

**CURRICULUM
OF
BS INFORMATION TECHNOLOGY**

(2026)



**RAWALPINDI WOMEN UNIVERSITY,
RAWALPINDI**

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1. Program Vision

To empower women with cutting-edge knowledge, critical thinking, and innovative solutions in information technology, fostering their role as leaders and change-makers in the digital era.

2. Program Mission

To deliver high-quality education in information technology, inspiring women to excel as innovative professionals, researchers, and ethical contributors to the global IT industry. By promoting economic independence, sustainable practices, and lifelong learning, the department aims to prepare students for dynamic challenges in technology-driven fields.

3. Program Objectives (PO's)

Professional Competence (PO 1): Our graduates will have professional career in industry, academia, R&D organizations or in a self-initiated entrepreneurial undertaking.

Complex Problem-Solving (PO 2): Our graduates will be able to analyze problems and create sustainable solutions using their domain knowledge and modern IT tools. Also, they will have the ability to adapt to the changes in technology and the needs of society.

Lifelong Learning (PO 3): Our graduates will continue to seek knowledge for professional advancement and enhanced awareness about safe IT practices and environmental concerns.

Ethical Responsibility and Team Work (PO 4): Our graduates will manage assigned projects as individuals or as part of an interdisciplinary team. They will be effective communicators and will conduct themselves with integrity, upholding the principles of ethics and social responsibly.

4. Mapping of PEOs to University and Departmental Vision and Mission

Vision and Mission	Program Objectives (POs)			
	PEO-1	PEO-2	PEO-3	PEO-4
University Vision	✓	✓	✓	✓
Department Vision	✓	✓	✓	✓
Department Mission	✓	✓	✓	✓

5. Graduate Attributes (GAs)

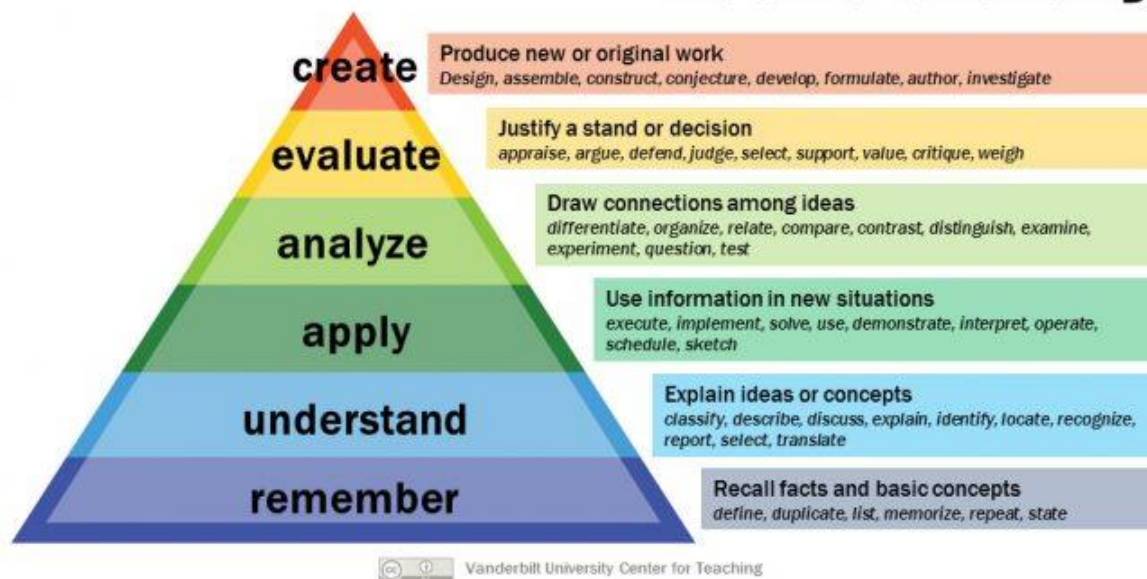
Computing programs prepare students to attain educational objectives by ensuring that students demonstrate achievement of the following outcomes.

