectives of one's own discipline.

Course Outcomes

CO1: Apply algorithmic thinking to understand, define and solve problems

CO2: Design and implement algorithm(s) for a given problem

CO3: Apply the basic programming constructs for problem solving

CO4: Understand an algorithm by tracing its computational states, identifying bugs and correcting them.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1												
CO2	3	2	3		3			3	3	3				
CO3	2	1												
CO4	1	1	2		2									

Syllabus

Unit 1

Problem Solving and Algorithmic Thinking Overview – problem definition, logical reasoning; Algorithm – definition, practical examples, properties, representation, algorithms vs programs.

Unit 2

Algorithmic thinking – Constituents of algorithms – Sequence, Selection and Repetition, input-output; Computation – expressions, logic; algorithms vs programs, Problem Understanding and Analysis – problem definition, input-output, variables, name binding, data organization: lists, arrays. Algorithms to programs.

Unit 3

Problem solving with algorithms – Searching and Sorting, Evaluating algorithms, modularization, recursion. C for problem solving – Introduction, structure of C programs, data types, data input, output statements, control structures.

Text Book

Riley DD, Hunt KA. Computational Thinking for the Modern Problem Solver. CRC press; 2014 Mar 27.

Reference(s)

1. *Ferragina P, Luccio F. Computational Thinking: First Algorithms, Then Code. Springer; 2018.*

2. *Beecher K. Computational Thinking: A beginner's guide to Problem-solving and Programming. BCS Learning & Development Limited; 2017.*

3. *Curzon P, McOwan PW. The Power of Computational Thinking: Games, Magic and Puzzles to help you become a computational thinker. World Scientific Publishing Company; 2017.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS102	PRINCIPLES OF ENGINEERING	L-T-P-C: 2-0-3-3

Prerequisites: Nil

Course Objectives

- Understand basic connections between science and engineering
- To impart basic knowledge of electrical quantities and provide working knowledge for the analysis of DC and AC circuits.
- Understand the characteristics and applications of diode and Transistors.
- To facilitate understanding of Thyristors and operational amplifier circuits.

Course Outcomes

CO1: Ability to understand the engineering concepts and basic electric and magnetic circuits.

CO2: Ability to analyse DC and AC circuits.

CO3: Ability to understand the basic principles of PN junctions and transistors.

CO4: Ability to analyse basic transistor and op-amp based circuits.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3												2	
CO2	3	3	2										2	
CO3	3												2	
CO4	3	2	2										3	

Syllabus

Unit 1

Overview and history of Engineering. Engineering marvels of the ancient world. Connections between Science and Engineering, connection between Maths and Engineering. Roles of different fields of Engineering.

Introduction to Electrical Engineering, current and voltage sources, Resistance, Inductance and Capacitance; Ohm's law, Kirchhoff's law, Energy and Power, Super position Theorem, Network Analysis – Mesh and Node methods- Faraday's Laws of Electro-magnetic Induction, Magnetic Circuits, Self and Mutual Inductance, Single Phase, 3 Phase and Network Grids.

Unit 2

PN Junction diodes, Diode Characteristics, Diode approximation- Clippers and Clampers, Rectifiers: Half wave, Full wave, Bridge- Zener Diode- Design of regulator and characteristics, Optoelectronic devices, Introduction to BJT, Characteristics and configurations, Transistor as a Switch.

Unit 3

Field Effect Transistors – Characteristics, Thyristors – operation and characteristics, Diac, Triac –Thyristor based power control, IC 555 based Timer-multi-vibrators, Operational Amplifiers – Inverting and Non-inverting amplifier, Oscillators, Instrumentation amplifiers.

Textbook

Edward Hughes. Electrical and Electronic Technology, 10th Edition, Pearson Education Asia, 2019.

Reference Book(s)

1. *A. P. Malvino, Electronic Principles, 7th Edition, Tata McGraw Hill, 2007.*
2. *Handley, Brett, Craig Coon, and David M. Marshall. Principles of engineering. Cengage Learning, 2012.*
3. *S. K. Bhattcharya, Basic Electrical and Electronics Engineering, Pearson, 2012.*
4. *Vincent Del Toro, Electrical Engineering Fundamentals, Prentice Hall of India Private Limited, 2nd Edition, 2003.*
5. *David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2008.*

6. *Michael Tooley B. A., Electronic circuits: Fundamentals and Applications, 3rd Edition, Elsevier Limited, 2006.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS103	COMPUTER HARDWARE AND SYSTEM ESSENTIALS	L-T-P-C: 2-0-3-3

Prerequisites: Nil

Course Objectives

- Computer hardware essentials is designed to introduce students to a basic understanding of the different types of computing devices, computer components (CPU, memory, power supplies, etc.), and operating systems.
- It also introduces building a fully functional Linux and Installing applications
- Understand the basic of circuit building

Course Outcomes

CO1: Understanding the working principles of different computing devices (desktop computers, laptops, etc.).

CO2: Understand PC and laptop hardware components.

CO3: Understand connection interfaces between peripheral devices, storage devices, displays.

CO4: Understand the procedure for Installation of OS - Linux and supporting, upgrading and new applications.

CO5: Understand the concepts of number system and circuit building.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1			1								3	2
CO2	3	2			1								3	2
CO3	2	1											3	2
CO4	1	1			2								3	2
CO5	1	1			1				2	2	1	1	3	2

Syllabus

Unit 1

Components of Computer System: Computer Memory: Secondary storage device types, Basic Principles of operation: Sequential Access device, Direct Access device -Magnetic disks,

Optical disks, memory storage devices, Ports: Serial and Parallel Ports, Specialized Expansion Ports: SCSI, USB, MIDI, Expansion Slots and Boards, PC Cards, Plug and Play, HDMI ports, networking ports. System software: bootstrap module, configuration, OS loading: typical Linux virtual machine. Installing a Linux virtual machine. Using package manager to install/update software. Understanding disk partitions and obtaining partition information using system tools. Obtaining essential system resource utilization and information using system tools and proc file system: disk utilization, memory utilization, process information, CPU utilization.

Unit 2

Operating System: Introduction, Objectives, classification and functions of Operating System, Basics of popular operating system (LINUX, WINDOWS). Kernel prompt, Shell commands. The User Interface: Task Bar, Icons, Menu, Running an Application. Operating System Simple Setting: Changing System Date and Time, Changing Display Properties, To Add or Remove a Windows Component, Changing Mouse Properties, Adding and removing Printers. File and Directory Management: Creating and renaming of files and directories, Common utilities. Interrupts statements in various OS and its uses.

Unit 3

Number systems - Signed and Unsigned numbers arithmetic, Binary, Decimal, Octal, Hex, BCD etc. Introduction to logic circuits: Variables and functions, Inversion- Truth tables - Logic Gates and Networks - Boolean algebra - Synthesis using gates - Design examples - Optimized implementation of logic functions: Karnaugh map - Strategy for minimization - Minimization of product of sums forms - Incompletely specified functions - Multiple output circuits - Tabular method for minimization. Combinational circuit building blocks: Multiplexers - Decoders - Encoders, Sequential circuit building blocks: Flipflops-SR, JK, D and T- Registers - Counters - A simple sequential circuit design example from state diagram.

Textbook

Brookshear JG. Computer science: an overview. Eleventh Edition, Addison-Wesley Publishing Company; 2011.

Reference(s)

1. *Norton, Peter. Introduction to computers. Sixth edition, Tata McGraw-HILL; 2008.*
2. *Wakerly JF. Digital Design Principles and Practices. Fourth Edition, Pearson Education; 2008.*
3. *Sinha, Pradeep K., and Priti Sinha. Computer fundamentals. BPB publications; 2010.*
4. *Givone DD. Digital Principles and Design.Tata McGraw Hill Publishing Company Limited; 2003.*
5. *Mano MM, Ciletti MD. Digital Design with Introduction to the Verilog HDL.Fifth Edition, Pearson Education; 2015.*

6. *Silberschatz A, Gagne G, Galvin PB. Operating system concepts. Ninth Edition, Wiley; 2012.*
7. *Cobbaut P. Linux Fundamentals. Samurai Media Limited; 2016.*
8. *Halsey M. Windows 10 Troubleshooting. Apress; 2016.*
9. *Soyinka W. Linux Administration: A Beginner's Guide. Fifth Edition, Mc Graw Hill Professional; 2008.*
10. *Englander, Irv. The Architecture of Computer Hardware, System Software, and Networking. An Information Technology Approach, Sixth Edition, John Wiley & Sons; 2021.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CUL101	CULTURAL EDUCATION – I	L-T-P-C: 2-0-0-2

Course Objective

- The course is designed as an introductory guide to the variegated dimensions of Indian cultural and intellectual heritage, to enable students to obtain a synoptic view of the grandiose achievements of India in diverse fields.
- It will equip students with concrete knowledge of their country and the mind of its people and instill in them some of the great values of Indian culture.

Course Outcomes

CO1: Be introduced to the cultural ethos of Amrita Vishwa Vidyapeetham, and Amma's life and vision of holistic education.

CO2: Understand the foundational concepts of Indian civilization like puruśārtha-s, law of karma and varṇāśrama.

CO3: Gain a positive appreciation of Indian culture, traditions, customs and practices.

CO4: Imbibe spirit of living in harmony with nature, and principles and practices of Yoga.

CO5: Get guidelines for healthy and happy living from the great spiritual masters.

CO-PO Mapping

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO														
CO1						3	2	3				2		
CO2						3	1	3				2		
CO3						3	1	3				2		
CO4						3	3	3				2		
CO5						3	1	3				2		

Syllabus

Unit 1

Introduction to Indian culture; Understanding the cultural ethos of Amrita Vishwa Vidyapeetham; Amma's life and vision of holistic education.

Unit 2

Goals of Life – Purusharthas; Introduction to Varnasrama Dharma; Law of Karma; Practices for Happiness.

Unit 3

Symbols of Indian Culture; Festivals of India; Living in Harmony with Nature; Relevance of Epics in Modern Era; Lessons from Ramayana; Life and Work of Great Seers of India.

Text Book

Cultural Education Resource Material Semester-1

Reference Book(s)

1. *The Eternal Truth (A compilation of Amma's teachings on Indian Culture)*
2. *Eternal Values for a Changing Society. Swami Ranganathananda. Bharatiya Vidya Bhavan.*
3. *Awaken Children (Dialogues with Mata Amritanandamayi) Volumes 1 to 9*
4. *My India, India Eternal. Swami Vivekananda. Ramakrishna Mission.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

SEMESTER II

19MAT115	DISCRETE MATHEMATICS	L-T-P-C: 2-0-3-3

Prerequisites: Nil

Course Objectives

- Familiar various concepts in logic and proof techniques.
- Understand the concepts of various types of relations, partial ordering and equivalence relations.
- Understand the concepts of generating functions and apply to solve the recurrence relations.

Course Outcomes

CO1: Understand the basic concepts of Mathematical reasoning and basic counting techniques. Also understand the different types of proves like mathematical induction.
CO2: Understand the concepts of various types of relations, partial ordering and equivalence relations.
CO3: Apply the concepts of generating functions to solve the recurrence relations.
CO4: Apply the concepts of divide and conquer method and principle of inclusion and exclusion to solve some simple algorithms in discrete mathematics.
CO5: Understand various definitions and problems under graphs and trees and study their applications.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1										2	1
CO2	3	3	2											2
CO3	3	3	2										1	
CO4	3	2	1											2
CO5	2	3	2										1	2

Syllabus

Unit-1

Logic, Mathematical Reasoning and Counting: Logic, Prepositional Equivalence, Predicate and Quantifiers, Theorem Proving, Functions, Mathematical Induction. Recursive Definitions, Recursive Algorithms, Basics of Counting, Pigeonhole Principle, Permutation and Combinations

Unit-2

Relations and Their Properties: Representing Relations, Closure of Relations, Partial Ordering, Equivalence Relations and partitions

Unit-3

Advanced Counting Techniques and Relations: Recurrence Relations, Solving Recurrence Relations, Generating Functions, Solutions of Homogeneous Recurrence Relations, Divide and Conquer Relations, Inclusion-Exclusion.

Unit-4

Graphs: Special types of graphs, connectivity, Euler and Hamiltonian Paths.
Trees: Applications of trees, Tree traversal, Spanning trees.

Textbook

Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw- Hill Publishing Company Limited, New Delhi, Sixth Edition, 2007.

Reference(s)

1. *James Strayer, Elementary Number Theory, Waveland Press, 2002.*
2. *R.P. Grimaldi, Discrete and Combinatorial Mathematics, Pearson Education, Fifth Edition, 2007.*
3. *Thomas Koshy, Discrete Mathematics with Applications, Academic Press, 2005.Liu, Elements of Discrete Mathematics, Tata McGraw- Hill Publishing Company Limited, 2004.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20MAT112	NUMBER THEORY AND ALGEBRA	L-T-P-C: 3-0-0-3

Prerequisites: Nil

Course Objectives

- To familiar basic results in number theory and understand it applications in information security.
- Familiar few important concepts in number theory like primitive roots, quadratic residues etc.
- Understand the basic concepts of algebraic structures like groups rings and fields.
- Understand the hard problems in number theory and abstract algebra and its applications.

Course outcomes

CO1: Understand integers with divisibility properties and realize the group structure in integers using modular operations.

CO2: To Understand concepts of quadratic residues and Primitive roots.

CO3: To understand the basic concepts of algebraic structures like groups, rings and fields

CO4: To Understand the computationally hard problems like factorization and discrete logarithm problems and the techniques to solve these problems.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1										1	2
CO2	3	3	2										2	3
CO3	3	3	2										1	1
CO4	3	2	1										1	1

Syllabus

Unit 1

Algorithms for integer arithmetic: Divisibility, GCD, modular arithmetic, modular exponentiation, congruence, Chinese remainder theorem, orders and primitive roots, quadratic residues, integer and modular square roots, continued fractions, and rational approximations.

Unit 2

Algebraic Structures - Groups, Rings and Fields; Representation of finite fields: Prime and extension fields, representation of extension fields, polynomial basis, primitive elements, irreducible polynomials.

Unit 3

Root-finding and factorization algorithm. Elliptic curves: The elliptic curve group, elliptic curves over finite fields, Schoof's point counting algorithm. Primality testing algorithms: Fermat Basic Tests, Miller–Rabin Test. Integer factoring algorithms: Trial division, Pollard rho method, Computing discrete logarithms over finite fields: Baby-step-giant-step method, Pollard rho method, Pohlig-Hellman method, index calculus methods, linear sieve method.

Textbook

James Strayer, Elementary Number Theory, Waveland Press, 2002.

Reference(s)

1. *John B. Fraleigh, A First Course in Abstract Algebra, Seventh Edition, Pearson Education Inc. 2003.*
2. *Apostol, Tom M. Introduction to analytic number theory. Springer Science & Business Media, 20131.*
3. *Yan, Song Y. Computational Number Theory and Modern Cryptography. John Wiley & Sons, 2012.*
4. *Joseph A. Gallian, Contemporary Abstract Algebra, Cengage Learning, 2013.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS111	DIGITAL SIGNAL PROCESSING	L-T-P-C: 2-1-0-3

Pre-Requisite(s): Nil

Course Objectives

- To introduce the frequency domain concepts and filter design in signal processing applications.
- To develop knowledge in efficient transforms for signal analysis.
- To provide knowledge in designing and developing signal processing systems suitable for various applications.

Course Outcomes

CO1: To understand the concepts of signals and systems.

CO2: To analyze the frequency domain characteristics of discrete time signals and systems

CO3: To comprehend realization structures for filters.

CO4: To develop a digital signal processing system for different applications.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2										2	2	
CO2	3	2	3									2	2	
CO3	3	2		2								2	2	
CO4	3	2	3	2								2	2	2

Syllabus

Unit 1

Basic signals: unit step, unit impulse, sinusoidal and complex exponential signals - Types of signals- Basic operations on signals - system properties -Time Domain characterization of continuous time and discrete time LTI system-Convolution Integral - Convolution sum-Analysis of LTI system described by differential and difference equations.

Unit 2

Discrete Fourier transforms: Fourier Transform, Fourier analysis of discrete time signals and systems: Discrete Time Fourier series – Discrete Time Fourier Transform - properties of DTFT – Introduction to DFT- properties of DFT – linear filtering methods based on DFT – FFT algorithms.

Unit 3

Digital filters: Introduction, specifications of practical filters, Characteristics of commonly used analog filters – IIR filters: design by approximation of derivatives – impulse invariance and bilinear transformation – Butterworth filter- frequency transformations for analog and digital filters, Structures for IIR systems. FIR filters: symmetric and anti-symmetric FIR filters – design of linear phase FIR filter using windows –Structures for FIR systems – direct form structures, Linear phase, and cascade form structures. Brief introduction to Wavelets and Wavelet transform.

Textbook

Simon Haykin, Barry Van Veen, Signals and Systems, Second Edition, John Wiley and Sons, 2007.

Reference(s)

1. *Alan V. Oppenheim, Alan S. Wilsky, S, Hamid Nawab, Signals and Systems, Prentice Hall India private Limited, Second Edition, 1997.*
2. *John G Proakis, G. Manolakis, Digital Signals Processing Principles, Algorithms, Applications, Prentice Hall India Private Limited, Fourth Edition, 2007.*
3. *Sanjit K. Mitra, Digital Signal Processing: A computer-based approach, Tata McGraw Hill Publishing Company Limited, Fourth Edition,2010.*
4. *Allen V. Oppenheim, Ronald W. Schafer, Discrete time Signal processing, Prentice Hall India Private Limited, Third Edition, 2013.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS112	COMPUTER ORGANIZATION AND ARCHITECTURE	L-T-P-C: 3-0-3-4

Pre-Requisite(s): Nil

Course Objectives

- This course aims at introducing the concepts of computer architecture and organization.
- It describes overview of MIPS architecture in terms of instruction set, data path and pipelining.
- It introduces pipelining and memory systems in detail along with performance metrics for designing computer systems.

Course Outcomes

CO1: Understand the design principles of Instruction Set Architecture (ISA) by taking MIPS as reference.

CO2: Understand design of instruction execution using Multiple Clock Cycles and Analyze / Evaluate the performance of processors.

CO3: Understand Pipelined architecture and Design of 3 and 5 stage pipeline processor in MIPS

CO4: Understand the working of Arithmetic and Logic Unit and the concepts of Memory Organization.

CO5: Understand the microprocessor design, microcontroller, and addressing modes.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1										3	2
CO2	3	3	3	2	2								3	2
CO3	2	2	2										3	2
CO4	2	2	3	2									3	2
CO5	2	2	2	2	1								3	2

Syllabus

Unit 1

Introduction and Performance of Computing system, Processor Architecture with example as MIPS & Instruction Set, Single Cycle Datapath Design, Control Hardware, Computer Arithmetic, Floating Point Arithmetic, Role of performance, RISC and CISC processors.

Unit 2

Introduction to multicycle at a path, Pipelining Technique – Design Issues, Hazards: Structural Hazards, Data Hazards and Control Hazards, Static Branch Prediction, Dynamic Branch Prediction, Advanced Concepts in pipelining. Memory Organization - Introduction, Cache Memory Organization, Main Memory & Interleaving, VRAM, Input-output organization - Accessing I/O devices-program controlled I/O-interrupts – Enabling & Disabling interrupts - handling multiple devices - device identification - vectored interrupts – interrupt nesting – Simultaneous requests. Bus structures–Synchronous and asynchronous - Arbitration - I/O interface circuits – parallel and serial interfaces-Interconnection standards. Modern Processors, Parallel Processing, Secondary storage devices like SSD and flash disk.

Unit 3

Introduction to 8-bit microprocessor: Internal architecture of Intel 8085 microprocessor: Block diagram, Registers, Internal Bus Organization, Functional details of pins, Control signals, External Address / Data bus multiplexing, Demultiplexing. 8085 instruction set: Instructions, Classifications, addressing modes, Programming examples, Instruction Timing, I/ O mapped I/ O, and memory mapped I/ O techniques. Interrupts of the 8085 Microprocessor. Introduction to 8086 - 8086 Architecture - Addressing Modes - Instruction Set and Programming, Assembler Directives. 8086 hardware design: minimum mode and maximum mode configurations, Bus structure, bus buffering, latching, system bus timing with diagram, Interrupt of 8086 Microprocessor. I/O and memory interfacing using 8085 and 8086: Memory interfacing and I/O interfacing with 8085 and 8086 – Parallel communication interface (8255) –Timer (8253 / 8254) – Keyboard / Display controller (8279) – Interrupt controller (8259) – DMA controller (8257).

Textbook

Patterson DA, Hennessy JL. Computer Organisation and Design, The Hardware/Software interface (ARM Edition). Fourth Edition, Morgan Kaufmann; 2010.

Reference(s)

1. *Hamacher et.al. Computer Organisation. Sixth Edition, McGraw-Hill; 2017.*
2. *Hennessy JL, Patterson DA. Computer architecture: a quantitative approach. Fifth Edition, Morgan Kauffmann; 2011.*
3. *Hayes JP. Computer Organisation and Architecture. Third Edition, McGraw Hill; 2017.*
4. *Stallings W. Computer Organisation and Architecture.Tenth Edition, PHI; 2016.*
5. *Carl Hamacher, Naraig Manjikian, Safwat G. Zaky, Zvonko G. Vranesic, Computer Organization and Embedded Systems ,6th Edition,McGraw Hill Education (India) Private Limited. ISBN: 9780071089005.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS113	COMPUTER PROGRAMMING	L-T-P-C: 3-0-0-3

Pre-Requisite(s): 19CSE100 Problem Solving and Algorithmic Thinking

Course Objectives

- This course provides the foundations of programming.
- Apart from the usual mechanics of a typical programming language, the principles and methods will form the focus of this course.
- Shift from learn to program programming to learn forms the core of this course.

Course Outcome

CO1: Understand the typical programming constructs: data (primitive and compound), control, modularity, recursion etc. thereby to understand a given program

CO2: Understand and analyze a given program by tracing, identifying coding errors and debugging them.

CO3: Make use of the programming constructs appropriately and effectively while developing computer programs.

CO4: Develop computer programs that implement suitable algorithms for problem scenarios and applications.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1							1					1	2
CO2	1	1	1					1						1
CO3	1	2	2					2					1	
CO4	2	3	2					3					1	2

Syllabus

Unit 1

Introduction and Review of C language constructs. Functions – inter function communication, standard functions, scope. Recursion – recursive definition, recursive solution, designing recursive functions, limitations of recursion. Arrays – 1D numeric, searching and sorting, 2D numeric arrays.

Unit 2

Pointers: introduction, compatibility, arrays and pointers, Dynamic memory allocation, arrays of pointers, pointer arithmetic. Strings: fixed length and variable length strings, strings and characters, string input, output, array of strings, string manipulation functions, sorting of strings.

Unit 3

Structures: structure vs array comparison, complex structures, structures and functions, Union. Files and streams, file input output, command line arguments.

Textbook

Forouzan BA, Gilberg RF. Computer Science: A structured programming approach using C. Third Edition, Cengage Learning; 2006.

Reference(s)

1. *Byron Gottfried. Programming with C. Fourth Edition, McGrawHill,; 2018.*
2. *Brian W. Kernighan and Dennis M. Ritchie. The C Programming Language. Second Edition, Prentice Hall, 1988.*
3. *Eric S. Roberts. Art and Science of C. Addison Wesley; 1995.*
4. *Jeri Hanly and Elliot Koffman. Problem Solving and Program Design in C. Fifth Edition, Addison Wesley (Pearson); 2007.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS181	COMPUTER PROGRAMMING LAB	L-T-P-C: 0-0-3-1

Pre-Requisite(s): 19CSE100 Problem Solving and Algorithmic Thinking

Course Objectives

- This course provides the foundations of programming.
- Apart from the usual mechanics of a typical programming language, the principles and methods will form the focus of this course.
- Shift from learn to program programming to learn forms the core of this course.

Course Outcome

CO1: Understand the typical programming constructs: data (primitive and compound), control, modularity, recursion etc. thereby to understand a given program

CO2: Understand and analyze a given program by tracing, identifying coding errors and debugging them.

CO3: Make use of the programming constructs appropriately and effectively while developing computer programs.

CO4: Develop computer programs that implement suitable algorithms for problem scenarios and applications.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1							1						2
CO2	1	1	1					1						2
CO3	1	2	2					2					1	
CO4	2	3	2					3						2

Syllabus

Unit 1

Working with functions: Introduction to modular programming, writing functions, formal parameters, actual parameters Pass by Value, Recursion, types of recursions, Arrays as Function Parameters, Structure, Union, Storage Classes, simple programs using functions,

sorting algorithms, Sorting in multidimensional arrays. Sorting in strings. Search problem: Linear search and binary search. Recursive and Iterative formulations.

Unit 2

Pointers and Files- Basics of Pointer: declaring pointers, accessing data though pointers, NULL pointer, array access using pointers, pass by reference effect. Pointers and strings. String operations in C. Structures in C. Operations on structures. Passing structures as function arguments. type defining structures. Self-referential structures. Dynamic Data Structures.

Unit 3

File Operations: Sequential access and random access to files: File input-output in C. Streams. Input, output and error streams. Opening, closing and reading from files. In built file handling functions (rewind() ,fseek(), ftell(), feof(), fread(), fwrite()), simple programs covering pointers and files. Programming for command line arguments.

Textbook

Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Second Edition, Pearson, 2015.

Reference(s)

1. *E. Balaguruswamy, Programming in ANSI C, 8Th Edition, Tata McGraw-Hill Education; 2019*
2. *Byron Gottfried, Schaum's Outline of Programming with C, Fourth Edition, McGraw-Hill Education; 2018*
3. *Anita Goel and Ajay Mittal, Computer fundamentals and Programming in C, Pearson Education India; 2016*
4. *Rajaraman V, PHI, Computer Basics and Programming in C, Prentice-Hall of India Pvt.Ltd; 2008*
5. *Yashavant P, Kanetkar, Let us C, 16TH Edition, BPB Publications; 2017*

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS114	CYBER SECURITY ESSENTIALS	L-T-P-C: 2-0-3-3

Pre-Requisite(s): Nil

Course Objectives:

- Understand the field of digital security and concepts of access control mechanism.
- To introduce keywords and jargons involved in securing browser
- Understanding network basic and familiarize on security of network protocols
- Awareness and understanding on cyber-attacks and data privacy

Course Outcomes:

CO1: Apply a solid foundation in digital security and measures taken to protect device from threats.

CO2: Learning access control mechanism and understand how to protect servers

CO3: Understand the importance of a network basics and brief introduction on security of network protocols

CO4: To understand cyber-attacks and learn data privacy issues and preventive measures

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		1	2	1		1	3	2			1	2	3	1
CO2		2	2	2		1					1	2	3	1
CO3		1	2	3	2	2		1				2	3	2
CO4		1	3	3	3	3	3	3			1	3	3	3

Syllabus

Unit 1

Basics of digital security, protecting personal computers and devices, protecting devices from Virus and Malware, Identity, Authentication and Authorization, need for strong credentials, keeping credentials secure, protecting servers using physical and logical security, World Wide Web (www), the Internet and the HTTP protocol, security of browser to web server interaction,

Unit 2

Networking basics (home network and large-scale business networks), Networking protocols, Security of protocols, sample application hosted on-premises.

Unit 3

Introduction to cyber-attacks, application security (design, development and testing), operations security, monitoring, identifying threats and remediating them, Principles of data security - Confidentiality, Integrity and Availability, Data Privacy, Data breaches, preventing attacks and breaches with security controls, Compliance standards, Computer Ethics.

Textbooks

Sammons, John, and Michael Cross. The basics of cyber safety: computer and mobile device safety made easy. Elsevier, 2016.

References:

1. *Charles P. Pfleeger, Shari Lawrence, Pfleeger Jonathan Margulies; Security in Computing, Pearson Education Inc . 5th Edition, 2015*
2. *Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short. Cybersecurity essentials. John Wiley & Sons, 2018*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CUL111	CULTURAL EDUCATION - II	L-T-P-C: 2-0-0-2

Course Objective

- To deepen students' understanding and further their knowledge about the different aspects of Indian culture and heritage.
- To instill into students a dynamic awareness and understanding of their country's achievements and civilizing influences in various fields and at various epochs.

Course Outcome

CO1: Get an overview of Indian contribution to the world in the field of science and literature.

CO2: Understand the foundational concepts of ancient Indian education system.

CO3: Learn the important concepts of Vedas and Yoga sutras and their relevance to daily life.

CO4: Familiarize themselves with the inspirational characters and anecdotes from the Mahabharata and Bhagavad-Gita and Indian history.

CO5: Gain an understanding of Amma's role in the empowerment of women

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3	3					2		
CO2						1		3				2		
CO3						3	3	3				2		
CO4						3	3	3				2		
CO5						1		1						

Syllabus

Unit 1

To the World from India; Education System in India; Insights from Mahabharata; Human Personality. India's Scientific System for Personality Refinement.

Unit 2

The Vedas: An Overview; One God, Many Forms; Bhagavad Gita – The Handbook for Human Life; Examples of Karma Yoga in Modern India.

Unit 3

Chanakya's Guidelines for Successful Life; Role of Women; Conservations with Amma.

Textbook

Cultural Education Resource Material Semester-2

Reference Book(s)

1. *Cultural Heritage of India. R.C.Majumdar. Ramakrishna Mission Institute of Culture.*
2. *The Vedas. Swami Chandrashekhara Bharati. Bharatiya Vidya Bhavan.*
3. *Indian Culture and India's Future. Michel Danino. DK Publications.*
4. *The Beautiful Tree. Dharmapal. DK Publications.*
5. *India's Rebirth. Sri Aurobindo. Auroville Publications.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

SEMESTER III

20CYS201	OPTIMIZATION TECHNIQUES	L-T-P-C: 3-1-0-4

Pre-Requisite(s): Nil

Course Objectives

- To build an understanding of basics of optimization techniques
- To introduce basics of linear programming and meta-heuristic search techniques
- To understand the basics of an evolutionary computing paradigm known as genetic algorithms and its application to engineering optimization problems

Course Outcomes

CO1: Formulate mathematical models for optimization problems

CO2: Analyze the complexity of solutions to an optimization problem

CO3: Develop hybrid models to solve an optimization problem

CO4: Apply Evolutionary Computation Methods to find solutions to complex problems

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1										
CO2	3	3	2	1										
CO3	3	3	3	2										
CO4	3	3	3	2										

Syllabus

Unit 1

Introduction to optimization: optimal problem formulation, engineering optimization problems, optimization algorithms, numerical search for optimal solution.
Calculus: Single variable nonlinear optimization - Optimality criteria, maxima, minima and inflection point with problems, Multivariable nonlinear optimization- Optimality criteria, Hessian matrix, convexity and concavity of a function, global minima and maxima, local minima and maxima, and saddle point with problems.

Unit 2

Geometry of LPP, Simplex algorithm, two phases of Simplex method, Revised Simplex method, Duality in LPP, Dual simplex method

Unit 3

Region elimination methods: Interval halving method, Fibonacci search method, golden section search method. Point estimation method: successive quadratic search method.
Derivative based methods: Bisection method, Secant method, Newton's method.

Unit 4

Gradient based methods: Steepest descent method, Newton's method, Levenberg-Marquardt Method and Powell method.

Unit 5

Nature inspired optimization techniques: Genetic Algorithm (GA) (Genetic Operations on Binary Strings, Analysis of GA), Introduction to Particle Swarm Optimization and ant colony Optimisation.

Textbooks

Singiresu S. Rao. Engineering Optimization: Theory and Practice. Fifth edition. Wiley; 2019.

Reference books

1. *R.L. Burden, J. D. Faires, Numerical Analysis, 9th edition, Richard Stratton, 2011.*
2. *S.Haykin, Neural Networks: A Comprehensive Foundation. Upper Saddle River, NJ: Prentice Hall Inc, 1999.*
3. *D. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning. Reading, MA: Addison-Wesley, 1989.*
4. *S. Nayak, Fundamentals of Optimization Techniques with Algorithms, 1st edition, Academic Publisher, 2020.*
5. *Kalyanmoy Deb, Optimization for Engineering Design: Algorithms and Examples, Prentice Hall, 2002.*
6. *J. Zurada, Introduction to Artificial Neural Systems. St. Paul, MN: West Publishing Co., 1992.*
7. *D. Fogel, Evolutionary Computation. New York: IEEE Press, 1995.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS202	USER INTERFACE DESIGN	L-T-P-C: 1-0-3-2

Pre-Requisite(s): Nil

Course Objectives

- To impart the design, development and implementation of Dynamic Web Pages.
- To develop programs for Web using JavaScript
- To give an introduction to responsive web design
- To deploy web applications

Course Outcome

CO1: Understand the basics of World Wide Web.

CO2: Develop interactive Web pages using HTML

CO3: Present a professional document using Cascaded Style Sheets.

CO4: Construct websites for user interactions using JavaScript.

CO5: Develop and deploy web applications

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1												3	3
CO2	1	2						1	3				2	2
CO3	1	2						2	3	2			2	2
CO4	1	2						2	3				2	2
CO5	3	2	2					2	3	2	3		2	2

Syllabus

Unit 1

Introduction to Web – Client/Server - Web Server - Application Server- HTML Basics- Tags - Adding Web Links and Images-Creating Tables-Forms - Create a Simple Web Page - HTML 5 Elements - Media – Graphics.

Unit 2

CSS Basics – Features of CSS – Implementation of Borders - Backgrounds- CSS3 - Text Effects - Fonts - Page Layouts with CSS.
Responsive Web Design - Grid view, Media Queries, Images, Videos, frameworks and templates.

Unit 3

Introduction to Java Script – Form Validations – Event Handling – Document Object Model - Deploying an application.

Text Book(s)

1. *DT Editorial Services. HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery). Second Edition, Dreamtech Press; 2016.*
2. *Ben Frain. Responsive Web Design with HTML5 and CSS. Third Edition. Packt Publishing;2020.*

Reference(s)

1. *Ethan Marcotte, Responsive Web Design, Second Edition; 2014*
2. *Tittel E, Minnick C. Beginning HTML5 and CSS3 for Dummies. Third edition, John Wiley & Sons; 2013.*
3. *Powell TA, Schneider F. JavaScript: the complete reference. Paperback edition, Tata McGraw-Hill; 2012.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	10	
Continuous Assessment (Lab) (CAL)	40	
End Semester		30

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS203	OPERATING SYSTEMS	L-T-P-C: 3-0-0-3

Pre-Requisite(s): 20CYS103 - Computer Hardware and System Essentials

Course Objectives

- To introduce the structure and implementation of modern operating systems, virtual machines and their applications.
- To summarize techniques for achieving process synchronization and managing resources like memory, CPU, and files and directories in an operation system.
- To study common algorithms used for both pre-emptive and non-pre-emptive scheduling of tasks in operating systems (such a priority, performance comparison, and fair-share schemes) will be done.
- To give a broad overview of memory hierarchy and the schemes used by the operating systems to manage storage requirements efficiently.

Course Outcomes

CO1: Understand the architecture and functionalities of modern OS.

CO2: Understand and apply the algorithms for resource management and scheduling.

CO3: Analyze and apply semaphores and monitors for classical and real-world synchronization scenarios.

CO4: Engage in independent learning as a team to study characteristic features of modern operating systems.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1												3	1
CO2	2												3	2
CO3	2	2											2	2
CO4	3				2			2	3	2	2	2	2	3

Syllabus
Unit 1

Operating systems Services: Overview – hardware protection – operating systems services – system calls – system structure – virtual machines. Process and Processor management: Process concepts – process scheduling – operations on process – cooperating process – inter-process communication – multi threading models – threading issues – thread types – CPU scheduling – scheduling algorithms.

Unit 2

Process synchronization: critical section problem – synchronization hardware – semaphores – classical problems of synchronization – critical regions – monitors – deadlocks – deadlock characterization – methods of handling deadlocks – deadlock prevention – avoidance – detection and recovery. Memory management – swapping – contiguous memory allocation. Paging and segmentation – segmentation with paging – virtual memory – demand paging – process creation – page replacement – thrashing.

Unit 3

File management: File systems: directory structure – directory implementation – disk scheduling. Case study: threading concepts in operating systems, kernel structures.

Textbook(s)

Silberschatz A, Gagne G, Galvin PB. Operating System Concepts. Tenth Edition, Wiley; 2018.

Reference Book(s)

1. *Deitel HM, Deitel PJ, Choffnes DR. Operating systems. Third Edition, Prentice Hall; 2004.*
2. *Tannenbaum AS. Modern Operating Systems. Fourth Edition, Prentice Hall; 2016.*
3. *Stevens WR, Rago SA. Advanced programming in the UNIX environment. Second Edition, Addison-Wesley; 2008.*
4. *Nutt G. Operating systems. Third Edition, Addison Wesley; 2009.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS281	OPERATING SYSTEMS LAB	L-T-P-C: 0-0-3-1

Pre-Requisite(s): 20CYS203 Operating Systems, 20CYS103 Computer Hardware and System Essentials

Course Objectives:

- This course aims to provide the students an in-depth understanding of process management, inter process communication and implementation of various CPU scheduling algorithms.
- To impart an in-depth knowledge on semaphores, threads, deadlock, paging and page replacement techniques.
- To implement various file Organization methods and file allocation strategies.

Course Outcomes

CO1: Experiment with Linux commands

CO2: Implement program for file and process management using system calls

CO3: Choose the best CPU scheduling algorithm for a given problem instance

CO4: Identify the performance of various page replacement algorithms

CO5: Develop algorithm for deadlock avoidance, detection and file allocation strategies

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	3				1	1	1		2	2
CO2	2	2	2	1	3				1	2	1		3	3
CO3	2	2	2	1	3				1	2	1		2	3
CO4	1	2	1	2	3				2	1	1		3	2
CO5	2	2	2	2	3				1	1	1		3	3

Syllabus

Unit 1

Basics of Linux Commands: Simulation of linux commands like cp, ls, grep - Exploring System calls: fork, exec, getpid, exit, wait, close, stat, opendir, readdir etc. - Shell Programming: I/O, Decision making, Looping, Multi-level branching – Virtualization: Implementation of OS / Server Virtualization - Threads: Building multi-threaded and multi-process applications - CPU Scheduling algorithms: Implementation of Round Robin, Shortest Job First, first come first served.

Unit 2

Semaphores: Implementation of Semaphores – Implementation of Shared memory, IPC. Deadlock: Bankers Algorithm for Deadlock Avoidance, Implementation of Deadlock Detection Algorithm. CPU Synchronization: Implementation of threading and synchronization applications. Memory Allocation Methods for fixed partition: First Fit, Worst Fit, Best Fit. Paging: Implementation of Paging Technique, Page Replacement Algorithms: First in First Out (FIFO), Least recently used (LRU), least frequently used (LFU).

Unit 3

File Organization: Implementation of the various File Organization Techniques (Single level directory, two level, Hierarchical, DAG) - File Allocation Strategies: Sequential, Indexed, Linked.

Textbook(s)

Silberschatz A, Gagne G, Galvin PB. Operating system concepts. Tenth Edition, John Wiley and Sons; 2018.

Reference Book(s)

1. *Garry. J. Nutt, Operating Systems: A Modern Perspective, Third Edition, Addison-Wesley; 2012*
2. *Andrew S. Tanenbaum and Herbert Bros, Modern Operating Systems, Fourth Edition, Pearson; 2015*
3. *Russ Cox, Frans Kaashoek, Robert Morris, xv6: a simple, Unix-like teaching operating system; 2020*
4. *Sumitabha Das, UNIX Concepts and Applications, Fourth Edition, Tata McGraw-Hill Education; 2017*

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CSE201	ADVANCED PROGRAMMING	L-T-P-C: 2-0-3-3

Pre-Requisite(s): 20CYS113 Computer Programming

Course Objectives

- Primary objective of this course is to introduce advanced programming concepts such as Object-oriented paradigm, advanced pointers etc.
- This course focuses on learning Python and C++ with an emphasize on ADT and STL usage for implementing data structures.

Course Outcomes

CO1: Understand the static object-oriented programming concepts and thereby to understand a given program.

CO2: Understand the dynamic object-oriented programming concepts and thereby to understand a given program.

CO3: Implement ADT in static and dynamic object-oriented paradigm.

CO4: Analyze the similarities, differences and code efficiency among object-oriented programming languages.