1. Academic Education	Completion of an accredited program of study designed to prepare graduates as computing professionals.
2. Knowledge for Solving Computing Problems	Apply knowledge of computing fundamentals, knowledge of a computing specialization, and mathematics, science, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.
3. Problem Analysis	Identify and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.
4. Design/Development of Solutions	Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs.
5. Modern Tool Usage	Create, select, or adapt and then apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
6. Individual and Teamwork	Function effectively as an individual and as a member or leader of a team in multidisciplinary settings.
7. Communication	Communicate effectively with the computing community about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions
8. Computing Professionalism and Society	Understand and assess societal, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice

9. Ethics	Understand and commit to professional ethics, responsibilities, and norms of professional computing practice.
10. Life-long Learning	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.

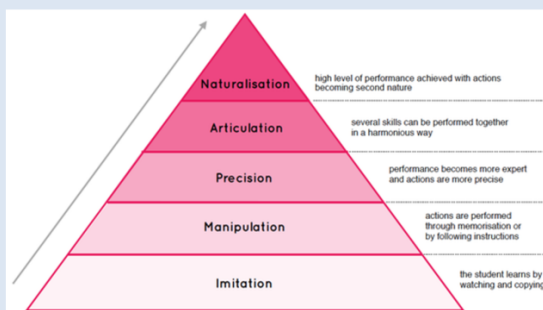
6. Bloom's Taxonomy for Cognitive Domain (Program Courses)

Bloom's Taxonomy



7. Bloom's Taxonomy for Psychomotor Domain (Program Labs)

Lab CLOs - Psychomotor Domain (Dave's Taxonomy)



BT Level	Keywords
Imitation	Attempt, Copy, Imitate, Mimic, Follow, Repeat, Duplicate, Replicate, Reproduce
Manipulation	Act, Build, Execute, Perform, Complete, Accomplish, Follow, Play, Produce.
Precision	Achieve automatically, Excel expertly, Perform masterfully, Demonstrate skillfully, Calibrate perfectly
Articulation	Adapt, Construct, Combine, Create, Customize, Modify, Formulate, Alter, Originate
Naturalization	Create, Design, Develop, Invent, Manage naturally or perfectly

8. CLO-GA Mapping

CLO to GA Mapping												
BS (IT) Courses			Academic Education	Knowledge for Solving Computing Problems	Problem Analysis	Design/Development of Solutions	Modern Tool Usage	Individual and Teamwork	Communication	Computing Professionalism and Society	Ethics	Life-long Learning
Semester	Course Code	Course Title	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10
Semester 1	ENG-110	Functional English	1	0	0	0	0	0	1	0	1	1
	PAK-103	Ideology and Constitution of Pakistan	1	0	0	0	0	0	0	1	0	1
	PHY-103	Applied Physics	1	1	1	1	0	0	0	0	0	0
	PHY-103L	Applied Physics (Lab)	1	0	0	1	1	1	0	0	0	0
	MTH 104	Calculus and Analytical Geometry (QR-I)	1	1	0	0	0	0	0	0	0	0
	CS-122	Programming Fundamentals	1	0	1	1	1	0	0	0	0	0
	CS-122L	Programming Fundamentals (Lab)	1	1	0	1	0	1	0	0	0	0
	CS-107	Application of Information and Communication Technologies	1	1	0	1	0	0	0	0	0	0
	CS-107L	Application of Information and Communication Technologies (Lab)	0	0	1	0	1	1	0	0	0	0
Semester 2	CS-209	Professional Practices (Arts and Humanities)	1	1	0	0	0	0	0	1	1	1
	CS-125	Object Oriented Programming	1	1	0	1	0	0	0	0	0	0