CO5: Develop computer programs that implement suitable algorithms for given problem scenario and applications.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1				3								3	2
CO2	1				3								3	2
CO3	2	3	2		3			2					3	2
CO4	1	2	2		3			2					3	2
CO5	2	3	2		3			3					3	2

Syllabus

Unit 1

Overview of Object-Oriented Paradigm, Programming in C++: Objects as a group of variables, Classes as a named group of methods and data, morphing from structures to classes, Input and Output, Access Specifiers, Member functions: Accessor, Mutator and Auxiliary, Constructors and Destructors, New and Delete Operators, Overloading, Inheritance: Handling Access and Specialization through Overriding, Polymorphism: Virtual Functions, Abstract Class and Virtual Function Tables.

Unit 2

Revisiting Pointers: Pointers to Pointers, Pointers and String Array, Void Pointers and Function Pointers, Standard Template Library, Implementation of Stack, Queue, Hash Table and Linked Lists with STL. Basic Python: Multi-paradigm language, Data Types and Variables, Indentation, Input and Output statements, Lists and Strings, Deep and Shallow Copy, Tuples and Dictionaries, Set and Frozen Sets, Control Statements and Loops, Iterators and Iterable, Functions, Recursion and Parameter Passing, Namespaces and Variable Scope, Exception Handling.

Unit 3

Object Oriented Concepts in Python: Class, Instance Attributes, Getters, Setters, Inheritance, Multiple Inheritance, Magic Methods and Operator Overloading, Class Creation, Slots, Meta Classes and Abstract Classes, Implementation of Stack, Queue, Hash Table and Linked Lists.

Text Book(s)

1. *Stroustrup B. Programming: principles and practice using C++. Second edition, Addison Wesley; 2014.*
2. *Charles R. Severance. Python for Everybody: Exploring Data Using Python 3, Charles Severance; 2016.*

Reference(s)

1. *Guttag J. Introduction to Computation and Programming Using Python: With Application to Understanding Data. Second Edition.MIT Press; 2016.*
2. *Gaddis T. Starting out with Python. Third Edition, Pearson; 2014.*

3. *Lambert KA. Fundamentals of Python: first programs. Second Edition, Cengage Learning; 2018.*
4. *Downey AB. Think Python: How to Think Like a Computer Scientist. O'Reilly Media; 2012.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS204	DATABASE MANAGEMENT SYSTEMS	L-T-P-C: 2-0-3-3

Pre-Requisite(s): Nil

Course Objective

- To understand the concepts of database design, database languages.
- To understand database-system implementation and maintenance.
- To expose to some of the recent trends in databases.

Course Outcomes

CO1: Formulate and apply relational algebraic expressions, SQL and PL/SQL statements to query relational databases.

CO2: Design and build ER models for real world databases.

CO3: Design and build a normalized database management system for real world databases.

CO4: Understand and apply the principles of transaction processing and concurrency control.

CO5: To learn different high-level databases and selection of right database.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3								3	2
CO2	1	3	3	3	3								3	2
CO3	2	3	2	3	3			2			2	2	3	2
CO4	1	1		2	2								3	2
CO5	1	1											1	2

Syllabus

Unit 1

Introduction: Overview of DBMS fundamentals – Overview of Relational Databases and Keys. Relational Data Model: Structure of relational databases – Database schema – Formal Relational Query Languages – Overview of Relational Algebra and Relational Operations. Database Design: Overview of the design process - The E-R Models – Constraints - Removing Redundant Attributes in Entity Sets - E-R Diagrams - Reduction to Relational Schemas - Entity

Relationship Design Issues - Extended E-R Features – Alternative E-R Notations – Overview of Unified Modelling Language (UML).

Unit 2

Relational Database Design: Features of Good Relational Designs - Atomic Domains and 1NF - Decomposition using Functional Dependencies: 2NF, 3NF, BCNF and Higher Normal Forms. Functional Dependency Theory - Algorithm for Decomposition – Decomposition using multi-valued dependency: 4NF and 4NF decomposition. Database design process and its issues. SQL: review of SQL – Intermediate SQL – Advanced SQL.

Unit 3

Case Study: Different types of high-level databases – MongoDB, Hadoop/Hbase, Redis, IBM Cloudant, DynamoDB, Cassandra and CouchDB etc. Tips for choosing the right database for the given problem.

Text Book (s)

Silberschatz A, Korth HF, Sudharshan S. *Database System Concepts. Sixth Edition, McGraw Hill; 2013.*

Reference(s)

1. *Garcia-Molina H, Ullman JD, Widom J. Database System ; The complete book. Second Edition, Pearson Education India, 2011.*
2. *Elmasri R, Navathe SB. Fundamentals of Database Systems. Fifth Edition, Addison Wesley; 2006.*
3. *Ramakrishnan R, Gehrke J. Database Management Systems. Third Edition, TMH; 2003.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS205	MODERN CRYPTOGRAPHY	L-T-P-C: 3-1-0-4

Pre-Requisite(s): 20CYS101 Classical Cryptography

Course Objective

- To introduce the basic terminology, concepts, and standards of cryptography.
- Familiarize students with the main approaches, algorithms, and protocols in modern cryptography.
- To explain the principles and underlying mathematical theory of today's cryptographic algorithms.
- To provide an understanding of potential weaknesses and problems with ciphers

Course Outcomes

CO1: Understand the concepts of symmetric cryptosystem.

CO2: Understand different techniques for message integrity.

CO3: Understand the concepts of public key cryptosystem.

CO4: Understand the concept of digital signatures.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2												3	3
CO2	2	2	2					1					3	3
CO3	2	1											3	3
CO4	2	1						2					3	3

Syllabus:

Stream ciphers: Pseudo-random generators, Attacks on the one-time pad, Linear generators, Cryptanalysis of linear congruential generators, Block ciphers: Pseudorandom functions and permutations, DES, AES, modes of operation. Message integrity: Cryptographic hash functions, message authentication code, CBC MAC and its security, Cryptographic hash functions-based MACs, SHA512, SHA3. Public key encryption: RSA, Rabin, Knapsack cryptosystems, Diffie-Hellman key exchange protocol, ElGamal encryption, Elliptic curve cryptography. Digital signatures: Generic signature schemes, RSA, ElGamal, ECDSA

Textbooks:

Douglas Robert Stinson, Maura Paterson. Cryptography: Theory and Practice (Textbooks in Mathematics). Fourth Edition. Chapman and Hall/CRC;2018.

Reference Books:

1. *William Stallings, Cryptography and Network Security Principles and Practices, Seventh edition, Pearson; 2017*
2. *Wade Trappe, Lawrence C Washington, Introduction to Cryptography with coding theory, Pearson; 2006*
3. *W. Mao, Modern Cryptography – Theory and Practice, Pearson Education; 2004*
4. *Charles P. Pfleeger, Shari Lawrence Pfleeger, Security in computing, Fifth Edition, Prentice Hall of India; 2015*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19AVP201	AMRITA VALUE PROGRAM	L-T-P-C:1-0-0-1

Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Course Outcome

CO1: Understanding the impact of itihasas on Indian civilization with a special reference to the Adiparva of Mahabharata

CO2: Enabling students to importance of fighting adharma for the welfare of the society through Sabha and Vanaparva.

CO3: Understanding the nuances of dharma through the contrast between noble and ignoble characters of the epic as depicted in the Vana, Virata, Udyoga and Bhishmaparvas.

CO4: Getting the deeper understanding of the Yuddha Dharma through the subsequent Parvas viz., Drona, Karna, Shalya, Sauptika Parvas.

CO5: Making the students appreciative of spiritual instruction on the ultimate triumph of dharma through the presentations of the important episodes of the MB with special light on Shanti, Anushasana, Ashwamedhika, Ashramavasika, Mausala, Mahaprasthanika and Swargarohana Parvas.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2	2	3	3	3		3		
CO2						3	3	3	3	2		3		
CO3						3	2	3	3	3		3		
CO4						3		3	3	3		3		
CO5						3		3	3	2		3		

Courses offered under the framework of Amrita Values Programmes I and II

Message from Amma's Life for the Modern World

Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

Lessons from the Ramayana

Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

Lessons from the Mahabharata

Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

Lessons from the Upanishads

Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, SatyakamaJabala, Aruni, Shvetaketu.

Message of the Bhagavad Gita

Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar - Relevance of Mahabharata for modern times.

Life and Message of Swami Vivekananda

Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji's life.

Life and Teachings of Spiritual Masters India

Sri Rama, Sri Krishna, Sri Buddha, AdiShankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri RamanaMaharshi, Mata Amritanandamayi Devi.

Insights into Indian Arts and Literature

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

Kerala Mural Art and Painting

Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Course on Organic Farming and Sustainability

Organic farming is emerging as an important segment of human sustainability and healthy life. Haritamritam' is an attempt to empower the youth with basic skills in tradition of organic farming and to revive the culture of growing vegetables that one consumes, without using chemicals and pesticides. Growth of Agriculture through such positive initiatives will go a long way in nation development. In Amma's words "it is a big step in restoring the lost harmony of nature".

Benefits of Indian Medicinal Systems

Indian medicinal systems are one of the most ancient in the world. Even today society continues to derive enormous benefits from the wealth of knowledge in Ayurveda of which is recognised as a viable and sustainable medicinal tradition. This course will expose students to the fundamental principles and philosophy of Ayurveda and other Indian medicinal traditions.

Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is 'Únity in Diversity" and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

Science of Worship in India

Indian mode of worship is unique among the world civilisations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realisation of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

Text Books/References:

1. *Rajagopalachari. C, The Ramayana*
2. *Valmiki, The Ramayana, Gita Press*

SEMESTER IV

20CYS211	PROBABILITY AND STATISTICS	L-T-P-C:3-1-0-4

Pre-Requisite(s): Nil

Course Objectives

- To introduce the modern theory of probability, statistics and its applications to modeling and analysis of stochastic systems.
- To understand the important models of discrete and continuous probability distributions and widely used models of sampling distributions.
- To know important applications of probability and statistics in engineering as indispensable tools in decision analysis**.**

Course Outcome

CO1: Understand the concept of probability and its features.

CO2:. Identify the characteristics of different discrete and continuous probability distributions**.**

CO3: Identify the type of statistical situation to which different distributions can be applied

CO4: Apply and calculate expected value and moments

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1		1									3	3
CO2	3	1		2									3	3
CO3	3			1									2	2
CO4	3			1									3	3

Syllabus

Unit 1

Sample Space and Events, Interpretations and Axioms of Probability, Addition rules, Conditional Probability, Multiplication and Total Probability rules, Independence, Bayes theorem.

Unit 2

Random variables, Probability Distributions and Probability mass functions, Cumulative Distribution functions, mathematical expectation, variance, moments, and moment generating function.

Unit 3

Standard discrete distributions - Binomial, Poisson, Uniform, Geometric distributions, Negative binomial and Hypergeometric Distributions -Standard continuous distributions - Uniform, Exponential, Gamma, Beta and Normal distributions. Chebyshev's theorem.

Unit 4

Two dimensional random variables-Joint, marginal and conditional probability distributions for discrete and continuous cases, independence, expectation of two-dimensional random variables - conditional mean, conditional variance, covariance and correlation.

Unit 5

Theory of estimation, Point Estimation, Minimum Variance Unbiased Estimate, Standard Error, Maximum Likelihood Estimation method, Bayesian Estimation of Parameters, Statistical Interval for Mean and Variance, Test of Hypothesis for Single Sample – Mean, Variance. Statistical Inference of Two Samples, Inference for the Difference of Two Means, Inference on two variances. Sampling Distributions

Textbooks:

Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers. Seventh Edition. Wiley;2018.

Reference books:

1. *Ross S.M., Introduction to Probability and Statistics for Engineers and Scientists, 3rd edition, Elsevier Academic Press; 2004*
2. *Kreyszig, Erwin. Advanced Engineering Mathematics, Tenth Edition, Wiley; 2010*
3. *Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, Eighth Edition, Pearson Education Asia; 2007.*
4. *Amir D Azcel, Jayavel Sounderpandian, Palanisamy Saravanan and Rohit Joshi, Complete Business Statistics, Seventh Edition McGraw Hill education; 2012*
5. *Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS212	MULTIMEDIA PROCESSING	L-T-P-C:2-0-3-3

Pre-Requisite(s): 20CYS111 Digital Signal Processing**,** 20MAT102 Linear Algebra

Course Objectives

- To study the image fundamentals and mathematical transforms necessary for image transform.
- To study the image processing techniques like image enhancement, image reconstruction, image compression, image segmentation and image representation.

Course Outcomes

CO1: Understand fundamental principles of image processing and perform basic operations on pixels.

CO2: Apply the image processing algorithms and filters in spatial domain for image enhancement and restoration.

CO3: Analyze images in the frequency domain and explore the frequency domain filters for image enhancement and restoration.

CO4: Apply segmentation algorithms on Images and analyze their performance.

CO5: Apply morphological processing on images for simple image processing applications.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1				2								1	1
CO2	2			1	3				2	2	2		2	2
CO3	2	2			3				2	2	2		3	2
CO4	2			2	3				2	2	2		2	3
CO5	2				3				2	2	2		2	2

Syllabus

Unit 1

Digital Image Fundamentals: Elements of Visual Perception- Image Sensing and Acquisition- Image Sampling and Quantization – Basic Relationships between Pixels - Image interpolation.

Multimedia Data - Discrete and Continuous Media, Analog and Digital Signals: Analog/Digital Converter, Text and Static Data, Audio- digitizing Sound, noise cancelation, Graphics, Video, Digital Sampling: Nyquist's theorem. Intensity Transformations - spatial filtering-smoothing and sharpening spatial filters.

Unit 2

Filtering in frequency domain- Fourier transform of two variables, smoothing and sharpening using frequency domain. Restoration: Noise Models – Restoration using Spatial Filters. Morphological Image Processing: Erosion – Dilation, Erosion, Opening, Closing on Binary Images. Image Segmentation: Fundamentals – Point, Line and Edge Detection – Thresholding - Region Based Segmentation – Region Growing.

Unit 3

Basic Image compression methods: Simple coding schemes, Frequency based coding - Huffman coding, Relative encoding, Run length encoding, LZW compression - Image and video compression standards -MJPEG, MPEG2, MPEG4, H.264, H.26. Color image processing.

Textbook(s)

Gonzalez RC, Woods RE. Digital Image Processing. Third edition. Pearson Education India ;2016.

Reference(s)

1. *Castleman K R. Digital Image Processing, Prentice Hall;1996.*
2. *Li, Ze-Nian, Mark S. Drew, and Jiangchuan Liu. Fundamentals of multimedia. Upper Saddle River (NJ) Pearson Prentice Hall, 2004.*
3. *Russ JC, Russ JC. Introduction to Image Processing and Analysis.CRC press; 2007*
4. *Joan, L. M., J. L. Didier, and F. Chad. MPEG video compression standard, Digital multimedia standards series.1996.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS213	SYSTEM SECURITY	L-T-P-C:3-0-0-3

Pre-Requisite(s): 20CYS203 Operating System and 20CYS204 Database Management System

Course Objectives

- Capable of analysing, evaluating and enhancing the security of information systems by identifying potential threats and possible countermeasures in the field of database and system security.

Course Outcome:

CO1: A quick refresher to the fundamentals of Database and Operating Systems

CO2: Exploring access control security models and policies in database and operating systems

CO3: Familiarize the Challenges, Attacks and Defences in Database Systems

CO4: Exploring the basic functionalities of different types of Malwares

CO5: Familiarize the Challenges, Attacks and Defences in Operating Systems

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				3	1		2						3	1
CO2				3	1		2						3	1
CO3				3	1		2						3	1
CO4				3	1		2						3	1
CO5				3	1		2						3	1

Syllabus:

Program vs processes, Transaction recovery and concurrency control in database systems- Schedule, Concurrency control protocols, Deadlock handling. Access control mechanisms in general computing systems - Lampson's access control matrix. Mandatory access control, Authentication mechanisms in databases, DAC, MAC, RBAC, SELinux. Auditing in databases, Statistical inferencing in databases, Private information retrieval viewed as a database access problem. Privacy in data publishing, Virtual Private Databases, Hadoop security. Security and protection in operating systems - access control, auditing, trusted computing base with reference to Multics and the commercial Operating Systems Malware analysis and protection- viruses, worms and Trojans, Rootkits, Ransomware, Polymorphic

malware, Malware capture and analysis using honeypots. Common vulnerabilities and Exposures, Secure system configuration, Minimal footprint, Security of booting, Trusted computing, Virtualization techniques for security, Mobile Operating Systems security especially in Android.

Textbooks:

1. *Charles P. Pfleeger and Shari Lawrence Pfleeger, Security in computing, Prentice Hall Professional Technical Reference, Fourth Edition; 2006.*
2. *Michael Palmer, Guide to Operating System Security, Cengage Learning; Second Edition; 2019*

References

1. *M. Gertz and S. Jajodia, Handbook of Database Security-Applications and Trends, Springer; 2008.*
2. *T. Jaeger, Operating System Security, Vol. 1 of Synthesis Lectures on Information Security, Privacy and Trust, Morgan & Claypool Publishers; 2008.*
3. *W. Mauerer, Professional Linux Kernel Architecture, John Wiley and Sons, New York; 2008.*
4. *R Anderson, Security engineering, John Wiley & Sons; 2008.*
5. *Matt Bishop, Computer security: Art and Science, Vol. 2, Addison-Wesley; 2012.*
6. *E. Nikolay, Android Security Internals: An In-Depth Guide to Android's Security Architecture, No Starch Press; 2014.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS282	SYSTEM SECURITY LAB	L-T-P-C:0-0-3-1

Pre-Requisite(s): 20CYS203 Operating System and 20CYS204 Database Management System

Course Objectives

- To experiment with various security vulnerabilities, attacks and countermeasures in OS and Databases

Course Outcome:

CO1: Experimenting with fundamentals of Database and Operating Systems

CO2: Experimenting with access control models in Database and Operating Systems

CO3: Exploring Challenges, Attacks and Defences in Database Systems with demonstration

CO4: Exploring the basic functionalities of different types of Malwares

CO5: Exploring Challenges, Attacks and Defences in Operating Systems with demonstration

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				1	3		1						1	3
CO2				1	3		1						1	3
CO3				1	3		1						1	3
CO4				1	3		1						1	3
CO5				1	3		1						1	3

List of Experiments:

1. Exploring the concepts of binaries, libraries (static and dynamic) and Makefile
2. Implementing the discretionary access control mechanism in operating Systems (linux)
3. Implementing the discretionary access control mechanism in databases (mysql)
4. Linux Virtualization (Chroot)
5. Implementing the mandatory access control mechanism (SElinux or AppArmor)
6. Virtual private databases (Oracle label Security)
7. Exploring different types of Malwares and analysis (Static, Dynamic tools and Cuckoo sandbox)

8. Exploring the Honeypot IDS(KFSensor)
9. Exploring the file system of Android Mobile operating system and Malware Analysis (MobSF)

Textbook:

1. *Charles P. Pfleeger and Shari Lawrence Pfleeger, Security in computing, Prentice Hall Professional Technical Reference, 4th Edition, 2006*
2. *Michael Palmer, Guide to Operating System Security, Cengage Learning; 2nd edition (January 1, 2019)*

Reference:

1. *Oracle Label Security, https://www.oracle.com/in/database/technologies/security/label-security.html*
2. *Cuckoo Sandbox, https://cuckoosandbox.org/*
3. *KFSensor, http://www.keyfocus.net/kfsensor/*
4. *MobSF, https://www.cyberpunk.rs/mobile-security-framework-mobsf*

Evaluation Pattern:

Assessment	Internal	External
Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS215	MACHINE LEARNING IN CYBER SECURITY	L-T-P-C:2-0-3-3

Pre-Requisite(s): 20MAT102 Linear Algebra, 20CYS211 Probability and Statistics

Course Objectives

- The aim of this course is to provide foundational knowledge in machine learning.
- The students will learn to implement, train and validate the machine learning models and understand the recent algorithms in machine learning through case studies.

Course Outcomes

CO1: Understand issues and challenges of machine learning: data, model selection, model complexity.

CO2: Design and implement various machine learning algorithms in a range of real-world applications.

CO3: Understand strengths and weaknesses of many popular machine learning approaches.

CO4: Analyse the underlying mathematical relationships within and across Machine Learning algorithms.

CO5: Apply the paradigms of supervised and un-supervised learning on use cases of security.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2			2								2	2
CO2	2	2		2	3	3	3	2	2	2			2	2
CO3	2	2			3				2	2			3	2
CO4	2	2			3				2	2			2	3
CO5	2	2			3				2	2			2	2

Syllabus

Unit 1

Foundations of supervised learning - Decision trees and inductive bias, Regression Vs Classification, Supervised: Linear Regression, Logistic Regression, Generalisation, Training, Validation and Testing, Problem of Overfitting, Bias vs Variance, Performance metrics,

Decision Tree, Random Forest, Perceptron, Beyond binary classification. Case study: Anomaly detection

Unit 2

Advanced supervised learning - Naive Bayes, Bayesian Belief Network, K-Nearest Neighbour, Support vector machines, Markov model, Hidden Markov Model, Parameter Estimation: MLE and Bayesian Estimate, Expectation Maximisation, Neural Networks.

Unit 3

Unsupervised Learning: Curse of Dimensionality, Dimensionality Reduction Techniques, Principal component analysis, Linear Discriminant Analysis Clustering: K-means, Hierarchical, Spectral, subspace clustering, association rule mining. Case Study: Spam filtering /machine learning for end point protection/network protection/ Application security

Text Book(s)

Tom Mitchell. Machine Learning. First Edition McGraw Hill Education; 2017.

Reference(s)

1. *Christopher M Bishop. Pattern Recognition and Machine Learning. Springer 2010*
2. *Richard O. Duda, Peter E. Hart, David G. Stork. Pattern Classification. Wiley, Second Edition;2007*
3. *Kevin P. Murphey. Machine Learning, a probabilistic perspective. The MIT Press Cambridge, Massachusetts, 2012.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS214	DATA STRUCTURES AND ALGORITHMS	L-T-P-C:3-0-0-3

Pre-Requisite(s): 20CYS113 Computer Programming

Course Objectives

- This course aims to provide the students an in-depth understanding of structure and implementation of the common data structures used in computer science.
- It imparts the ability to solve problems by choosing and applying the right data structures.
- It also imparts the ability to improve the efficiency of programs by applying the right data structures.

Course Outcomes

CO1: Understand the linear data structures – Stacks, Queue and Linked List and their functionalities.

CO2: Understand the non-linear data structures – Trees and Graphs and their functionalities.

CO3: To impart familiarity with various sorting, searching and hashing techniques.

CO4: Develop skills to identify and apply appropriate data structures to solve problems and improve their efficiency.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		1		3			3					3	
CO2	3	3	3	2										3
CO3	1	3	1	1									2	3
CO4	2	2	2	2	3			3					2	2

Syllabus

Unit 1

Introduction to Data Structures - Abstract Data Types and Data Structures - Principles, and Patterns. Sorting and Selection – Linear Sorting –Divide and Conquer based sorting - Merge Sort - Quick Sort. Arrays and sparse matrices representation, Linked Lists and Recursion: Using Arrays - Lists - Array based List Implementation – Linked Lists – LL ADT – Singly Linked List – Doubly Linked List – Circular Linked List Stacks and Queues: Stack ADT - Array based Stacks, Linked Stacks – Implementing Recursion using Stacks, Stack Applications. Queues - ADT, Array based Queue, Linked Queue, Double-ended queue, Circular queue, applications.

Unit 2

Trees: Tree Definition and Properties – Tree ADT - Basic tree traversals - Binary tree - Data structure for representing trees – Linked Structure for Binary Tree – Array based implementation. Introduction to Merkle Trees and Dat – Data distribution tool. Priority queues: ADT – Implementing Priority Queue using List – Heaps. Maps and Dictionaries: Map ADT – List based Implementation – Hash Tables - Dictionary ADT, Bloom filter and its variance. Skip Lists – Implementation – Complexity.

Unit 3

Search trees – Binary search tree, AVL tree, tries- splay trees, 2-3 Trees. Threaded binary trees, Tree based indexing- B trees and B+ trees. Implementation. External Memory Sorting and Searching. Graphs: ADT- Data structure for graphs - Graph traversal- Transitive Closure- Directed Acyclic graphs - Weighted graphs – Shortest Paths - Minimum spanning tree – Greedy Methods for MST.

Text Book

Goodrich MT, Tamassia R, Goldwasser MH. Data Structures and Algorithms in Python. John Wiley & Sons Ltd; 2013.

Reference(s)

1. *Goodrich MT, Tamassia R, Goldwasser MH. Data Structures and Algorithms in Java. Sixth edition, John Wiley & Sons Ltd; 2014.*
2. *Tremblay JP, Sorenson PG. An Introduction to Data Structures with Applications. Second Edition, McGraw Hill Education; 2017.*
3. *Shaffer CA. Data Structures and Algorithm Analysis in JAVA. Third Edition, Dover Publications; 2011.*
4. *Robert Lafore, Data Structures and Algorithms in JAVA, Second Edition, Pearson; 2017.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS283	DATA STRUCTURES AND ALGORITHMS LAB	L-T-P-C:0-0-3-1

Pre-Requisite(s): 20CYS181 Computer Programming Lab

Course Objectives

- To implement basic linear and non-linear data structures and their major operations.
- To implement applications using right data structures.
- To implement algorithms for various sorting techniques

Course Outcomes

CO1: Implementing concepts and functionalities of Data Structures efficiently.

CO2: Analyzing the time complexity of implemented algorithms.

CO3: Implement linear and non-linear data structures using linked lists.

CO4: Design and apply various data structure such as stacks, queues, trees, graphs, etc. to solve various computing problems.

CO5: Implement various kinds of searching and sorting techniques.

CO6: Identify and use a suitable data structure and algorithm to solve a real-world problem

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2												1	
CO2			3	2									3	
CO3	2		3										3	
CO4	1		2	3									2	1
CO5	1	2	2	1									1	2
CO6			3	2									2	2

Syllabus

List of data structures and algorithms to be implemented:

1. Implementation of linear sorting, and Divide and Conquer based sorting algorithms
2. Array and Linked list implementation of List, Stack and Queue ADTs.
3. Doubly linked list and circular linked list
4. Applications of List, Stack and Queue ADTs.

5. Array based and linked structure-based implementation of Binary Tree operations
6. Implementation of Merkle Trees
7. Implementation of priority queues-heaps
8. List based implementation of hash tables
9. Implementation of skip lists
10. Implementation of binary search trees, AVL trees and Splay trees
11. Implementation of graph traversals

Text Book

Goodrich MT, Tamassia R, Goldwasser MH. Data Structures and Algorithms in Python. John Wiley & Sons Ltd; 2013.

Reference(s)

1. *Tremblay JP, Sorenson PG. An Introduction to Data Structures with Applications. Second Edition, McGraw Hill Education; 2017.*
2. *Bradley N Miller, David L Ranum, Problem Solving with Algorithms and Data Structures Using Python. Franklin, Beedle and Associates; 2006.*

Evaluation Pattern

Assessment	Internal	External
*Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS383	JAVA PROGRAMMING LAB	L-T-P-C:0-0-3-1

Pre-Requisite(s): Nil

Course Objectives

- To build software development skills using java programming for real world applications.
- To implement concurrency using Threads
- To use Collections in JAVA

Course Outcome

CO1: Execute Java programs using object-oriented class structures with parameters, constructors, and utility and calculations methods, including inheritance, test classes and exception handling.

CO2: Execute Java programs manipulating Strings and text documents.

CO3: Execute Java programs that include GUIs and event driven programming.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		1	1	3		1		1		1		2	2
CO2	2		2	1	3		1		1		1		2	2
CO3	2		2	1	3		1		1		1		2	2

Syllabus

Unit 1

Introduction to Java, Classes and Objects: create, initialize, use and delete, Interfaces: Define, Implement, Typing, Extending/Evolving Interface, Annotations, Inheritance, overriding and hiding methods: static, interface and instance methods. Polymorphism, Hiding Fields, Object Class, Final Class and Methods, Abstract class and methods, Interfaces and Packages.

Unit 2

Wrapper classes, String, and StringBuilder classes, Number, Math, Random, Array methods, Date-Time. Java files and I/O, Exceptions, Inner classes. Collection framework- Comparator and Comparable, Vector and Array list, Iterator and Iterable, Collection Interfaces: Collection, Set, List, Queue, Dequeue, Map, Object ordering, Sorted Set, Sorted Map, Generics, Serialization, Networking.

Unit 3

Concurrency Creating Threads, Thread states, Runnable threads, Coordinating Threads, Interrupting Threads, Multi-threading, Runnable Interface. UI integration of Java concepts with Swing – Frame Layouts, Widgets, displaying image and graphics, Applet basics.

Text Book(s)

1. *Deitel PJ. Java how to program. Eleventh Edition, Pearson; 2018.*
2. *Naughton P. and Schildt H. Java 2: The complete reference. Eighth Edition, Tata McGraw- Hill; 2011.*

Reference(s)

1. *Campione and Walrath, The Java Tutorial, Addison Wesely; 1996.*
2. *Barry Burd, Beginning Programming with Java for Dummies, 5th Edition; 2017*

Evaluation Pattern

Assessment	Internal	External
*Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19AVP211	AMRITA VALUE PROGRAM II	L-T-P-C:1-0-0-1

Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Course Outcome

CO1: Understanding the impact of itihasas on Indian civilization with a special reference to the Adiparva of Mahabharata

CO2: Enabling students to importance of fighting adharma for the welfare of the society through Sabha and Vanaparva.

CO3: Understanding the nuances of dharma through the contrast between noble and ignoble characters of the epic as depicted in the Vana, Virata, Udyoga and Bhishmaparvas.

CO4: Getting the deeper understanding of the Yuddha Dharma through the subsequent Parvas viz., Drona, Karna, Shalya, Sauptika Parvas.

CO5: Making the students appreciative of spiritual instruction on the ultimate triumph of dharma through the presentations of the important episodes of the MB with special light on Shanti, Anushasana, Ashwamedhika, Ashramavasika, Mausala, Mahaprasthanika and Swargarohana Parvas.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2	2	3	3	3		3		
CO2						3	3	3	3	2		3		
CO3						3	2	3	3	3		3		
CO4						3		3	3	3		3		
CO5						3		3	3	2		3		

Courses offered under the framework of Amrita Values Programmes I and II

Message from Amma's Life for the Modern World

Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

Lessons from the Ramayana

Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

Lessons from the Mahabharata

Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

Lessons from the Upanishads

Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, SatyakamaJabala, Aruni, Shvetaketu.

Message of the Bhagavad Gita

Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar - Relevance of Mahabharata for modern times.

Life and Message of Swami Vivekananda

Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji's life.

Life and Teachings of Spiritual Masters India

Sri Rama, Sri Krishna, Sri Buddha, AdiShankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri RamanaMaharshi, Mata Amritanandamayi Devi.

Insights into Indian Arts and Literature

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

Kerala Mural Art and Painting

Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Course on Organic Farming and Sustainability

Organic farming is emerging as an important segment of human sustainability and healthy life. Haritamritam' is an attempt to empower the youth with basic skills in tradition of organic farming and to revive the culture of growing vegetables that one consumes, without using chemicals and pesticides. Growth of Agriculture through such positive initiatives will go a long way in nation development. In Amma's words "it is a big step in restoring the lost harmony of nature"

Benefits of Indian Medicinal Systems

Indian medicinal systems are one of the most ancient in the world. Even today society continues to derive enormous benefits from the wealth of knowledge in Ayurveda of which is recognised as a viable and sustainable medicinal tradition. This course will expose students to the fundamental principles and philosophy of Ayurveda and other Indian medicinal traditions.

Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is "Unity in Diversity" and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

Science of Worship in India

Indian mode of worship is unique among the world civilisations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realisation of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

Text Books/References:

1. *Rajagopalachari. C, The Ramayana*
2. *Valmiki, The Ramayana, Gita Press*

19SSK211	SOFT SKILLS - I	L-T-P-C:1-0-3-2

Course Outcome

CO1 - Soft Skills: At the end of the course, the students would have developed self-confidence and positive attitude necessary to compete and challenge themselves. They would also be able to analyses and manage their emotions to face real life situations.

CO2 - Soft Skills: At the end of the course, the students would hone their presentation skills by understanding the nuances of content creation, effective delivery, use of appropriate body language and the art of overcoming nervousness to create an impact in the minds of a target audience.

CO3 - Aptitude: At the end of the course, the student will have acquired the ability to analyze, understand and classify questions under arithmetic, algebra and logical reasoning and solve them employing the most suitable methods. They will be able to analyze, compare and arrive at conclusions for data analysis questions.

CO4 – Verbal: At the end of the course, the students will have the ability to dissect polysyllabic words, infer the meaning, inspect, classify, contextualize and use them effectively.

CO5 - Verbal: At the end of the course, the students will have the ability to understand the nuances of English grammar and apply them effectively.

CO6 – Verbal: At the end of the course, the students will have the ability to identify, analyse and interpret relationship between words and use the process of elimination to arrive at the answer. They will also have the ability to judge, evaluate, summarise, criticise, present and defend their perceptions convincingly.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								2	3	3		3		
CO2									2	3		3		
CO3		3		2										
CO4										3		3		
CO5									3	3		3		
CO6										3		3		

Soft skills and its importance: Pleasure and pains of transition from an academic environment to work - environment. Need for change. Fears, stress and competition in the professional world. Importance of positive attitude, Self-motivation and continuous knowledge upgradation.

Self-confidence: Characteristics of the person perceived, characteristics of the situation, characteristics of the perceiver. Attitude, values, motivation, emotion management, steps to like yourself, positive mental attitude, assertiveness.

Presentations: Preparations, outlining, hints for efficient practice, last minute tasks, means of effective presentation, language, gestures, posture, facial expressions, professional attire.

Vocabulary building: A brief introduction into the methods and practices of learning vocabulary. Learning how to face questions on antonyms, synonyms, spelling error, analogy, etc. Faulty comparison, wrong form of words and confused words like understanding the nuances of spelling changes and wrong use of words. Listening skills: The importance of listening in communication and how to listen actively.

Prepositions, articles and punctuation: A experiential method of learning the uses of articles and prepositions in sentences is provided.

Problem solving level I: Number system; LCM &HCF; Divisibility test; Surds and indices; Logarithms; Ratio, proportions and variations; Partnership;

Problem solving level II: Time speed and distance; work time problems;

Data interpretation: Numerical data tables; Line graphs; Bar charts and Pie charts; Caselet forms; Mix diagrams; Geometrical diagrams and other forms of data representation.

Logical reasoning: Family tree; Deductions; Logical connectives; Binary logic; Linear arrangements; Circular and complex arrangement; Conditionalities and grouping; Sequencing and scheduling; Selections; Networks; Codes; Cubes; Venn diagram in logical reasoning; Quant based reasoning; Flaw detection; Puzzles; Crypto algorithms.

Textbooks

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa& Co.*
4. *The Hard Truth about Soft Skills, by Amazone Publication.*
5. *Quantitative Aptitude by R. S. Aggarwal,S. Chand*

6. *Quantitative Aptitude – AbijithGuha, TMH.*
7. *Quantitative Aptitude for Cat - Arun Sharma. TMH.*

References:

1. *Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova.*
2. *More Games Teams Play, by Leslie Bendaly, McGraw Hill Ryerson.*
3. *The BBC and British Council online resources*
4. *Owl Purdue University online teaching resources*
5. *www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites.*

SEMESTER V

20CYS301	DIGITAL COMMUNICATION	L-T-P-C:3-0-0-3

Pre-Requisite(s): Nil

Course Objectives

- To introduce fundamental communication models
- To understand the fundamental principles of digital modulation and demodulation methods.
- To quantify the impact of noise and channel impairments on digitally modulated signals.
- To design digital signals and optimum receivers to combat the impact of noise and channel impairments.

Course Outcomes

CO1: Understand the fundamental principles of digital modulation and demodulation methods.

CO2: Identify and list various issues present in the design of a communication system

CO3: Apply the time domain and frequency domain concepts of signals in data communication

CO4: Design suitable error detection and error correction algorithms to achieve error free data communication.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1											2	2
CO2	3	2											3	3
CO3	3	2											2	2
CO4	3	2	2										2	3

Syllabus

Unit 1

Introduction to communication systems, Data, signal and Transmission: Analog and Digital, Transmission modes, Transmission Impairments, data rates for different types of multimedia data (audio, video, text), Data Rate Limits - Nyquist's and Shannon's capacity equations, Performance, Digital Transmission: Digital data over Digital channel, Analog data over Digital channel, Analog Transmission: Analog data over Analog channel, Digital data over Analog channel. Source of noises and attenuation methods- Delay Distortion, Noise, Thermal Noise, Intermediation Noise, Crosstalk Noise, Impulse Noise, Channel Capacity.

Unit 2

Transmission media Guided media, Open Wire, Twisted Pair, Optical Fiber, Unguided transmission media; Ground wave propagation, Line of sight propagation; Radio Frequencies, Microwave, Satellites, Wired LANs – Ethernet: - IEEE standards, Standard Ethernet, changes in the standard, Fast Ethernet, Gigabit Ethernet. Encoding: Line coding and Block coding, Error detection codes, Modulation: Digital to Analog and Analog to Analog conversion techniques Bandwidth utilization techniques: Multiplexing: Frequency division, Time division and Wave division multiplexing, spread spectrum concepts, Code division multiple access, digitization of wave forms, PCM, digital modulation techniques- ASK, PSK, FSK and its variants.

Unit 3

Information Theory: Measure of Information, Entropy, Discrete and Continuous channel, Shannon's encoding algorithms, Error Detection and Correction: Block Coding, Linear Block Codes, hamming distance, Cyclic Codes, Checksum – CRC - capabilities of CRC, FEC: Hamming code, constant ratio code, convolutional Code-Threshold decoding, Sequential decoding, Viterbi decoding.

Text book(s)

1. *John G. Proakis and Masoud Salehi, Digital Communications. Fifth Edition. McGraw Hill Education; 2014.*
2. *Simon Haykin, Digital Communication Systems, John Wiley & Sons; 2014.*

Reference(s)

1. *Bruce Carlson, Paul.B. Crilly, Janet.C. Ruteledge, Communication Systems, Fourth Edition McGraw-Hill; 1993.*
2. *Rodger. E. Ziemer, William. H. Tranter, Principle of Communication, Fifth Edition, John Wiley; 1998*
   Behrouz A. Forouzan, Data Communication and Networking, 5th Edition, McGraw Hill; 2012

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS302	SECURE CODING	L-T-P-C:3-0-0-3

Pre-Requisite(s): 20CYS113 Computer Programming and 20CYS213 System Security

Course Objectives

- This course facilitates learning various techniques for systems and applications programmers to write code securely, as well as to find and mitigate vulnerabilities in existing code.

Course Outcomes

CO1: Understand the common security threats in software applications.

CO2: Identify and mitigate the vulnerabilities due to string manipulation errors.

CO3: Identify and mitigate the vulnerabilities based on dynamic memory management errors and integer operations.

CO4: Identify and mitigate the vulnerabilities due to errors in formatted output functions and concurrency.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2				1	1						3	3	1
CO2	3	2	3	2	1	2		2				3	3	1
CO3	3	2	3	2	1	2		2				3	3	1
CO4	3	2	3	2	1	2		2				3	3	1

Syllabus

Introduction - Gauging the threat – Security concepts - SetUID Programs. Strings - Common String Manipulation errors - Improperly Bounded String Copies - Off-by-One Errors - Null-Termination Errors - String Truncation - String Errors without Functions - String vulnerabilities - Buffer Overflow - Process memory organization – Stack management - Stack smashing – Mitigation techniques – String handling functions – Runtime protection strategies.

Dynamic Memory Management – C Memory management functions - Common C Memory Management Errors – Initialization Errors - Failing to Check Return Values - Dereferencing Null or Invalid Pointers - Referencing Freed Memory - Freeing Memory Multiple Times - Memory Leaks - Zero-Length Allocations - Mitigation Strategies. Integer Security –

Introduction to integer types - Integer Data Types - Integer Conversions – Integer operations - Integer Vulnerabilities – Mitigation strategies.

Formatted Output - Variadic Functions - Formatted Output Functions - Vulnerabilities - Mitigation Strategies. Concurrency - Common Errors - Race Conditions – File I/O - TOCTOU – Mitigation strategies.

Textbooks:

Robert C. Seacord, Secure Coding in C and C++, 2nd Edition, Addison-Wesley, 2013.