	CS-125L	Object Oriented Programming (Lab)	0	1	1	0	1	0	0	0	0	0
	CS-126	Digital Logic Design	1	1	0	1	0	0	0	0	0	0
	CS-126L	Digital Logic Design (Lab)	0	1	1	0	0	1	0	0	0	0
	MTH 107	Multivariable Calculus	1	1	1	0	0	0	0	0	0	0
	ISL-101/ETH-101	Islamic Studies/Ethics	0	1	0	0	0	0	1	0	1	1
	CS-123	Discrete Structures (QR-II)	0	1	1	1	0	0	0	0	0	0
	UHQ-101/ETH-103	Understanding of Holy Quran-I/Ethics-I	1	1	0	0	0	0	1	1	1	1
Semester 3	CS-210	Data Structures	1	1	0	1	1	0	0	0	0	0
	CS-210L	Data Structures (Lab)	0	1	1	0	0	1	0	0	0	0
	CS-208	Computer Networks	1	1	1	1	0	0	0	0	0	0
	CS-208L	Computer Networks (Lab)	0	0	1	0	1	1	0	0	0	0
	STA 106	Introduction to Probability and Statistics	1	1	1	1	0	0	0	0	0	0
	CS-203	Database Systems	1	1	0	1	0	0	0	0	0	0
	CS-203L	Database Systems (Lab)	0	1	1	1	0	0	0	0	0	0
	CS-201	Software Engineering	1	1	1	1	0	0	0	0	0	0
Semester 4	MGT-104	Introduction to Management (Social Sciences)	1	1	0	0	0	0	0	0	1	0
	ENG-111	Expository Writing	1	0	0	0	0	0	1	0	1	0
	PAK 103	Pakistan Studies	1	1	0	0	0	0	0	1	0	1
	CCE-497	Civic and Community Engagement	0	0	0	0	0	1	0	1	1	0
	CS-206	Artificial Intelligence	1	1	0	1	0	0	0	0	0	0
	CS-206L	Artificial Intelligence (Lab)	0	1	0	1	1	0	0	0	0	0
	MGT-108	Entrepreneurship	0	1	1	0	0	0	0	0	0	0
	UHQ-102/ETH-104	Understanding of Holy Quran-II/Ethics-II	1	1	1	0	0	0	1	0	1	1
	CS-316	Operating Systems	1	1	1	0	0	0	0	0	0	0

Semester 5	CS-316L	Operating Systems (Lab)	0	0	0	1	1	1	0	0	0	0
	IT-318	Database Administration and Management	1	0	1	1	0	0	0	0	0	0
	IT-318L	Database Administration and Management (Lab)	0	1	0	0	1	1	0	0	0	0
		Domain Elective 1	0	0	0	0	0	0	0	0	0	0
		Domain Elective 2	0	0	0	0	0	0	0	0	0	0
	CS-319	Information Security	1	0	0	1	1	0	0	0	0	0
	CS-319L	Information Security (Lab)	0	1	1	0	0	1	0	0	0	0
	MTH 111	Elementary Linear Algebra	1	1	0	0	0	0	0	0	0	0
Semester 6	IT-312	Information Technology Infrastructure	1	1	1	0	0	0	0	0	0	0
	IT-312L	Information Technology Infrastructure (Lab)	0	0	0	1	1	1	0	0	0	0
	CS-413	Analysis of Algorithms	1	1	1	1	0	0	0	0	0	0
	IT-311	Cyber Security	0	1	1	1	0	0	0	0	0	0
	IT-311L	Cyber Security (Lab)	1	0	0	0	1	1	0	0	0	0
		Domain Elective 3	0	0	0	0	0	0	0	0	0	0
		Domain Elective 4	0	0	0	0	0	0	0	0	0	0
		Domain Elective 5	0	0	0	0	0	0	0	0	0	0
Semester 7		Total Cr Hrs	0	0	0	0	0	0	0	0	0	0
	CS-318	Computer Organization and Assembly Language	1	1	1	0	0	0	0	0	0	0
	CS-318L	Computer Organization and Assembly Language (Lab)	0	0	1	1	1	0	0	0	0	0
	IT-310	Web Technologies	0	1	1	1	0	0	0	0	0	0
	IT-310L	Web Technologies (Lab)	0	0	0	1	1	1	0	0	0	0
		Domain Elective 6	0	0	0	0	0	0	0	0	0	0
		Domain Elective 7	0	0	0	0	0	0	0	0	0	0
	INT-499	Internship	0	0	0	0	0	0	0	0	0	0