References:

1. *CERT C Coding Standard. Available online: https://wiki.sei.cmu.edu/confluence/display/c/SEI+CERT+C+Coding+Standard.*
2. *Wenliang Du, Computer Security – A hands-on Approach, Second Edition, Create space Independent Pub; 2019.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS304	ALGORITHMS: DESIGN AND ANALYSIS	L-T-P-C:3-0-0-3

Pre-Requisite(s): 20CYS214 - Data Structures and Algorithms

Course Objectives

- To provide the fundamentals of algorithm design and analysis, specifically in terms of design techniques, application of these design techniques for real-world problem solving and analysis of complexity and correctness of algorithms.
- To provide understanding of how the worst-case time complexity of an algorithm is defined, how asymptotic notation is used to provide a rough classification of algorithms.
- To explain various computational models, order notation and complexity measures to analyse complexity & performance of algorithms associated with real-world problems.

Course Outcomes

CO1: Evaluate the correctness and analyze complexity of algorithms.

CO2: Understand and implement various algorithmic design techniques and solve classical problems.

CO3: Design solutions for real world problems by identifying, applying and implementing appropriate design techniques.

CO4: Analyze the impact of various implementation choices on the algorithm complexity.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2								1	1
CO2	3	3	2	3	3								2	2
CO3	2	2	3	2	2								2	2
CO4	2	2	1	3	3								1	1

Syllabus

Unit 1

Role of Algorithm in Computing. Space and Time Complexity, Rate of growth of functions. Basic complexity analysis – Best, Worst, and Average Cases, Asymptotic notations. Recurrence relations and methods to solve them: Recursion tree, Substitution, Master Method. Analysis of Sorting algorithms - Bubble, Insertion, Selection and Heap Sort. Graph Algorithms – Graph Traversal: BFS, DFS, Its Applications, Topological sort, Strongly Connected Components. Path algorithms: Shortest path algorithms (along with analysis) SSSP: Bellman Ford. APSP: Floyd Warshall Algorithm. Minimum Spanning Tree- Kruskal's, Prims, its analysis

Unit 2

Divide and Conquer: Merge Sort and Binary search type strategies, Pivot based strategies. Strassens's Algorithm for matrix multiplication, Long integer multiplication – Maximum subarray sum - Closest Pair problem as examples. Greedy Algorithm - Introduction to the method, Fractional Knapsack problem, Task Scheduling Problem, Huffman coding as examples. Dynamic Programming: Introduction to the method, Fibonacci numbers, 0-1 Knapsack problem, Matrix chain multiplication problem, Longest Common Subsequence, and other problems including problems incorporating combinatorics as examples.

Unit 3

Backtracking, Branch and Bound 0-1 Knapsack, N-Queen problem, subset sum as some examples. String Matching: Rabin Karp, Boyer Moore, Knuth-Morris-Pratt (KMP). Network Flow and Matching: Flow Algorithms - Maximum Flow - Cuts Maximum Bipartite Matching. Introduction to NP class: Definitions P, NP, NP complete, NP hard, Examples of P and NP.

Text Book

Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein. Introduction to Algorithms, Third Edition, The MIT Press Cambridge, Massachusetts; 2009 (Indian reprint: Prentice-Hall).

Reference(s)

1. *Michael T. Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples. John Wiley and Sons; 2001.*
2. *Dasgupta S, Papadimitriou C and Vazirani U. Algorithms, Eighth Edition, Tata McGraw-Hill; 2009.*
3. *Jon Kleinberg, Eva Tardos. Algorithm Design, First Edition, Pearson New International Edition, Pearson Education Limited; 2014.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS303	COMPUTER NETWORKS	L-T-P-C:3-0-0-3

Pre-Requisite(s): 20CYS103 - Computer Hardware and System Essentials

Course Objectives

- This course introduces the fundamental principles of computer networks including important layers and protocols
- This course will focus on the most important layers including transport layer and link layer along with their functionalities.
- This course will help students with network programming and debugging capabilities.

Course Outcomes

CO1: Understand the basic architectural components of computer networks and apply mathematical foundations to solve computational problems in computer networking.

CO2: Apply network application services, protocols and programming.

CO3: Analyze protocols for data transfer mechanisms, buffer management and flow handling mechanisms.

CO4: Analyze devices for routing and apply routing protocols.

CO5: Apply and Analyze network access protocols and error handling codes to design Local Area Network.

CO6: Comprehend concepts of virtualization and data centric networking.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	4	4	2	1										
CO2	3	2	4	1	3								2	
CO3	2	1	3	2	4							1		
CO4		2	1	2	4								1	
CO5		2	2	3	4									
CO6		2	1	3	3								1	

Unit 1

The Internet-The Network Edge, the Network Core, Network Topology, Types of Networks, Delay, Loss, and Throughput in Packet Switched Networks. Protocol Layers and their Service Models. Principles of Network Applications: The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, DNS, Peer-to-Peer Applications. Introduction and Transport Layer Services: Multiplexing and demultiplexing, Connectionless Transport - UDP, Principles of Reliable Data Transfer.

Unit 2

Transport layer - Connection Oriented Transport - TCP, Principles of Congestion Control, TCP Congestion Control. Introduction Network Layer: Virtual Circuit and Datagram Networks, Inside a Router, The Internet Protocol (IP) - Forwarding and Addressing in the Internet, Routing Algorithms, Routing in the Internet, Broadcast and Multicast Routing.

Unit 3

The Link Layer and Local Area Networks - Introduction and Services, Error-Detection and Correction Techniques, Multiple Access Protocols - Link-Layer Addressing, Ethernet, Link-Layer Switches– Case Study: Virtualization and data center Networking.

Text Book

Kurose J F and Ross K W. Computer Networking: A Top-Down Approach. Seventh Edition, Pearson Press, 2017.

Reference(s)

1. *Tanenbaum A S. Computer Networks. Fifth Edition, Pearson Education India; 2013.*
2. *Stallings W. Data and computer communications. Tenth Edition, Pearson Education India; 2013.*
3. *Forouzan B A. Data Communication and Networking. Fourth Edition, Tata McGraw Hill; 2017.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS382	COMPUTER NETWORKS LAB	L-T-P-C: 0-0-3-1

Pre-Requisite(s): 20CYS103 - Computer Hardware and System Essentials

Course Objectives

- To be familiarized with the use network commands.
- To learn socket programming.
- To implement and analyze various network protocols.
- To use simulation tools to analyze the performance of various network protocols.

Course Outcomes

CO1: Hands on training regarding the design, troubleshooting, modelling and evaluation of computer networks.

CO2: Perform simulations that will help them evaluate their design approaches and expected network performance.

CO3: Use simulation tools to analyze the performance of various network protocols.

CO4: Analyze and simulate various routing algorithms.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					3		1							1
CO2				2	3		1						2	1
CO3				2	3		1						2	1
CO4					3		1						2	1

List of Experiments:

1. Basic Networking commands.
2. Socket Programming - Client server communication using sockets (TCP and UDP)
3. Implementation of unicast, broadcast and multicast Communication
4. Implementation of Checksum and congestion control algorithms
5. Implementation and simulation of algorithm for routing protocols
6. Implementation of SMTP protocol using UDP
7. Development of a packet capture and filtering application using raw sockets.

8. Experimental study of Application Protocols using Network packet sniffers and analyzers.
9. Familiarization of network simulator software - Setting up a small network, Configure interfaces, IP addresses and routing Protocols.
10. Setting up a Network LAN with subnetting and CIDR concept for a specific scenario.

Text Book(s)

Kurose J F and Ross K W. Computer Networking: A Top-Down Approach. Seventh Edition, Pearson Press, 2017.

Reference(s)

1. *https://www.csd.uoc.gr/~hy556/material/tutorials/cs556-3rd-tutorial.pdf*
2. *https://www.nsnam.org/*
3. *https://www.wireshark.org/*
4. *https://www.netacad.com/courses/packet-tracer*

Evaluation Pattern

Assessment	Internal	External
*Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS304	ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS	L-T-P-C:3-0-3-4

Pre-Requisite(s): 20MAT102 - Linear Algebra, 20CYS211 - Probability and Statistics

Course Objectives

- This course provides a comprehensive, introduction to artificial intelligence, emphasizing advanced topics such as advanced search, reasoning and decision-making under uncertainty.
- This course aims to make the learners understand the basic principles in AI and Neural Networks.

Course Outcome

CO1: Understand the fundamental of Artificial Intelligence (AI) and Neural Networks.

CO2: Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

CO3: Apply the understanding of AI techniques in various applications of intelligent agents, expert systems, and artificial neural networks.

CO4: Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2									2	2
CO2	2	3	3	3	2								2	3
CO3	2	3	3	3	3								3	3
CO4	3	3	2	3	2	2		2		2			2	3

Unit 1

Introduction to AI and systems - Problem formulation, problem definition, Control Strategies, Search Strategies - Depth first, Breadth first, problem characteristics, system characteristics, problem solving methods - problem graphs, matching, indexing, heuristic functions, A* search

algorithm, Hill climbing, Constraint satisfaction - related algorithms, handling uncertainty in terms of probability, measure of performance**.**

Unit 2

Knowledge representation - Game playing - Predicate logic, Introduction to Predicate calculus, Resolution, use of predicate calculus, Knowledge representation using other logic - Structured representation of knowledge. Knowledge inference - Production based system, Frame based system. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning – Certainty factors, Bayesian Theory - Bayesian Network-Dempster - Shafer theory. Planning and machine learning - Basic plan generation systems

Unit 3

Perceptrons - classification - limitations of linear nets and perceptrons - Multi-Layer Perceptrons (MLP) - activation functions - linear, softmax, Tanh, ReLU; error functions – feed - forward networks - Back propagation - recursive chain rule (back propagation) - Learning weights of a logistic output - Loss functions - learning via gradient descent - optimization - momentum method; Adaptive learning rates – RmsProp - mini-batch gradient descent - bias-variance trade off, regularization - overfitting - inductive bias – regularization - drop out - generalization. Probabilistic Neural Network - Hopfield Net, Boltzman machine, RBMs, Sigmoid net, Auto-encoders: Conditional Random Fields - Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy. Brief introduction to Deep Learning and Adversarial Neural Networks.

Text Book

Stuart J. Russell, Peter Norvig. Artificial Intelligence: A Modern Approach Prentice-Hall, Inc., 2009.

Reference(s)

1. *Hawkins J, Blakeslee S. On intelligence: How a new understanding of the Brain Will lead to the creation of Truly Intelligent Machines. Macmillan; 2004*
2. *Rich Elaine, Kevin Knight, B. Shivashankar Nair. Artificial Intelligence 3E (Sie). India, Tata McGraw-Hill Publ., 2019.*
3. *Dean, T., Allen, J. & Aloimonos, Y. Artificial Intelligence Theory and Practice. New York: Benjamin Cummings;1995.*
4. *Ginsberg M. Essentials of Artificial Intelligence. Newnes; 2012.*
5. *Luger, G. F.,Stubblefield, W. A. Artificial Intelligence - Structures and Strategies for Complex Problem Solving. New York, NY: Addison Wesley, Fifth edition;2005.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CAT – Can be Quizzes, Assignment, Projects, and Reports.

19SSK301	SOFT SKILLS - 2	L-T-P-C:1-0-3-2

Course Outcomes

CO1 - Soft Skills: At the end of the course, the students will have the ability to communicate convincingly and negotiate diplomatically while working in a team to arrive at a win-win situation. They would further develop their inter-personal and leadership skills.

CO2 - Soft Skills: At the end of the course, the students shall learn to examine the context of a Group Discussion topic and develop new perspectives and ideas through brainstorming and arrive at a consensus.

CO3 - Aptitude: At the end of the course, students will be able to identify, recall and arrive at appropriate strategies to solve questions on geometry. They will be able to investigate, interpret and select suitable methods to solve questions on arithmetic, probability and combinatorics.

CO4 – Verbal: At the end of the course, the students will have the ability to relate, choose, conclude and determine the usage of right vocabulary.

CO5 - Verbal: At the end of the course, the students will have the ability to utilise prior knowledge of grammar to recognise structural instabilities and modify them.

CO6 – Verbal- At the end of the course, the students will have the ability to comprehend, interpret, deduce and logically categorise words, phrases and sentences. They will also have the ability to theorise, discuss, elaborate, criticise and defend their ideas.

Syllabus

Professional grooming and practices: Basics of corporate culture, key pillars of business etiquette. Basics of etiquette: Etiquette – socially acceptable ways of behaviour, personal hygiene, professional attire, cultural adaptability. Introductions and greetings: Rules of the handshake, earning respect, business manners. Telephone etiquette: activities during the conversation conclude the call, to take a message. Body Language: Components, undesirable body language, desirable body language. Adapting to corporate life: Dealing with people.

Group discussions: Advantages of group discussions, structured GD – roles, negative roles to be avoided, personality traits to do well in a GD, initiation techniques, how to perform in a group discussion, summarization techniques.

Listening comprehension advanced: Exercise on improving listening skills, grammar basics: Topics like clauses, punctuation, capitalization, number agreement, pronouns, tenses etc.

Reading comprehension advanced: A course on how to approach middle level reading comprehension passages.

Problem solving level III: Money related problems; Mixtures; Symbol based problems; Clocks and calendars; Simple, linear, quadratic and polynomial equations; special equations; Inequalities; Functions and graphs; Sequence and series; Set theory; Permutations and combinations; Probability; Statistics.

Data sufficiency: Concepts and problem solving.

Non-verbal reasoning and simple engineering aptitude: Mirror image; Water image; Paper folding; Paper cutting; Grouping of figures; Figure formation and analysis; Completion of incomplete pattern; Figure matrix; Miscellaneous.

Spacial aptitude: Cloth, leather, 2D and 3D objects, coin, match sticks, stubs, chalk, chess board, land and geodesic problems etc., related problems.

Textbook(s)

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair. J., Effective Team Building: How to make a winning team, London, U.K: Pan Books; 1986*
3. *Gulati. S., Corporate Soft Skills, New Delhi, India: Rupa& Co; 2006*
4. *The Hard Truth about Soft Skills, by Amazon Publication.*
5. *Quick Maths – Tyra.*
6. *Quicker Arithmetic – Ashish Aggarwal*
7. *Test of reasoning for competitive examinations by Thorpe.E. TMH*
8. *Non-verbal reasoning by R. S. Aggarwal, S. Chand*

Reference(s)

1. *Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova*
2. *More Games Teams Play, by Leslie Bendaly, McGraw Hill Ryerson.*
3. *The BBC and British Council online resources*
4. *Owl Purdue University online teaching resources*
5. *www.the grammarbook.com - online teaching resources www.englishpage.com-online teaching resources and their useful websites*.

19LIV390	LIVE – IN - LABS	[3]

Course Objectives

- Identify and analyse the various challenge indicators present in the village by applying concepts of Human
- Centered Design and Participatory Rural Appraisal.
- User Need Assessment through Quantitative and Qualitative Measurements
- Designing a solution by integrating Human Centered Design concepts
- Devising proposed intervention strategies for Sustainable Social Change Management

Course Outcome

CO1: Learn ethnographic research and utilise the methodologies to enhance participatory engagement.

CO2: Prioritize challenges and derive constraints using Participatory Rural Appraisal.

CO3: Identify and formulate the research challenges in rural communities.

CO4: Design solutions using human centered approach.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3		3		1	1		3	3		3		
CO2		3						3	3	3				
CO3		3					1		3	3		3		
CO4	3		3				3	3	3	3		3		

Syllabus

This initiative is to provide opportunities for students to get involved in coming up with technology solutions for societal problems. The students shall visit villages or rural sites during the vacations (after 4th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.

Thematic Areas

- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

The objectives and the projected outcome of the project will be reviewed and approved by the department chairperson and a faculty assigned as the project guide.

Evaluation Pattern

Assessment	Marks
Internal (Continuous Evaluation) [75 Marks]	
Workshop (Group Participation)	15
Village Visit Assignments and Reports	15
Problem Identification and Assessment	15
Ideation: Defining the Needs, Proposed Designs & Review	20
Poster Presentation	10
External [25 Marks]	
Research Paper Submission	25
Total	**100**
Attendance (To be added Separately)	5
Grand Total	**105**

SEMESTER VI

20CYS311	CYBER FORENSICS	L-T-P-C:2-0-3-3

Pre-Requisite: 20CYS114 - Cyber Security Essentials

Course Objectives

- To provide the fundamentals of digital and cyber space, impact of the activities.
- To cover the fundamentals of cyber-crime and steps involved in collecting the evidences through various tools.
- To provide basics of Cyber-crime incidents and how Cyber Law address them.

Course Outcomes

CO1: Explain the concept of digital forensics and cyber forensics

CO2: Understand and able to perform cyber forensics for the cybercrime incident

CO3: Able to use different forensics tools and standard to report the real-world cyber incidents

CO4: Familiarizing the fundamentals of Anti-forensics and Cyber laws

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1									2	2
CO2	2	3	3	3	2	2		2	2	2		2	3	3
CO3	3	3	3	3	3	2		2	2	2		2	3	3
CO4	2	2	2	3	2	3		3	2	3		3	2	2

Syllabus

Unit 1

Classifications of Cyber Crimes against individuals, property and nation, Need for Digital forensics and steps in digital forensics (scientific methods), Number System: Binary, Decimal,

Hexadecimal, ASCII, and Unicode representation of data, Arenas for digital forensics: disk, network, wireless, database, mobile, e-mail, GPS and memory, Incident handling and response with forensic triage, Ethical Hacking and future of cybercrime.

Unit 2

Locard's exchange principle and digital forensic investigation models, types: artifacts, identifying raw and proprietary forensic storage formats, identification of potential evidence: slack space, swap space, steganography, recovery of hidden, deleted and corrupt data, standard file formats with their headers and forensic file carving, planning your investigation, order of volatility and forensic triage, overview of file systems.

Unit 3

Rules of collecting Digital Evidence, Standard collection procedures: seizure, write blockers, bit-stream imaging, hashing, Chain of Custody (COC), evidence bags and SOP for collecting evidences, Source and Location of Digital Evidences, Duplicating and Preserving Digital Evidences, Importance of MAC timings, Types of System logs and Windows Registry.

Unit 4

Forensic laboratory requirements: setting up of lab, evaluating lab staff, selection of appropriate forensic workstations, backup and recovery plans, generating forensically sound reports., IPR and Cyber Laws in India - IT Act 2000 and 2008 Amendment and like-minded IPC sections, Code of Ethics, Expert Witness and analyzing sample forensic reports.

Unit 5

Validating and gathering evidence using DOS Commands and Unix/Linux Commands, Forensic imaging using DD commands, Software tools - Open Source and proprietary digital forensic frameworks, Hardware tools - write blockers, images and evidence protection containers/bags, NIST tools - CFReDS, CTFF and NSRL and analyzing e-mail headers and network packets.

Textbook(s)

1. *E. Casey, Handbook of Digital Forensics and Investigation, Academic Press; 2010.*
2. *David Cowen, Computer Forensics: A Beginners Guide, McGraw Hill Education; 2013.*
3. *Bill Nelson, Amelia Phillips, Christopher Steuart, Guide to Computer Forensics and Investigations, Fourth Edition; 2014.*

Reference(s)

1. *Brian Carrier, File System Forensic Analysis, Pearson, 2006.*
2. *Marjie T. Britz, Computer Forensics and Cyber Crime, Pearson, 2012.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CAT – Can be Quizzes, Assignment, Projects, and Reports.

20CYS312 PRINCIPLES OF PROGRAMMING LANGUAGES L-T-P-C:2-0-3-3

Pre-Requisite(s): 20CYS113 Computer Programming, and 19CSE201 Advanced Programming

Course Objectives

- This course provides a quick overview of different paradigms of programming languages.
- It focuses primarily on the functional programming paradigm using Haskell & Rust.

Course Outcomes

CO1: Understand and implement pure functional programs in Haskell

CO2: Understand and implement programs in Rust

CO3: Formulate abstractions with higher order procedures.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	3	2								2	2
CO2	2	3	3	3	2								2	2
CO3	2	3	2	3								2	3	3

Syllabus

Programming Paradigms - Overview of various Programming Paradigms. Functional Programming with Haskell - GHCi interpreter - functions and types, functional composition, numbers, lists, tuples, type classes, pattern matching, higher order functions: currying, lambdas, maps and filters, folds, IO monad.

Introduction to Rust - Data types, Operators, Decision Making, Loops, Functions, Tuple and Array, Ownership, Borrowing, Slices, Structure, Modules, Collections, Error Handling, File Input and Output, Package Manager, Iterator and Closure, References, Concurrency

Text Book(s)

1. *Bird R. Thinking functionally with Haskell. Cambridge University Press; 2014.*
2. *Jim Blandy and Jason Orendorff. Programming Rust. First Edition, O'Reilly Media; 2018*

Reference(s)

1. *Graham Hutton. Programming in Haskell. Second Edition, Cambridge University Press;2016*
2. *Steve Klabnik, Carol Nichols. The Rust Programming Language. No Starch Press; 2018*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CAT – Can be Quizzes, Assignment, Projects, and Reports.

20CYS384	ADVANCED PROTOCOL ENGINEERING AND SECURITY LAB	L-T-P-C:0-0-3-1

Pre-Requisite(s): 20CYS382 Computer Networks Lab and 20CYS281 Operating System Lab

Course Objectives

- This course provides a quick overview of understanding the network topology and its attacks by visualizing it with network simulators.
- It also focusses on exploring network protocols and its attacks in Linux environment.
- Providing a platform to experiment with advanced testbed technologies, and formal verification of protocols.

Course Outcome

CO1: Familiarization of open-source network simulators and its experiments.

CO2: Understanding the protocol dynamics, simulation with active queue management schemes and visualization of attacks.

CO3: Familiarization with Linux Kernel Protocol implementation, kernel modification and recompilation.

CO4: Exploring the formal verification of protocols, network emulation, and testbed technologies.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3	3	3								3	3
CO2			3	2	3								3	3
CO3			1	2	3								2	3
CO4			3	3	3								3	3

Syllabus

Experiments with open-source network simulators (NS2 and NS3): Installation and configuration, Creation of network topology and understanding of packet switched network, Simulation and visualization of different types of traffic—congestion controlled and non-

congestion controlled, Trace analysis and visualization of protocol dynamics (throughput; packet drop, buffer dynamics, congestion window, round-trip-time, bandwidth delay product, receiver window, etc), Simulation with active queue management schemes, Simulation and visualization of attacks (e.g. IP spoofing and reflection attacks). Socket programming: implementation of IP spoofing and reflection DDoS attacks. Linux Kernel: Familiarization with Linux kernel protocol implementation (TCP/IP) implementation, Tracing and debugging of Linux Kernel TCP/IP source code, Kernel modification and recompilation, Implementation of a non-attack in Linux kernel Network Emulation and testbeds: Network emulation and traffic control using tc (traffic control), dummynet and other advanced tools, Familiarization with advanced testbed technologies (e.g. Emulab, DETER and PlanetLab, etc.), formal verification of protocol: SPIN, UPPAL.

Textbooks:

Issariyakul T, Hossain E. Introduction to network simulator 2 (NS2), Springer, Boston, MA; 2009.

References:

1. *Seth S, Venkatesulu MA. TCP/IP Architecture, Design, and Implementation in Linux. John Wiley & Sons; 2009.*
2. *https://www.emulab.net/portal/frontpage.php*
3. *https://deter-project.org/*
4. *https://planetlab.cs.princeton.edu/*
5. *http://spinroot.com/spin/whatispin.html*
6. *https://uppaal.org/*

Evaluation Pattern

Assessment	Internal	External
*Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS313	NETWORK SECURITY	L-T-P-C:3-0-0-3

Pre-Requisite(s): 20CYS303 - Computer Networks

Course Objectives

- This Course provides the understanding about the fundamental concepts of Network Security.
- To transfer a message securely over insecure channel.
- To be able to maintain the confidentiality, Integrity and Availability of a data transferred over a Network.

Course Outcome

CO1: Understand various techniques for Network Protection and explore new tools and attacks in network security domain

CO2: Exploring DNS, DNS based attacks and DNSSEC

CO3: Familiarize the LAN based attacks and its mitigations

CO4: Exploring Secure Network Communication protocols and attacks

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		3	3	3								3	3
CO2	1		3	2	3								3	3
CO3	1		3	2	3								2	3
CO4	1		3	3	3								3	3

Syllabus

Unit 1

Techniques for Network Protection, Monitoring and Detection: Firewalls, packet filter and stateful firewalls, application aware firewalls, personal firewalls-IPtables, Proxies, NAT, Intrusion Detection System-Snort, Signature and Anomaly based detection, Honeypots and Honeynets, Network Log management-syslog or SPLUNK; RBAC: Role mining; DNS-Dig tool: DNSSEC-DS and NSEC records.

Unit 2

Protocols and Standards: SCP, SSH, SSL3.0, TLS 1.2, STARTTLS, IPSec, VPN and Secure HTTP; Encrypting and Signing Emails: PGP- GPG/open PGP, DKIM and SPF; Single Sign On (SSO)-OAUTH and OPENID.

Unit 3

Attack Techniques: Network reconnaissance-Nmap and vulnerability audits-openVAS; DNS based attacks, Phishing-DNSTwist; Network based malware attacks: Remote access Trojan-Poison Ivy and Domain name generation algorithm based Botnets; LAN attacks: ARP Cache poisoning- Ettercap/arpspoof, MAC flooding, Man in the middle attacks, Port Stealing, DHCP attacks, VLAN hopping; Network Sniffing - Wireshark and Password Cracking-John the Ripper; Attacks on SSL/TLS: SSL stripping, Drown and Poodle attack; Network packet creation and Manipulation using scapy and dpkt libraries.

Text Books

1. *William Stallings, Cryptography and Network Security: Principles and Practice,8th Edition, Pearson edition, 2020.*
2. *Behrouz A. Forouzan, Cryptography & Network Security, McGraw-Hill, 3rd Edition 2015.*

References:

1. *W. Stallings, Network Security Essentials: Applications and Standards,6th Edition, Pearson Prentice Hall, 2016.*
2. *Bryan Sullivan and Vincent Liu, Web Application Security, A Beginner's Guide, McGraw-Hill Education, 2012*
3. *C. Kaufman, R. Perlman and M. Speciner, Network Security: Private Communication in a Public World, 2nd Edition, Prentice Hall PTR, 2002.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS314	APPLIED CRYPTOGRAPHY	L-T-P-C:3-1-0-4

Pre-Requisite(s): 20CYS101 Classical Cryptography and 20CYS205 Modern Cryptography

Course Objectives

- The course will provide mechanisms and properties of cryptographic protocols that establish and maintain security properties of information exchange in two-party and multiparty settings within ambient open communications networks.

Course Outcome

CO1: Acquire an overview and understanding of the problems, notions, definitions, design principles and proof techniques for selected cryptographic protocols.

CO2: Evaluate a given security protocol against the state of the art.

CO3: Understanding and analyzing some typical applications of cryptographic protocols in networked systems.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			2								2	
CO2		3		3									3	2
CO3	2	2	2	1									3	2

Syllabus

Protocols for identification and login: Interactive protocols, ID protocols, Password protocols, Challenge-response protocols, Schnorr's identification protocol, Proving properties in zero-knowledge.

Authenticated Key Exchange: Goals for authentication and Key Establishment, encryption-based protocol and its attacks, Perfect forward secrecy, Protocol based on ephemeral encryption, Attacks on Insecure variations, Identity protection, One-sided authenticated key exchange, Security of protocol AKE1, Password authenticated key exchange - Phishing attacks, Protocol PAKE0, Protocol PAKE1, Protocol PAKE2, Explicit key confirmation. Key exchange protocol with an online TTP, Insecure variations of protocol Online TTP

Classes of Key Agreement protocols: Diffie Hellman Key Agreement, MTI Protocols, Diffie Hellman-Based Protocols. Protocols not based on Diffie Hellman.

Pairing based cryptographic protocol: ID based encryption schemes, Boneh and Franklin's Scheme, Shamir's encryption and signature schemes.

Conference Key protocols: Security goals, Static and dynamic groups, Generalizing Diffie-Hellman key agreement.

Text Books:

1. *Boyd, Colin, Anish Mathuria, and Douglas Stebila. Introduction to Authentication and Key Establishment. Protocols for Authentication and Key Establishment. Springer, Berlin, Heidelberg; 2020*
2. *Boneh, Dan, and Victor Shoup. A graduate course in applied cryptography. Draft 0.5; 2020*

References:

1. *J. Menezes, P. C. V. Oorschot and S. A. Vanstone, Handbook of Applied Cryptography, CRC Press, 1996.*
2. *J. Pieprzyk, T. Hardjono and J. Seberry, Fundamentals of computer security, Springer; 2003.*
3. *Abhijit Das and Veni Madhavan C. E., Public-key Cryptography, Theory and Practice, Pearson Education; 2009.*
4. *L. Dong and K. Chen, Cryptographic Protocol: Security Analysis Based on Trusted Freshness, Springer; 2012.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS315	AUTOMATA THEORY AND COMPILER DESIGN	L-T-P-C:2-0-3-3

Pre-Requisite(s): 20CYS214 - Data Structures and Algorithms

Course Objectives

- To provide an overview of the problems that can be solved by various kinds of abstract machines such as finite state machine and pushdown automata.
- To understand how lexical analysis and syntax analysis are done using regular expressions and context free grammars respectively.
- To understand various intermediate representations and code generation algorithms for compiler design.

Course Outcome

CO1: Design and development of various finite state machines and regular expressions.

CO2: Apply the concepts of finite automata and regular expressions for the lexical analysis of a program.

CO3: Demonstrate the push down automata and context free grammar to recognize Context free languages and apply the same for syntax analysis or parsing.

CO4: Generate intermediate code and target code for a simple compiler.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	1								1	2
CO2	2	2	3	3	2								1	3
CO3	2	2	3	3									2	3
CO4	3	3	3	3	2								2	3

Syllabus

Unit 1

Finite State Machines: Deterministic Finite Automata (DFA) - Non-Deterministic Finite Automata (NFA) - Equivalence of NFA and DFA - Minimization of DFA - Regular Expression

Regular Language - Properties of Regular Languages - Definition of a compiler - phases of compiler - Lexical Analysis.

Unit 2

Context Free Languages (CFL) and Parsing: Pushdown Automata - Context Free Grammar (CFG) - Properties of CFL - Normal Forms - Syntax analysis - top-down parser - Non recursive predictive parser - Bottom-up parser – SLR - CLR.

Unit 3

Intermediate Representations: Abstract Syntax Tree, Three Address Code - Symbol Tables - Basic blocks - Flow graphs. Code generation: A simple code generation Algorithm - code generation.

Text Book(s)

1. *Linz P, An Introduction to Formal Languages and Automata. Sixth edition, Jones and Bartlett Learning; 2016.*
2. *Cooper, Keith, and Linda Torczon, Engineering a Compiler, Second Edition, Morgan Kaufman, 2011.*

Reference(s)

1. *Hopcroft JE, Motwani R, Ullman JD. Introduction to Automata Theory, Languages and Computation. Third Edition, Pearson; 2006.*
2. *Aho, Alfred V., Monica S. Lam, Ravi Sethi, and Jeffrey Ullman, Compilers: Principles, Techniques and Tools, Prentice Hall, Second Edition, 2006*
3. *Parr T. Language implementation patterns: create your own domain-specific and general programming languages. Pragmatic Bookshelf; First Edition, 2010.*
4. *Mak R. Writing compilers and interpreters: a software engineering approach. John Wiley & Sons; Third Edition, 2009.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CAT – Can be Quizzes, Assignment, Projects, and Reports.

19SSK311	SOFT SKILLS - 3	L-T-P-C:1-0-3-2

Course Outcomes:

CO1 - Soft Skills: At the end of the course, the students will have the ability to prepare a suitable resume (including video resume). They would also have acquired the necessary skills, abilities and knowledge to present themselves confidently. They would be sure-footed in introducing themselves and facing interviews.

CO2 - Soft Skills: At the end of the course, the students will have the ability to analyse every question asked by the interviewer, compose correct responses and respond in the right manner to justify and convince the interviewer of one's right candidature through displaying etiquette, positive attitude and courteous communication.

CO3 - Aptitude: At the end of the course, students will be able to interpret, critically analyze and solve logical reasoning questions. They will have acquired the skills to manage time while applying methods to solve questions on arithmetic, algebra, logical reasoning, and statistics and data analysis and arrive at appropriate conclusions.

CO4 – Verbal: At the end of the course, the students will have the ability to understand and use words, idioms and phrases, interpret the meaning of standard expressions and compose sentences using the same.

CO5 - Verbal: At the end of the course, the students will have the ability to decide, conclude, identify and choose the right grammatical construction.

CO6 – Verbal: At the end of the course, the students will have the ability to examine, interpret and investigate arguments, use inductive and deductive reasoning to support, defend, prove or disprove them. They will also have the ability to create, generate and relate facts / ideas / opinions and share / express the same convincingly to the audience / recipient using their communication skills in English.

Syllabus

Team work: Value of team work in organisations, definition of a team, why team, elements of leadership, disadvantages of a team, stages of team formation. Group development activities: Orientation, internal problem solving, growth and productivity, evaluation and control. Effective team building: Basics of team building, teamwork parameters, roles, empowerment, communication, effective team working, team effectiveness criteria, common characteristics of effective teams, factors affecting team effectiveness, personal characteristics of members, team structure, team process, team outcomes.

Facing an interview: Foundation in core subject, industry orientation / knowledge about the company, professional personality, communication skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, critical reasoning: A course on verbal reasoning. Listening comprehension advanced: An exercise on improving listening skills.

Reading comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Problem solving level IV: Geometry; Trigonometry; Heights and distances; Co-ordinate geometry; Mensuration.

Specific training: Solving campus recruitment papers, national level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In mathematics).

Lateral thinking problems. Quick checking of answers techniques; Techniques on elimination of options, estimating and predicting correct answer; Time management in aptitude tests; Test taking strategies.

Textbook(S)

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair. J., (Effective Team Building: How to make a winning team , London, U.K: Pan Books; 1986*
3. *Gulati. S., Corporate Soft Skills, New Delhi, India: Rupa & Co; 2006.*
4. *The Hard Truth about Soft Skills, by Amazone Publication.*
5. *Data Interpretation by R. S. Aggarwal, S. Chand*
6. *Logical Reasoning and Data Interpretation – Niskit K Sinkha*
7. *Puzzles – Shakuntala Devi*
8. *Puzzles – George J. Summers.*

Reference(S)

1. *Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova.*
2. *More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.*
3. *The BBC and British Council online resources*
4. *Owl Purdue University online teaching resources*
5. *www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites.*

19LIV490	LIVE-IN-LABS II	L-T-P-C:0-0-0-3

Course Objectives

- Proposal writing in order to bring in a detailed project planning, enlist the materials required and propose budget requirement.
- Use the concept of CoDesign to ensure User Participation in the Design Process in order to rightly capture user needs/requirements.
- Building and testing a prototype to ensure that the final design implementation is satisfies the user needs, feasible, affordable, sustainable and efficient.
- Real time project implementation in the village followed by awareness generation and skill training of the users (villagers)

Course Outcome

CO1: Learn co-design methodologies and engage participatorily to finalise a solution

CO2: Understand sustainable social change models and identify change agents in a community.

CO3: Learn Project Management to effectively manage the resources

CO4: Lab scale implementation and validation

CO5: Prototype implementation of the solution

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	3	3			1	3	3	3		3		
CO2									3	3				
CO3									3	3	3			
CO4	3		3			3	1	3	3	3		3		
CO5			1						3	3				

Syllabus

The students shall visit villages or rural sites during the vacations (after 6th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.

Thematic Areas

- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

Evaluation Pattern

Assessment	Marks
Internal (Continuous Evaluation) [63 Marks]	
1. Proposed Implementation	**2**
Presentation Round 1	
2. Proposal Submission + Review	**6**
3. Co-design	**6**
Village Visit I (Co-Design Field Work Assignments)	4
Presentation of Co-design Assessment	2
4. Prototype Design	**14**
Prototype Design	4
Prototype Submission	8
Sustenance Plan	2
5. Implementation	**35**
Implementation Plan Review	3
Implementation	24
Testing & Evaluation	4
Sustenance Model Implementation	4
External [37 Marks]	
6. Research Paper	18
7. Final Report	15
8. Poster Presentation	4
Total	**100**
Attendance	5
Grand Total	**105**

SEMESTER VII

20CYS401	SECURE SOFTWARE ENGINEERING	L-T-P-C:2-0-3-3

Pre-Requisite(s): Nil

Course Objectives

- Understanding various system process models and build a secure environment.
- Apply vulnerability analysis into architecture and design process, access controlled and clean environment to build software, target environment hardening and secure application deployment.
- To familiarize with containerization for software development and also focus on security testing of software and software security economics

Course Outcome

CO1: Develop secure system models depending on user requirements.

CO2: Able to build analysis model and apply threat model for analysing the vulnerabilities in the system.

CO3: Understanding software security economics and practices in containerized development.

CO4: Develop security testing of software and understand basics of security governance, risk and compliance.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3	3	3	3				2		1			
CO2		3	3	3		3		2	2		1		3	2
CO3			3	3			3	1				1	2	2
CO4			3	3			3	1				1	2	2

Unit 1

Process Models–Waterfall, incremental, evolutionary, concurrent, Agile Programming-Introduction, Flavors of Agile Development, Agile Manifesto, Refactoring Techniques, Limitations of the Agile Process, Agile Modeling with XP, Scrum Methodology. How sprint works: Sprint Planning, Daily scrum meeting, updating sprint backlog, Burn down chart, sprint review, sprint retrospective. Scrum Metrics- velocity, burn down, defects carried over. Secure development and build environment.

Unit 2

Requirements Engineering: Tasks Initiation-Elicitation-Developing Use Cases-Building the analysis Model-Negotiation- Validation Requirements Modelling - building the analysis model, Scenario based methods, UML Models, Data Models. Design engineering Design concepts, Design models, software architecture, architectural styles and patterns, Architectural design: styles and patterns, architectural design, Refining architecture to components. Performing user interface Design-Golden Rules-User Interface Analysis and Design- Interface Analysis-Interface design steps. Threat Modeling –STRIDE, Information flow and vulnerability model to build security into life cycle phase of software (and hardware) components, Vulnerability analysis into architecture and design process, Access-controlled and clean environment to build software, Target environment hardening and secure application deployment, Attack trees.

Unit 3

Containerized development: Docker, Kubernets, Continuous Integration and Continuous Delivery (CI/CD). Security testing of software: Unit testing, integration testing, validation and system testing, fuzzing. Software security economics- logging/ monitoring and physical and operational security aspects. Basics of security governance, risk and compliance.

Text Book

Pressman R S, Bruce R. Maxim, Software Engineering - A Practitioner's Approach. Eighth Edition, McGraw-Hill Education, 2019.

Reference(s)

1. *Crowder JA, Friess S. Agile project management: managing for success. Cham: Springer International Publishing; 2015.*
2. *Stellman A, Greene J. Learning agile: Understanding scrum, XP, lean, and kanban, O'Reilly Media, Inc.; 2015.*

3. *Rubin KS. Essential Scrum: a practical guide to the most popular agile process. Addison-Wesley; 2012.*
4. *S. Garfinkel and L. F. Cranor, Security and Usability: Designing Secure Systems That People Can Use, O'Reilly, 2008.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CAT – Can be Quizzes, Assignment, Projects, and Reports.

20CYS402	DISTRIBUTED SYSTEMS AND CLOUD COMPUTING	L-T-P-C:2-0-3-3

Pre-Requisite(s): 20CYS203 - Operating System, 20CYS204 - Database Management System

Course Objectives

- Introduction to distributed systems and cloud computing.
- Understand different cloud architectures and technology.
- Illustrate the use of Hadoop clusters and Peer to Peer Systems

Course Outcome

CO1: Classify and describe the architecture and taxonomy of parallel and distributed computing, including shared and distributed memory, and data and task parallel computing

CO2: Characterize the distinctions between Infrastructure, Platform and Software as a Service (IaaS, PaaS, SaaS) abstractions, and Public and Private Clouds, and analyze their advantages and disadvantages.