	ENG 104	Business and Technical Writing	1	1	1	0	0	0	1	0	1	0
		Total Cr Hrs	0	0	0	0	0	0	0	0	0	0
Semester 8	CP-499	Capstone Project	1	1	1	1	1	1	1	1	1	1
	IT-405	System and Network Administration	0	1	1	1	0	0	0	0	0	0
	IT-405L	System and Network Administration (Lab)	1	0	0	0	1	1	0	0	0	0
		Elective Supporting Course	0	0	0	0	0	0	0	0	0	0
	IT-406	Parallel and Distributed Computing	1	0	1	1	0	0	0	0	0	0
	IT-406L	Parallel and Distributed Computing (Lab)	0	1	0	0	1	1	0	0	0	0
		Total Subject Targeting Each PLO	35	39	28	28	17	16	7	6	10	8

9. Final Year Project Learning Outcome

In line with the department's academic objectives and the guidelines provided by the Higher Education Commission (HEC) and national accreditation bodies, the Final Year Project (FYP) serves as a capstone experience for students. It allows them to demonstrate their competence across the Graduate Outcomes (GAs) that span technical, professional, ethical, and communication skills.

The following FYP assessment rubrics have been carefully designed to ensure a transparent, comprehensive, and outcomes-based evaluation of each student's performance, mapped directly to the PLOs of the Information Technology program.

It is mandatory for each FYP to map to United Nations Sustainable Development Goals UN SGDs.

FYP CLOs

GA	CLO	Taxonomy Level	Excellent (4)	Good (3)	Satisfactory (2)	Poor (1)
GA 1 Academic Education	Describe core principles and foundational knowledge in information technology, defining real-world project problems.	C1 Remember	Applies broad, in-depth knowledge across courses	Applies relevant knowledge with minor gaps	Applies basic knowledge with limited scope	Fails to apply relevant academic knowledge
GA 2 Knowledge for Solving Computing Problems	Elaborate scope, problem statement and objectives of the design/research project using the acquired engineering knowledge and skills.	C2 Understand	Uses appropriate theory, math, and domain knowledge effectively	Applies most required concepts correctly	Applies few relevant concepts; limited problem focus	Concepts misapplied or irrelevant
GA 3 Problem Analysis	Examine problem formulation of the design/research project in accordance with the existing literature.	C4 Analyze	Clearly identifies, analyzes, and justifies problem scope	Good analysis with some minor flaws	Problem identified with weak justification	Problem poorly identified or unjustified
GA 4 Design and Development of Solutions	Design and implementation of an appropriate technical solution	C3 Apply	Innovative, complete, and technically sound solution	Functional design with some limitations	Basic or partially working solution	Incomplete or faulty solution
GA 5 Modern Tool Usage	Adapt the use of appropriate computing tools and technologies	P6 Adaptation	Tools selected and used proficiently with customization	Suitable tools used effectively	Tools used with limited efficiency	Tools misused or inappropriate

GA	CLO	Taxonomy Level	Excellent (4)	Good (3)	Satisfactory (2)	Poor (1)
GA 6 Individual and Teamwork	Initiation and demonstration of teamwork and role responsibility	A4 Organize	Excellent leadership and consistent contribution	Active participation with clear role	Minimal participation or unclear role	Lacks contribution; negatively impacts team
GA 7 Communication	Verification of the quality of written, oral, and visual project communication	A5 Internalize	Clear, engaging, professional reports and presentations	Generally clear with minor communication flaws	Adequate but needs improvement	Unclear, disorganized, or ineffective communication
GA 8 Computing Professionalism and Society	Pursue the awareness of societal and professional responsibilities and mapping of project to one or more UN SGDs	A3 Value	Fully considers legal, ethical, and societal impacts	Considers most relevant professional issues	Limited or partial awareness shown	No consideration of social or professional issues
GA 9 Ethics	Adoption of ethical practices and academic integrity	A3 Value	Fully ethical with proper citations and professional behavior	Minor ethical lapses; mostly proper conduct	Lapses in citation or handling of data/code	Major ethical breaches or plagiarism
GA 10 Life-long Learning	Initiative to learn new skills or tools beyond curriculum	A5 Internalize	Independently learns and applies new advanced skills	Seeks and applies new knowledge with guidance	Minimal new learning effort	No attempt to learn or adapt new knowledge

10. Admission Criteria for BSIT

As per approved Admission Policy RWU notified vide Notification No. RWU/VC/01/341;
dated: 10th Mar, 2023