CO3: Exploring Hadoop clusters and Peer to Peer Systems

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1			1	1							2	2
CO2	2	2	1		1	1							2	2
CO3	2	1	2		1	1							2	2

Syllabus

Introduction to distributed systems, Distributed computing paradigms, Inter process communication mechanisms, Process models in distributed systems, The CAP theorem, Consistency models and Replication, Consensus algorithm: Clock Synchronization – Logical clocks – Mutual Exclusion, global positioning of nodes, Distributed Commit protocols – 2PC, 3PC, Check-pointing and Recovery, Election algorithms, Failure Models, Paxos algorithm-Apache Zookeeper, Distributed file system – Eg: CODA and Ceph, Distributed storage implementation – Data sharding, nosql key value stores and its properties – Eg: Google Big Table, Amazon DynamoDB. Cloud computing benefits and its challenges, Types – Private, Public and Hybrid clouds, Models – IaaS, PaaS and SaaS. Role of virtualization in enabling

the cloud computing; Business Agility: Benefits and challenges to cloud architecture. AWS cloud services and management – scalability, availability, concurrency with practical aspects, REST API services including load balancing, server authentication and debug handling, AWS Zelkova for Provable Security. Hadoop cloud computing framework – HDFS and MapReduce, Cloud data processing using Pig and Hive, Amazon EMR for creating Hadoop clusters within AWS. Peer to Peer Systems – Napster, Gnutella, FastTrack, BitTorrent, Distributed Hash Tables, IPFS.

Text Book(s)

1. *Andrew S. Tannenbaum and Maarten van Steen, Distributed Systems: Principles and Paradigms, Third Edition, Prentice Hall, 2017.*
2. *Ronald L. Krutz, Russell Dean Vines. Cloud Security: A comprehensive Guide to Secure Cloud Computing, Wiley India 2010.*

Reference(s)

1. *Ajay D. Kshemkalyani and Mukesh Singhal, Distributed Computing: Principles, Algorithms, and Systems, Cambridge University Press, 2011.*
2. *Garg VK, Garg VK. Elements of distributed computing. John Wiley & Sons; 2002.*
3. *George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, Distributed Systems: Concepts and Design, Fifth Edition, Pearson Education, 2017.*
4. *Fokkink W. Distributed algorithms: an intuitive approach. Second Edition, MIT Press; 2018.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CAT – Can be Quizzes, Assignment, Projects, and Reports.

20CYS403	WEB APPLICATION SECURITY	L-T-P-C:2-0-3-3

Pre-Requisite(s): 20CYS202 User Interface Design

Course Objectives

- The course will cover the concepts involved in web application development.
- The course will introduce to various vulnerabilities in web applications and their mitigation techniques.

Course Outcome

CO1: Apply client-side web development to design interactive front-end web user interfaces.

CO2: Use server-side web application concepts to develop back-end web server application

CO3: Identify and mitigate various client-side web application security vulnerabilities

CO4: Identify and mitigate various server-side web application security vulnerabilities

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	1	3	2						3	1	2
CO2	2	2	3	1	3	2						3	1	2
CO3	3	3	3	3	3	3			3			3	3	3
CO4	3	3	3	3	3	3			3			3	3	3

Syllabus:

Web application development – Introduction - Architecture – Client-side technologies and frameworks – HTML – CSS – Javascript - Ajax/Fetch - Data interchange formats – XML, JSON. Sever-side scripting and technologies - development – technologies - Handling client requests – Database connectivity – Sessions – Cookies.

Web application vulnerabilities – Client-side Vulnerabilities - Cross Site Scripting (XSS) - Cross Site Request Forgery (CSRF) - Cross-origin resource sharing (CORS) - Clickjacking. Server-side Vulnerabilities - SQL injection - OS command injection - Directory traversal - Authentication - Server-side request forgery (SSRF).

Text Books/References:

1. *Robin Nixon, Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites, Fifth Edition, O'Reilly Media, Inc.; 2018.*
2. *Dafydd Stuttard, and Marcus Pinto, The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Second Edition, John Wiley & Sons; 2011.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS404	ANDROID APPLICATION DEVELOPMENT	L-T-P-C:0-0-3-1

Pre-Requisite(s): 20CYS383 - Java Programming Lab and 20CYS203 - Operating System

Course Objectives

- This course covers the fundamentals of Android programming using the Android SDK.
- To provide and discuss various techniques and tools to develop & deploy Android Applications.
- To demonstrate various applications of Android programming and its practical implications.

Course Outcome

CO1: Demonstrate their understanding of the fundamentals of Android operating systems

CO2: Able to use Android software development tools

CO3: Design and develop software with reasonable complexity on mobile platform

CO4: Ability to debug the programs and deploy the software to mobile devices

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		1	2	3		1						1	2
CO2	1		3	3	3		1						2	2
CO3	1		3	3	3		1						2	2
CO4	1		2	3	3		1						3	3

Syllabus

Introduction to Android OS and App Development - Architecture, Types of Applications, Building an App, Understanding Activities, Activity Lifecycle, Managing State. Understanding various layouts and UI controls, Intents - Explicit, Implicit, Basic of Data Storage - SQLite, Shared Preferences. Understanding Broadcast receivers and Content

Providers. Basic of Connecting Web APIs, Basic of Working in Background - Services, Async Tasks, GPS and GoogleMaps, Sensors.

Text Book(s)

1. *Y. Karim, Embedded Android, O'Reilly Media, First Edition; 2013.*
2. *Michael Burton, Android Application Development for Dummies, Third Edition, Wiley; 2015.*

Reference(s)

Pradeep Kothari, Android Application Development Black Book, Dreamtech Press; 2014

Evaluation Pattern

Assessment	Internal	External
*Continuous Assessment (CA)	80	
End Semester		20

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS495	PROJECT - PHASE – 1 / SEMINAR	P/F

Couse Objectives

- First phase of academic project covers problem formulation, study of relevant literature and presentation of findings.
- Gives an opportunity for practical application of computer science in security and help the students to innovate.
- This in turn supports publications, patenting and entrepreneurship

Course Outcomes

CO1: Ability to formulate scientific problem and prepare project execution plan.

CO2: Ability to find and analyse related literature.

CO3: Ability to present, articulate and defend the findings.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			3				3	3		2	3	3	3
CO2			3		3			3	3		2	3	3	3
CO3		3	3		3			3	3	3	2	3	3	3

Evaluation Pattern

Assessment	Internal	External
*Continuous Assessment (CA)	60	
End Semester		40

*CA – Can be Quizzes, Assignment, Projects, and Reports.

SEMESTER VIII

20CYS499	PROJECT PHASE - 2	L-T-P-C:2-0-3-3

Course Objectives

- Second phase of academic project covers implementation, testing, scientific knowledge dissemination through research articles, and documentation.
- Gives an opportunity for practical application of computer science in security and help the students to innovate.
- This in turn supports scientific/research publications, patenting and entrepreneurship.

Course Outcomes

CO1: Fine-tune the scientific problem and prepare project execution plan

CO2: Design and develop the prototype

CO3: Implement, analyze the findings of the proposed problem

CO4: Present, articulate and defend the solution

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			3				3	3		2	3	3	3
CO2			3		3			3	3		2	3	3	3
CO3		3	3		3			3	3	3	2	3	3	3
CO4					3	3		3	3	3	2	3	3	3

Evaluation Pattern

Assessment	Internal	External
*Continuous Assessment (CA)	60	
End Semester		40

*CA – Can be Quizzes, Assignment, Projects, and Reports.

PROFESSIONAL ELECTIVE - I

20CYS331	WIRELESS SENSOR NETWORK SECURITY	L-T-P-C:3-0-0-3

Pre-Requisite(s): 20CYS303 - Computer Networks, 20CYS113 - Computer Programming

Course Objectives

- This course introduces the features of Wireless Sensor Networks, their architecture, its protocols, routing, localization and positioning schemes.
- The course also emphasizes on providing an overview of threats in WSN, security primitives to create secure WSN protocols, detection techniques and cryptographic primitives for hardware implementation.

Course Outcomes

CO1: Understand the basic features of Wireless Sensor networks.

CO2: Understand the protocols of Wireless sensor network, its Routing, Localization and Positioning schemes.

CO3: Understand the security attacks, threats and vulnerabilities of WSN.

CO4: Analyze the security frameworks, privacy protection mechanisms and intrusion detection techniques of WSN.

CO5: Understand secure routing, and data aggregation in WSNs.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			2	2	2								1	
CO2			3	1	2	2							1	
CO3			3	3	3	2	1					1	2	2
CO4			2	2	2	2						1	3	3
CO5			2	2	1	2	3					1	2	3

Syllabus

Unit 1

Overview of WSN: Introduction, Applications, Unique Constraints and challenges. Sensor Node Hardware: Mica2, TelosB, Cricket, i-Mote2, TMote, BTnode, Wasp mote, comparisons. Sensor Node platforms: TinyOS and Contiki. Network Architecture – Sensor network scenario-Design principles of WSN-Physical layer and fundamentals of MAC protocols, Low Duty cycle Protocols: SMAC, STEM, Contention Based Protocols: CSMA, PAMAS, Scheduling based Protocols: LEACH, TRAMA.

Unit 2

Routing: Gossiping, Energy efficient unicast, Broadcast and multicast. Localization and Positioning: GPS based localization; Event Driven Localization- Overview of data aggregation.

Overview of Wireless Sensor Network Security, Vulnerabilities and Attacks in Wireless Sensor Networks, Symmetric Primitives, Public-Key Primitives, Key Management in Wireless Sensor Networks.

Unit 3

WSN Link-Layer Security Frameworks, Secure Routing in Wireless Sensor Networks, Secure Data Aggregation in Wireless Sensor Networks, Privacy Protection Mechanisms for Sensor Networks, Intrusion Detection Techniques in Sensor Networks, Remote Attestation – Identification, On the Hardware Implementation Efficiency of Cryptographic Primitives.

Text Book(s)

1. *Karl H, Willig A. Protocols and architectures for Wireless Sensor Networks. John Wiley & Sons; 2005.*
2. *Javier Lopez, and Jianying Zhou, Wireless Sensor Network Security, IOS Press; 2008*

Reference(s)

1. *Dargie W, Poellabauer C. Fundamentals of Wireless Sensor Networks: theory and practice. John Wiley & Sons; 2010*
2. *Zhao F, Guibas LJ, Guibas L. Wireless Sensor Networks: an information processing approach. Morgan Kaufmann; 2004*

3. *Anna Hac. Wireless Sensor Networks Designs, John Wiley and Sons; 2004*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CSE436	MOBILE AND WIRELESS SECURITY	L-T-P-C:3-0-0-3

Pre-Requisite(s): 20CYS303 - Computer Networks

Course Objectives

- The focus of this course is to enable students to understand the aspects of information and network security that arise in this challenging and ever-evolving space of mobile communication systems.
- The enable students to understand mobile/cellular telephony, and wireless network with physical layer considerations.

Course Outcomes

CO1: Understand relevant aspects of information security in mobile and wireless networks

CO2: Understand the physical layer security mechanisms and protocols in wireless communication

CO3: Understand the authentication and key transport protocol mechanisms used in wireless network security

CO4: Understand security issues and provide solutions for practical wireless systems.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2									2	1
CO2	3	3	3	3	2							2	2	1
CO3	3	2		2								2	2	1
CO4	3	3	3	3	2							2	2	1

Syllabus

Unit 1

Fundamentals of Physical layer security – Information theoretic secrecy metrics – channel models - Secret Communication - Coding for Security - Asymptotic Analysis - Key Generation from wireless channels Key agreement techniques.

Unit 2

Secrecy with Feedback - Achieving Secrecy through Discussion and Jamming. MIMO Signal Processing Algorithms for Enhanced Physical Layer Security - Secrecy Performance Metrics.

Unit 3

Physical Layer Security in OFDMA Networks -Power Allocation Law for Secrecy - Multiple Eavesdroppers. Resource Allocation for Physical Layer Security in OFDMA Networks- Application of Cooperative Transmissions to Secrecy Communications - Stochastic Geometry Approaches to Secrecy in Large Wireless Networks.

Text Book(s)

Zhou X, Song L, Zhang Y. Physical layer security in wireless communications.CRC Press; 2013.

Reference(s)

1. *Chen L, Gong G. Communication system security. Chapman and Hall/CRC; 2012*
2. *Edney J, Arbaugh WA. Real 802.11 security: Wi-Fi protected access and 802.11 i. Addison-Wesley Professional; 2004.*
3. *Chaouchi H, Laurent-Maknavicius M. Wireless and Mobile Networks Security. John Wiley & Sons; 2009.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CSE446	INTERNET OF THINGS	L-T-P-C:3-0-0-3

Pre-Requisite(s): 20CYS113 Computer Programming

Course Objectives

- This course covers the fundamentals of IoT and provides skills for IoT based product development.
- The skills students learn in this subject include the selection of sensors, protocols, hardware boards, interfacing, and implementation for product building. Real life case studies are introduced in this course.

Course Outcomes

CO1: Understand the key techniques and theory behind the Internet of Things.
CO2: Apply effectively the various enabling technologies (both hardware and software) for IoT.
CO3: Understand the integration of Cloud and IoT, Edge and Fog Computing.
CO4: Apply various techniques for Data Accumulation, Storage and Analytics.
CO5: Design and build IoT systems for any one interesting Use case.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2								1	1	1
CO2	2	2	2	1	2							2	2	2
CO3	3	3	3	2	2								2	2
CO4	2	2	2	2									2	2
CO5	3	3	3	3	2								3	3

Syllabus

Unit 1

Introduction to IoT - IoT definition - Characteristics - Things in IoT - IoT Complete Architectural Stack - IoT Enabling Technologies - IoT Challenges - IoT Levels - A Case Study to realize the stack. Sensors and Hardware for IoT - Accelerometer, Proximity Sensor, IR sensor, Gas Sensor, Temperature Sensor, Chemical Sensor, Motion Detection Sensor. Hardware Kits - Arduino, Raspberry Pi, Node MCU. Case Study

Unit 2

Protocols for IoT - infrastructure protocol IPV4/V6|RPL), Identification (URLs), Transport (WiFi, LiFi, BLE), Discovery, Data Protocols, Device Management Protocols. - A Case Study with MQTT/CoAP usage. Cloud and Data analytics- Types of Cloud - IoT with cloud challenges - Selection of cloud for IoT applications - Fog computing for IoT - Edge computing for IoT - Cloud security aspects for IoT applications - RFM for Data Analytics - Case Study with AWS / AZURE / Adafruit / IBM Bluemix.

Unit 3

Case studies with architectural analysis: IoT applications - Smart City - Smart Water - Smart Agriculture - Smart Energy - Smart Healthcare - Smart Transportation - Smart Retail - Smart Waste Management.

Text Book

Bahga A, Madisetti V. Internet of Things: A Hands-on Approach; 2014.

Reference(s)

1. *Shriram K Vasudevan, Abhishek SN and Sundaram RMD. Internet of Things, First Edition, Wiley India;2019.*
2. *Raj P, Raman AC. The Internet of things: Enabling Technologies, Platforms, and Use-cases. Auerbach Publications; 2017.*
3. *Adrian McEwen. Designing the Internet of Things, Wiley;2013.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

PROFESSIONAL ELECTIVE - 2

20CYS431	PROGRAM OBFUSCATION	L-T-P-C:3-0-0-3

Pre-requisite: 20CYS212 - Multimedia Processing & 20CYS302 Secure Coding

Course Objectives

- To understand Obfuscation algorithms, application of code obfuscation techniques along with tamper proofing and watermarking.
- To provide understanding of program analysis using static and dynamic approach and familiarize with some of the reverse engineering tools.
- To explain various software similarity measures and a brief focus on data hiding techniques

Course Outcome

CO1: Study different methods of obfuscating code and various application of code obfuscation, watermarking, tamper proofing.

CO2: Understand program analysis using static and dynamic analysis and familiarize with reverse engineering tools

CO3: Can identify different software watermarking methods and how to resist attacks.

CO4: Apply software similarity analysis for testing purpose and also understand some of the hiding techniques in different media

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	1	2	3	3	3	3					3	3
CO2	2	3	1	2	3	3	1	2					3	3
CO3		1	2	2	3	3	3	3					3	3
CO4		1		1	3	3	1	2			2		1	3

Syllabus
Unit 1:

Introduction to Program Obfuscation – applications of code obfuscation, tamper proofing, software watermarking, software similarity. Methods of attack and defense – attack and defense strategies. Program analysis- static and dynamic analysis. reverse engineering tools. Code obfuscation- Complicating control flow, Opaque predicates, Data encoding, Breaking abstractions.

Unit 2:

Dynamic Obfuscation, Software tamper proofing – checking for tampering, responding mechanisms, remote tamper proofing. Software watermarking – different methods and its applications, tamper proofing watermarks, improving resilience and stealth, dynamic watermarking methods-by exploiting aliasing, parallelism, and expanding execution paths.

Unit 3:

Software similarity analysis- k-gram based analysis, API based analysis, tree and graph-based analysis, metrics-based analysis. Basics on hardware for protecting software.

Case study: Data hiding in digital Audio and Video, Operating System Data Hiding, Virtual Data Hiding, Data Hiding in Network Protocols, Data Hiding among Android Mobile Devices and Apple iOS, Forensics and Anti-Forensics, Mitigation Strategies.

Text Book(s):

1. *C. Collberg and J. Nagra, Surreptitious Software: Obfuscation, Watermarking, and Tamperproofing for Software Protection, Addison-Wesley; 2010*
2. *M. T. Raggo and C. Hosmer, Data Hiding: Exposing Concealed Data in Multimedia, Operating Systems, Mobile Devices and Network Protocols, 1st Edition, Syngress; 2012*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS432	VULNERABILITY ASSESSMENT AND PENETRATION TESTING	L-T-P-C:3-0-0-3

Pre-Requisite: 20CYS303 Computer Networks & 20CYS302 Secure Coding

Course Objectives

- Understand the legal aspects, industry ethics and the approaches and methodologies used when performing a penetration test.
- Be able to use the appropriate penetration testing tools for a given scenario and understand their output.
- Discuss implications of common vulnerabilities and recommend ways to rectify or mitigate them.

Course Outcome

CO1: To gain knowledge about vulnerability assessment and penetration testing.

CO2: To learn about various types of attacks, attackers and security threats and vulnerabilities present in the computer system.

CO3: To examine how social engineering can be done by attacker to gain access of useful & sensitive information about the confidential data.

CO4: To gain knowledge of the tools, techniques and ethical issues likely to face the domain of ethical hacking and VAPT.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		1						3					3	
CO2	2	2			2								2	
CO3			2	1	1	3		1					2	2
CO4	2	1	3	2	2									3

Syllabus

Unit 1

Introduction to vulnerability assessment, Foot printing & Social engineering Information gathering methodologies- Competitive Intelligence- DNS Enumerations- Social Engineering attacks. Scanning & Enumeration Port Scanning-Network Scanning- Vulnerability Scanning- NMAP scanning tool- OS Fingerprinting Enumeration. System Hacking Password cracking techniques- Key loggers- Escalating privileges.

Unit 2

Sniffers & SQL Injection Active and passive sniffing- ARP Poisoning- Session Hijacking- DNS Spoofing- Conduct SQL Injection attack - Countermeasures. Introduction to Metasploit: Metasploit framework, Metasploit Console, Payloads, Meterpreter, Introduction to Armitage, Installing and using Kali Linux Distribution, Introduction to penetration testing tools in Kali Linux. Case Studies of recent vulnerabilities and attacks.

Unit 3

Introduction to Reverse Engineering of Android Apps- Introduction to Android OS and App Development - Architecture, Types of Applications, Building an App, Understanding Activities, Activity Lifecycle, Managing State. Understanding various layouts and UI controls, Introduction to Android OS Security, Static and Dynamic Analysis of Android Apps, Native Library Exploitation, OWASP Top ten mobile vulnerabilities, Security Assessment with Drozer, Burp suite, Some of the attacks and Vulnerabilities in real world android apps: A case study. Hybrid Mobile Application Development and its security.

Textbooks:

1. *Kimberly Graves, CEH: Official Certified Ethical Hacker Review Guide, Wiley Publishing Inc.; 2007*
2. *Shakeel Ali and Tedi Heriyanto, Backtrack -4: Assuring security by penetration testing", PACKT Publishing; 2011*
3. *Baloch, R., Ethical Hacking and Penetration Testing Guide, CRC Press; 2015*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS433	BLOCKCHAIN TECHNOLOGY	L-T-P-C:3-0-0-3

Prerequisite(s): Nil

Course Objectives

- To provide an understanding of Decentralized blockchain-based systems, such as Bitcoin and Ethereum, and its position in the present technological landscape.
- To understand the impact and role of Blockchain Technology in financial, information, and other infrastructures. This course covers the technical aspects of public distributed ledgers, blockchain systems, cryptocurrencies, and smart contracts

Course Outcome

CO1: Understand the basic principles of Distributed Ledger Technology

CO2: Able to demonstrate the cryptographic primitives in Blockchain technology

CO3: Understand and Evaluate various consensus protocols

CO4: Develop Smart Contracts and create a DApp using Ethereum Blockchain

CO5: Analyze a real-world use case and provide how blockchain could be used to address the challenges faced

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2									2	2
CO2	3	3	3	3	3								3	3
CO3	2	3	3	3									2	2
CO4	3	2	3	3	2								2	3
CO5	3	3	3	3	2							2	3	3

Syllabus

Blockchain Data Structure – Hash Chain - Distributed Database - Blockchain Architecture - Terminologies in Blockchain: Hashes - Transactions - Addresses - Wallet - Private Key Storage - Ledgers - Blocks - Chaining Blocks; Consensus and multiparty agreements: Proof of Work (PoW) - Proof of Stake (PoS) - Delegated Proof of Stake (DPoS) - Proof of Elapsed Time (PoET) - Proof of Importance - Reputation-based mechanisms - Practical Byzantine Fault Tolerance (PBFT); Blockchain Platforms: Cryptocurrencies (Bitcoin, Litecoin, Ethereum) -

Hyperledger - Ethereum; Blockchain implementation; Smart Contract - Web3.js - MetaMask; Forking; Soft Fork - Hard Fork - Cryptographic Changes and Forks; Blockchain as a Service - IPFS and Blockchain - Challenges in Blockchain; Concurrency, Scalability and Privacy.

Text Book(s)

1. *Imran Bashir, Mastering Blockchain; 2017.*
2. *Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton Univ Press; 2016*
3. *Alex Leverington, Ethereum Programming, Packt Publishing Limited; 2017.*

Reference(s)

1. *Andreas M. Antonopoulos, Mastering Bitcoin - Programming the Open Blockchain, O'Reilly Media, Inc.; 2017*
2. *Draft NISTIR 8202, Blockchain Technology Overview - NIST CSRC; 2018.*
3. *Roger Wattenhofer, CreateSpace, The Science of the Blockchain, Independent Publishing Platform; 2016*

Evaluation Pattern (50:50)

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignments, Projects, and Reports

PROFESSIONAL ELECTIVE - 3

20CYS441	FORMAL METHODS FOR SECURITY	L-T-P-C:3-0-0-3

Prerequisite: 19MAT115: Discrete Mathematics

Course Objectives

- To provide basic understanding and fundamentals of Formal Methods and its role in Security.
- To discuss various methods for Logic and Program Verification.
- To demonstrate different tools available to perform analysis and detect security vulnerabilities.

Course Outcome

CO1: Introduction to Formal Methods - Logic and Program Verification.

CO2: Understand Temporal Logic and Model Checking for program verifications.

CO3: Verification of concurrent and reactive programs/systems using model-checking and propositional temporal logic.

CO4: Application of static and dynamic program analysis and model checking for detecting common security vulnerabilities in programs and communication protocols

CO5: Familiarizing SPIN, PVS, TAMARIN, Frama-C and Isabelle tools.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2									2	2
CO2	2	2	2	2	2								2	2
CO3	2	3	2	3	2								3	3
CO4	3	3	3	3	3								3	3
CO5	2	2	2	2	3								2	3

Syllabus

Formal Methods – Definition - Need for Formal Methods - Propositional and Predicate Logic, and theorem-proving, Fixed-points and their role in program analysis and model-checking, Verification of sequential programs using weakest preconditions and inductive methods, and verification of concurrent and reactive programs/systems using model-checking and propositional temporal logic (CTL and LTL), Application of static and dynamic program analysis and model-checking for detecting common security vulnerabilities in programs and communication protocols, Information flow and taint analysis for security of web applications, SPIN, PVS, TAMARIN, Frama-C and Isabelle tools.

Text Book(s)

1. *Veith, Helmut, et al. Model Checking. United Kingdom, MIT Press; 2018.*
2. *G. Bella, Formal Correctness of Security Protocols, Springer; 2009.*
3. *Datta A, Jha S, Li N, Melski D and Reps T, Analysis Techniques for Information Security, Synthesis Lectures on Information Security, Privacy, and Trust; 2010.*

Reference(s)

1. *Lloyd, J.W., Logic and Learning: Knowledge Representation, Computation and Learning in Higher-order Logic, Springer Berlin Heidelberg; 2003.*
2. *M. Ruth and M. Ryan, Logic in Computer Science - Modelling and Reasoning about Systems, Cambridge University Press; 2004.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS442	HARDWARE SECURITY	L-T-P-C:3-0-0-3

Pre-Requisite(s): Nil

Course Objectives

- To develop crypto algorithms on hardware platform by enabling security features.
- Familiarize with different side channel attacks and its preventive techniques.
- Understanding the fault-tolerance and verification of cryptographic hardware.

Course Outcomes

CO1: Able to develop crypto algorithms and incorporate security features on FPGA.

CO2: Identify side channel attack and its prevention techniques.

CO3: Able to understand different approaches for hardware Trojan and Piracy detection and analysis.

CO4: Evaluation and verifying of cryptographic Hardware.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3	3	3		1	1	2	2		2	3	3	
CO2		3	3	3		1	2	2	2		2	3	3	
CO3		3	3	3		1	3	2	2		2	3	3	3
CO4		3		3		3	3	2	2		2	3	3	3

Syllabus

Unit 1

Development of crypto algorithms and other security features on to hardware platform, standards of security –FIPS, 140-2 level 3. Overview of different issues of hardware security - Basics of Digital Design on Field-programmable Gate Array (FPGA), Optimization of Cryptographic Hardware on FPGA, Physically Unclonable Functions (PUFs), PUF Implementations, PUF Quality Evaluation, Design Techniques to Increase PUF Response Quality.

Unit 2

Side-channel Attacks on Cryptographic Hardware: Current-measurement based Side channel Attacks (Case Study: Kocher's Attack on DES), Design Techniques to Prevent Side channel Attacks, Improved Side-channel Attack Algorithms (Template Attack, etc.), Cache Attacks.

Unit 3

Testability and Verification of Cryptographic Hardware: Fault-tolerance of Cryptographic Hardware, Fault Attacks, Verification of Finite-field Arithmetic Circuits Hardware Trojans: Hardware Trojan Nomenclature and Operating Modes, Countermeasures such as Design and Manufacturing Techniques to Prevent/Detect Hardware Trojans, Logic Testing and Side-channel Analysis based techniques for Trojan Detection

Textbooks:

1. *Debdeep Mukhopadhyay and Rajat Subhra Chakraborty, Hardware Security: Design, Threats, and Safeguards, CRC Press; 2014*
2. *Bhunia, Swarup, and Mark Tehranipoor. Hardware security: a hands-on learning approach. Morgan Kaufmann; 2018*

References:

1. *Sadeghi, Ahmad-Reza, and David Naccache. Towards hardware-intrinsic security. Springer Berlin Heidelberg; 2010.*
2. *Huffmire, Ted, Cynthia Irvine, Thuy D. Nguyen, Timothy Levin, Ryan Kastner, and Timothy Sherwood. Handbook of FPGA design security. Springer Science & Business Media; 2010.*
3. *Mangard, Stefan, Elisabeth Oswald, and Thomas Popp. Power analysis attacks: Revealing the secrets of smart cards. Springer Science & Business Media; 2008*
4. *Tehranipoor, Mohammad, and Cliff Wang, eds. Introduction to hardware security and trust. Springer Science & Business Media; 2011.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20CYS443	BIOMETRICS AND SECURITY	L-T-P-C:3-0-0-3

Pre-Requisite: 20CYS212 Multimedia Processing

Course Objectives

- Understand the technological uplifts with biometrics compared to traditional securing mechanisms and standards applied to security
- To understand the concepts of different types of biometrics and to enable design of biometric system and its privacy risks
- To familiarize with biometric interface and biometric applications

Course Outcome

CO1: Apply biometric matching to identify algorithms for finger biometric technology, check the performance measures and its security

CO2: Develop facial biometric, iris biometric, voice biometric, physiological biometrics for identification technology.

CO3: Understand different types of user interfaces.

CO4: Designing privacy sympathetic biometric systems and identifying the area of biometric applications

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	2	3		3					3	3
CO2	2	3	3	2	2	3		3					3	3
CO3		3	3	1	2	3		2					2	2
CO4	2	3	3	3	2	3		3					3	3

Syllabus

Biometric Fundamentals and Standards: Biometrics versus traditional techniques, Characteristics, Key biometric processes: Verification -Identification -Biometric matching, Performance measures in biometric systems, Assessing the privacy risks of biometrics - Designing privacy sympathetic biometric systems, Different biometric standards, Application properties.

Physiological Biometrics: Facial scan, Ear scan, Retina scan, Iris scan, Finger scan, Automated fingerprint identification system, Palm print, Hand vascular geometry analysis, Knuckle, DNA, Dental, Cognitive Biometrics -ECG, EEG.

Behavioral Biometrics: Signature scan, Keystroke scan, Voice scan, Gait recognition, Gesture recognition, Video face, Mapping the body technology.

User interfaces: Biometric interfaces: Human machine interface -BHMI structure, Human side interface: Iris image interface -Hand geometry and fingerprint sensor, Machine side interface: Parallel port -Serial port -Network topologies, Case study: Palm Scanner interface.

Biometric applications: Categorizing biometric applications, Application areas: Criminal and citizen identification –Surveillance -PC/network access -E-commerce and retail/ATM, Costs to deploy, Issues in deployment, Biometrics in medicine, cancellable biometrics.

Text Books/References:

1. *Anil K Jain, Patrick Flynn and Arun A Ross, Handbook of Biometrics, Springer, US; 2010*
2. *John R Vacca, Biometric Technologies and Verification Systems, Elsevier, USA; 2009*
3. *Samir Nanavati, Michael Thieme and Raj Nanavati, Biometrics –Identity Verification in a Networked World, John Wiley and Sons ; 2003*
4. *Paul Reid, Biometrics for Network Security, Pearson Education; 2004*
5. *ReidM. Bolle et al, Guide to Biometrics, Springer, USA; 2004*
6. *David D Zhang, Automated Biometrics: Technologies and Systems, Kluwer Academic Publishers; 2000.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

ELECTIVES IN BUSINESS SYSTEMS

19CSE358	SOFTWARE PROJECT MANAGEMENT	L-T-P-C:3-0-0-3

Pre-requisite: Nil

Course Objectives

- This course describes the key aspects of a software project.
- It introduces the basic principles of Engineering Software Projects. Most, if not all, students' complete projects as part of assignments in various courses undertaken. These projects range in size, subject and complexity but there are basic project essentials that need to be understood and practiced for successful team project outcomes.
- The course provides an understanding of the purpose, methods and benefits of process management by exposing the student to the concepts, practices, processes, tools and techniques used in process management for software development.

Course Outcomes

CO1: To understand the basic concepts, terminologies and issues of software project management.

CO2: To apply appropriate methods and models for the development of solutions.

CO3: To analyze the cost-benefits of calculations so as to optimize the selection strategy.

CO4: To evaluate methods, models and technologies towards achieving project success.

CO5: To design and evaluate network planning models with criticality.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1								1		3	2
CO2	3	2	3						3	3		2	3	2
CO3	3	2	2	3	2	2	2	2	3	3	2	2	3	2
CO4	2	2	2	1	3	2	2	2	3	3		2	3	2
CO5	3	2	3	3	3	2	2	2	3	3		2	3	2

Syllabus

Unit 1

Introduction to Software Project Management- Software Projects - ways of categorizing software projects – problems with software projects - Project Life Cycle– Management -Setting objectives –Stakeholders - Project Team- Step-wise : An overview of project planning -project Evaluation –Selection Of Appropriate Project Objectives- Software Effort Estimation Techniques, Function Point Analysis-Object Point-COCOMO.

Unit 2

Activity planning-- project schedules - sequencing and scheduling projects - Network planning model – AON and AOA-identifying critical activities-Crashing And Fast Tracking-,Risk management—Categories , Risk planning, Management and Control - Evaluating risks to the schedule. PERT- Resource Allocation, Monitoring and Tracking - Monitoring and control - allocation - identifying resource requirements - scheduling resources - creating critical paths - publishing schedule - cost schedules- sequence schedule.

Unit 3

Monitoring and control – Visualizing Progress, earned value analysis, managing people and organizing teams-organizational structures- Planning for small projects. Case Study: PMBOK, Agile Development

Text Book

Mike Cotterell, Bob Hughes. Software Project Management, Fifth Edition, Tata McGraw-Hill; 2012.

Reference(s)

1. *Roger S. Pressman. Software Engineering – A Practioner's Approach, Eighth Edition, Tata McGraw-Hill publishers; 2014.*
2. *Jalote P. Software Project Management in practice, Second edition, Person Education; 2003.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19CSE359	FINANCIAL ENGINEERING	L-T-P-C:3-0-0-3

Pre-Requisite(s): Nil

Course Objectives

- This course serves as an introduction to financial engineering including cash flows, financial decision making etc.
- It gives a thorough yet highly accessible mathematical coverage of standard and recent topics of introductory investments: fixed-income securities, modern portfolio theory, optimal portfolio growth and valuation of multi-period risky investments.

Course Outcomes

CO1: Apply basic concepts to understand and evaluate cash flows.

CO2: Evaluate and arrive at a financial investment decision employing the underlying knowledge of stocks and derivatives.

CO3: Analyse and design Portfolio selection methods.

CO4: Understand capital market theory for stock performance evaluation

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1			2								3	2
CO2	2	3	1										3	2
CO3	1	3			2								3	2
CO4	2	1											3	2

Syllabus

Unit 1

Cash Flows and Fixed income securities: Investments and markets - Principal and interest - Present and future values of streams - IRR. Fixed income securities - Market value for future cash - Bond value - Bond details – Yields – Convexity – Duration - Immunization. Bond portfolio management - Level of market interest rates, Term structure of interest-rate theories.

Unit 2

Stocks and Derivatives: Common stock valuation - Present value of cash dividends - Earnings approach - Value versus price - Efficient markets theory - Technical analysis. Analysis of financial statements. Derivatives - futures and options - Black Scholes formula - Utility functions - Applications in financial decision making.

Unit 3

Portfolio analysis and capital market theory: Covariance of returns – Correlation - Portfolio return - Portfolio standard deviation - Two asset case - Efficient frontier - Optimum portfolio. Capital market theory - Capital market line - Sample diversifications to reduce risk - Characteristic line - Capital asset pricing model. Arbitrage price theory - Stock performance evaluation.

Text Book(s)

1. *David Luenberger, Investment Science. Second Edition, Oxford University Press; 2013*
2. *Jack Clark Francis, Richard W. Taylor. Investments, Schaum's Outlines, Tata McGraw Hill ;2006.*

Reference(s)

1. *Lyuu YD. Financial Engineering and Computation. Cambridge University Press; 2004.*
2. *Perry H. Beaumont. Financial Engineering Principles. John Wiley and Sons Inc, New Jersey; 2004.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

19MNG331	FINANCIAL MANAGEMENT	L-T-P-C:3-0-0-3

Course Objectives

The course would prepare engineering students to understand the overview of financial management; inculcate methods and concepts on valuation and familiarize with working capital management, financial analysis and planning.

Course Outcomes

CO1: Understand the overview of financial management.

CO2: Apply methods and concepts on valuation.

CO3: Understand with working capital management, financial analysis and planning.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3					1	1		3	3	3	2
CO2	2	3	3					2	1		3	3	3	2
CO3	2	3	2					1	1		3	3	3	2

Syllabus

Unit 1

Introduction: Financial Management an overview – Financial Decisions in a firm – Goal of FM – Function of the financial system.

Unit 2

Fundamental Valuation Concepts: Time value of money – Risk and Return. Capital Budgeting: Techniques of capital budgeting investment criteria– NPV – Benefit Cost Ratio – IRR – Payback Period – ARR – Investment appraisal in Practice – Estimation of Project cost flows.

Unit 3

Working Capital Management: Current Assets – Financing Ruling – Profit Criterion. Cash and Liquidity Management. Working Capital Financing, Financial Analysis and Planning**:** financial instruments, sources of long-term, intermediate term and short-term finance.

Analyzing Financial Performance – Break – even analysis and Leverages – Financial Planning and Budgeting, Mergers and Takeovers- International trade.

Text Book(s)

1. *Chandra, P. Financial Management: Theory and Practice, Ninth Edition, TMH; 2017.*
2. *Denzil Watson, Antony Head. Corporate Finance- Principles and Practice, Second Edition, Pearson Education Asia; 2016.*
3. *R L Varshney, K L. Maheshwari. Managerial Economics, S Chand & Sons; 2014.*

Reference(s)

1. *Stephen Blyth. An Introduction to Corporate Finance, McGraw Hill Book Company; 2014.*
2. *Brigham EF, Ehrhardt MC, Nason RR, Gessaroli J. Financial Management: Theory &Practice, Canadian Edition. Nelson Education; 2016.*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.

20MNG331	INFORMATION SECURITY RISK MANAGEMENT	L-T-P-C:3-0-0-3

Course Objectives

- Understand context of information security management, Identify and value information assets
- Identify and prioritize threats to information assets
- Define an information security strategy and architecture
- Understand the risk management surrounding information systems and learn how security and management are interrelated

Course Outcome

CO1: Able to identify threats and vulnerabilities to Information Systems.

CO2: Understand risk management, risk analysis and how to mitigate risks.

CO3: Able to perform testing and vulnerability assessment.

CO4: Able to manage information security and evaluate and design information architecture using secure coding practices.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		3	2	3	1					3		1	3	3
CO2		3	2	3	1					3		1	3	
CO3		3	2	3	3					3	3	2	3	3
CO4		3	3	3	3					3	3	2	3	3

Syllabus

Unit 1

Management systems, Context of information security management system, Security Governance and Management, Threats to Information Systems, Threat categorization, Vulnerability categorization, Information technology and security basics, Concept of IT security, Need for securing IT resources, Policy framework on IT assets security, Management of IT security, Importance of training, Business Process Outsourcing, Applications of e-business issues and trends, Concepts of risk management- Risk based planning of Information

Systems, Risk management of Information Systems, Why Risk Assessment, and When Risk Assessment to be conducted. Information Security Risk Analysis, Approaches to risk analysis / assessment, Risk Assessment, Risk Mitigation, Effectiveness Evaluation, Risk due to Social Engineering, Cost Benefit Analysis.

Unit 2

Disaster Recovery & Business Continuity Management, Business impact analysis, Business Continuity and DR Plan development, Exercising, Maintenance and revision of plan, importance of training, Objectives and methods for risk assessment, Natural disaster, Technological hazards and terrorist threats, implications for emergency response, Vulnerability of critical infrastructures. Privacy Management, Privacy regulations and laws, GDPR, HIPAA and PDPA

Unit 3

Managing Information Security, Organization and responsibilities, Information Security Governance, Security Incident Management, Application Security, Data and information Analyze, evaluate and design information architecture, Role of databases and database management systems, Knowledge management systems and data warehouses, Secure Coding Practices, ISO 27001 - Domains, Introduction to SOX, HIPAA, CoBlT.

Textbooks:

1. *Kairab, Sudhanshu. A practical guide to security assessments. CRC Press; 2004*
2. *Harold F. Tipton and Micki Krause, Information Security Management Handbook, Fifth Edition, CRC Press; 2004*

References:

1. *Kevin Lam, David LeBlanc and Ben Smith, Assessing Network Security, Microsoft Press; 2004*
2. *Simson Garfinkel, Web Security, Privacy & Commerce, Second Edition O'Rely, Computer networks / Security measures; 2002*
3. *Thomas R. Peltier, Information Security Risk Analysis, CRC Press; 2001*
4. *Whitman, M. and Mattord, H., Principles of Information Security, Second Edition, Boston: Thomson Course Technology; 2005*

Evaluation Pattern

Assessment	Internal	External
Periodical 1	15	
Periodical 2	15	
*Continuous Assessment (CA)	20	
End Semester		50

*CA – Can be Quizzes, Assignment, Projects, and Reports.