11. Division and Distribution of Courses for BSIT

S#	Areas	Credit Hours	Courses
1	Computing Core	46	14
2	Domain Core	18	6
3	Domain Elective	21	7
4	Mathematics and Supporting Courses (Interdisciplinary/ Allied)	12	4
5	Elective Supporting Courses	3	1
6	Mandatory	5	3
7	General Education Requirement	33	13
	Totals	138	48

- Total Credit Hours 138
- Duration 4 Years
- Semester Duration 16 - 18 Weeks
- Semesters 8
- Course Load Per Semester 15 - 18 Credit Hours

12.Scheme of Studies for Regular Batch BS IT

RAWALPINDI WOMEN UNIVERSITY, RAWALPINDI					
Department of Information Technology (SOS for 2025 onwards)					
Semester	Course Code	Course Title	Course Type	Pre-Req	Cr
Semester 1	ENG-110	Functional English	General Education	NIL	3
	PAK 104	Pakistan Studies	General Education	NIL	2
	PHY-103	Applied Physics	General Education	NIL	2
	PHY-103L	Applied Physics (Lab)	General Education	NIL	1
	MTH 104	Calculus and Analytical Geometry (QR-I)	General Education	NIL	3
	CS-122	Programming Fundamentals	Computing Core	NIL	3
	CS-122L	Programming Fundamentals (Lab)	Computing Core	NIL	1
	CS-107	Application of Information and Communication Technologies	General Education	NIL	2
	CS-107L	Application of Information and Communication Technologies (Lab)	General Education	NIL	1
	Total Cr Hrs				18
Semester 2	CS-209	Professional Practices (Arts and Humanities)	General Education	Nil	2
	CS-125	Object Oriented Programming	Computing Core	Programming Fundamentals	3
	CS-125L	Object Oriented Programming (Lab)	Computing Core	Programming Fundamentals	1
	CS-126	Digital Logic Design	Computing Core	NIL	2
	CS-126L	Digital Logic Design (Lab)	Computing Core	NIL	1
	MTH 107	Multivariable Calculus	Interdisciplinary/ Allied	Calculus and Analytical Geometry	3
	ISL-101/ ETH-101	Islamic Studies/ Ethics	General Education	NIL	2
	CS-123	Discrete Structures (QR-II)	General Education	Nil	3
	UHQ-101 /ETH-103	Understanding of Holy Quran- I/Ethics-I	Mandatory	NIL	1
	Total Cr Hrs				18
Semester 3	CS-210	Data Structures	Computing Core	Object Oriented Programming	3
	CS-210L	Data Structures (Lab)	Computing Core	Object Oriented Programming	1
	CS-208	Computer Networks	Computing Core	NIL	2
	CS-208L	Computer Networks (Lab)	Computing Core	NIL	1

	STA 106	Introduction to Probability and Statistics	Interdisciplinary/Allied	NIL	3
	CS-203	Database Systems	Computing Core	NIL	3
	CS-203L	Database Systems (Lab)	Computing Core	NIL	1
	CS-201	Software Engineering	Computing Core	NIL	3
		Total Cr Hrs			17
Semester 4	MGT-104	Introduction to Management (Social Sciences)	General Education	Nil	3
	ENG-111	Expository Writing	General Education	NIL	3
	PAK-103	Ideology and Constitution of Pakistan	General Education	NIL	2
	CCE-497	Civic and Community Engagement	General Education	NIL	2
	CS-206	Artificial Intelligence	Computing Core	Object Oriented Programming	2
	CS-206L	Artificial Intelligence (Lab)	Computing Core	Object Oriented Programming	1
	MGT-108	Entrepreneurship	General Education	NIL	2
	UHQ-102 /ETH-104	Understanding of Holy Quran- II/Ethics-II	Mandatory	NIL	1
		Total Cr Hrs			16
Semester 5	CS-316	Operating Systems	Computing Core	Data Structures	2
	CS-316L	Operating Systems (Lab)	Computing Core	Data Structures	1
	IT-318	Database Administration and Management	Domain Core	Database Systems	2
	IT-318L	Database Administration and Management (Lab)	Domain Core	Database Systems	1
		Domain Elective 1	Domain Elective	NIL	3
		Domain Elective 2	Domain Elective	NIL	3
	CS-319	Information Security	Computing Core	NIL	2
	CS-319L	Information Security(Lab)	Computing Core	NIL	1
	MTH 111	Elementary Linear Algebra	Interdisciplinary/	NIL	3
		Total Cr Hrs			18
Semester 6	IT-312	Information Technology Infrastructure	Domain Core	NIL	2
	IT-312L	Information Technology Infrastructure(Lab)	Domain Core	NIL	1
	CS-413	Analysis of Algorithms	Computing Core	Data structures	3
	IT-311	Cyber Security	Domain Core		2
	IT-311L	Cyber Security (Lab)	Domain Core		1

		Domain Elective 3	Domain Elective	NIL	3
		Domain Elective 4	Domain Elective	NIL	3
		Domain Elective 5	Domain Elective	NIL	3
		Total Cr Hrs			18
Semester 7	CS-318	Computer Organization and Assembly Language	Computing Core	Digital Logic Design	2
	CS-318L	Computer Organization and Assembly Language (Lab)	Computing Core	Digital Logic Design	1
	IT-310	Web Technologies	Domain Core	NIL	2
	IT-310L	Web Technologies(Lab)	Domain Core	NIL	1
		Domain Elective 6	Domain Elective	NIL	3
		Domain Elective 7	Domain Elective	NIL	3
	INT-499	Internship	Mandatory	NIL	3
	ENG 104	Business and Technical Writing	Interdisciplinary/Allied	NIL	3
	CP-499	Capstone Project*	Computing Core	NIL	6
		Total Cr Hrs			18
Semester 8	CP-499	Capstone Project	Computing Core	NIL	6
	IT-405	Domain Core 4 (System and Network Administration)	Domain Core	Operating systems	2
	IT-405L	System and Network Administration (Lab)	Domain Core	Operating systems	1
		Elective Supporting Course	SS	NIL	3
	IT-406	Parallel and Distributed Computing	Domain Core	Operating System	2
	IT-406L	Parallel and Distributed Computing(Lab)	Domain Core	Operating System	1
		Total Cr Hrs			15
Total Credit Hours: 138					

* The credit hours against Capstone stone project are not added to the cumulated credit hours of the semester.

13. Scheme of Studies for Lateral Entry Annual System

RAWALPINDI WOMEN UNIVERSITY, RAWALPINDI IT (SOS 2028 Lateral entry BSc with 50 Cr Hr)					
Semester	Course Cod	Course Title	Course Type	Pre-Requisite	Credit Hours
Fifth	CS-125	Object Oriented Programming	Computing Core	Programming Fundamentals	3
	CS-125L	Object Oriented Programming (Lab)	Computing Core	Programming Fundamentals	1
	MTH 104	Calculus and Analytical Geometry (QR-I)	General Education	Nil	3
	CS-413	Analysis of Algorithms	Computing Core	Nil	3
	CS-208	Computer Networks	Computing Core	Nil	2
	CS-208L	Computer Networks (Lab)	Computing Core	Nil	1
		Domain Elective 1	Domain Elective	Nil	3
	CS-319	Information Security	Computing Core	Nil	2
	CS-319L	Information Security (Lab)	Computing Core	Nil	1
Total					19
Sixth	CS-203	Database Systems	Computing Core	Nil	3
	CS-203L	Database Systems (Lab)	Computing Core	Nil	1
	IT-310	Web Technologies	Domain Core	Nil	2
	IT-310L	Web Technologies (Lab)	Domain Core	Nil	1
		Domain Elective 2	Domain Elective	Nil	3
		Domain Elective 3	Domain Elective	Nil	3
	IT-311	Cyber Security	Domain Core	Nil	2
	IT-311L	Cyber Security (Lab)	Domain Core	Nil	1
	CS-202	Data Structures	Computing Core	Object Oriented Programming	3
	CS-202L	Data Structures (Lab)	Computing Core	Object Oriented Programming	1
Total					20
Summer	STA 106	Introduction to Probability and Statistics	Interdisciplinary/ Allied	Nil	3
	MGT 105	Introduction to Digital Marketing	Social Sciences	Nil	3
	CS-123	Discrete Structures (QR-II)	General Education	Nil	3
Total					9
Seventh	INT-499	Internship	Mandatory	Nil	3
	IT-405	System and Network Administration	Domain Core	Nil	2
	IT-405L	System and Network Administration (Lab)	Domain Core	Nil	1
	ENG-104	Business and Technical Writing	Interdisciplinary/Allied	Nil	3
		Domain Elective 4	Domain Elective	Nil	3
	CCE-497	Civic and Community Engagement	General Education	Nil	2
	IT-312	Information Technology Infrastructure	Domain Core	Nil	2
	IT-312L	Information Technology Infrastructure (Lab)	Domain Core	Nil	1
	IT-406	Parallel and Distributed Computing	Domain Core	Nil	2
	IT-406L	Parallel and Distributed Computing (Lab)	Domain Core	Nil	1
	CP-499	Capstone Project	Computing Core	Nil	6
Total					20
Eighth	CP-499	Capstone Project	Computing Core	Nil	6
		Domain Elective 5	Domain Elective	Nil	3
		Domain Elective 6	Domain Elective	Nil	3
		Domain Elective 7	Domain Elective	Nil	3
	IT-318	DB Administration and Management	Domain Core	Database Systems	2
	IT-318L	DB Administration and Management (Lab)	Domain Core	Database Systems	1
	MGT-108	Entrepreneurship	General Education	NIL	2
Total					20
Grand Total					88
BSc					50
Total					138

14. Scheme of Studies for Lateral Entry Semester System

Sch+A1:F41eme of studies for ADP Lateral Entry Information Technology 2028 (65 credit hours)					
Semester	Course Code	Course Name	Course Type	Pre Requisite	Credit Hours
Fifth	CS-209	Professional Practices (Arts and Humanities)	General Education	Nil	2
	CS-413	Analysis of Algorithms	Computing Core	Nil	3
	CS-202	Data Structures	Computing Core	Object Oriented Programming	3
	CS-202L	Data Structures (Lab)	Computing Core	Object Oriented Programming	1
		Domain Elective 1	Domain Elective	Nil	3
	IT-310	Web Technologies	Domain Core	Nil	2
	IT-310L	Web Technologies (Lab)	Domain Core	Nil	1
	MTH-107	Multivariable Calculus	Interdisciplinary/Allied	Calculus and Analytical Geometry	3
Total					18
Sixth	STA 106	Introduction to Probability and Statistics	Interdisciplinary/Allied	Nil	3
	CS-316	Operating Systems	Computing Core	Data Structures	2
	CS-316L	Operating Systems (Lab)	Computing Core	Data Structures	1
		Domain Elective 2	Domain Elective	Nil	3
		Domain Elective 3	Domain Elective	Nil	3
	IT-311	Cyber Security	Domain Core	Nil	2
	IT-311L	Cyber Security (Lab)	Domain Core	Nil	1
		Domain Elective 4	Domain Elective	Nil	2
		Domain Elective 4 (Lab)	Domain Elective	Nil	1
	CCE-497	Civic and Community Engagement	General Education	Nil	2
Total					20
Seventh	INT-499	Internship	Mandatory	Nil	3
	IT-318	DB Administration and Management	Domain Core	Database Systems	2
	IT-318L	DB Administration and Management (Lab)	Domain Core	Database Systems	1
	ENG-104	Business and Technical Writing	Interdisciplinary/Allied	Nil	3
		Domain Elective 5	Domain Elective	Nil	3
	IT-405	System and Network Administration	Domain Core	Nil	2
	IT-405L	System and Network Administration (Lab)	Domain Core	Nil	1
	IT-312	Information Technology Infrastructure	Domain Core	Nil	2
	IT-312L	Information Technology Infrastructure (Lab)	Domain Core	Nil	1
	CP-499	Capstone Project	Computing Core	Nil	6
Total					18
Eighth	CP-499	Capstone Project	Computing Core	Nil	6
		Domain Elective 6	Domain Elective	Nil	3
		Domain Elective 7	Domain Elective	Nil	3
	IT-406	Parallel and Distributed Computing	Domain Core	Nil	2
	IT-406L	Parallel and Distributed Computing (Lab)	Domain Core	Nil	1
	MGT-108	Entrepreneurship	General Education	NIL	2
	Total				17
Total Credit Hours:					73
ADP					65
Degree Total Credit Hours:					138

15.List of Computing Core Courses of IT

Sr#	Course Code	Course Title	Pre- Requisite	Cr Hr.
1	CS-122	Programming Fundamentals		3
2	CS-122L	Programming Fundamentals (Lab)		1
3	CS-125	Object Oriented Programming	Programming Fundamentals	3
4	CS-125L	Object Oriented Programming (Lab)	Programming Fundamentals	1
5	CS-203	Database Systems		3
6	CS-203L	Database Systems (Lab)		1
7	CS-126	Digital Logic Design		2
8	CS-126L	Digital Logic Design (Lab)		1
9	CS-210	Data Structures	Object Oriented Programming	3
10	CS-210L	Data Structures (Lab)	Object Oriented Programming	1
11	CS-319	Information Security		2
12	CS-319L	Information Security (Lab)		1
13	CS-206	Artificial Intelligence	Object Oriented Programming	2
14	CS-206L	Artificial Intelligence (Lab)	Object Oriented Programming	1
15	CS-208	Computer Networks		2
16	CS-208L	Computer Networks (Lab)		1
17	CS-201	Software Engineering		3
18	CS-318	Computer Organization and Assembly Language	Digital Logic Design	2

19	CS-318L	Computer Organization and Assembly Language (Lab)	Digital Logic Design	1
20	CS-316	Operating Systems	Data Structures	3
21	CS-316L	Operating Systems (Lab)	Data Structures	1
22	CS-413	Analysis of Algorithms	Data Structures	3
23	CP-499	Capstone Project		6

16.Course Outlines for Computing Core Courses of IT

Programming Fundamentals

BS-Computer Science

Course Code: CS-122

Credit Hours: 03

Pre-requisite: Nil

Objectives

The objective of course is to introduce a disciplined approach to Problem solving methods and algorithm development. The aim is to teach the syntax and vocabulary of a modern programming language like C++. The significant philosophies and logical programming, including models or I/O, processing, and all related terminology will be taught. Simple programs will be constructed, using a number of different logical, calculation and algorithm.

Learning Outcomes

- **Understand** fundamental concepts of structured programming along with problem solving techniques and analytical thinking (**C2 Understand - PLO 1**).
- **Analyze** problem requirements to recognize what type of data and processes are involved in solution (**C4 Analyze - PLO 3**).
- **Apply** basic concepts to alter and expand short programs and algorithms. Writing pseudo-codes and simple program development using standard control structures and functions (**C3 Apply -PLO 4**).
- **Design** module-based approach to gratify those requirements, and organize program code for implementation (**C6 Create PLO-5**).

Course Outline

Unit 1. Introduction, Declarations, Control Structures

Analyzing, implementation, testing and debugging, Object oriented programming languages, what is C, Getting Started with C, Computer Program Engineering, Decision Control structure (if statement, Multiple Statements within if, if-else statement, Nested if-else's), logical operators Hierarchy and conditional operators.

Unit 2. Loops, Statements, Functions

Loop's structure (while, do while, for loop), break statement, continue statement, go to statement, case control structure, Decisions using switch, Function (prototype, declaration, calling, function body), User & system defined functions, why use functions, Parameters, arguments, passing values between functions, Scope rule of functions, Advanced features of functions, Call by value and call by reference, Recursion, Fibonacci series, Recursion vs. iteration.

Unit 3. Arrays & Pointers

What are arrays, Array initialization, Bounds checking, Passing array elements to functions, Passing an entire array to a function, More the one dimension, Initializing A 2-Dimensional array, Memory map of 2-Dimensional array, Three Dimensional arrays, Puppeting on string, What are strings, More about string., Pointers overview, Return data from function, Pointer and array, Pointers and strings, Double indirection ,Pointers to pointers , Pointer and array, Pointers and strings, Double indirection.

Unit 4. Searching and Sorting

Searching Algorithms, Sorting Algorithms, Graphics in C.

Unit 5. Structures & File Handling

Why use structures, declaring a structures, accessing structures elements, how structures elements are stored, Array of structures, Additional features of structures, Uses of structures, Unions, Unions of structures, Structures and pointers, Files, Types of Disk I/O, Standard Input/output, Binary Mode and Text Mode, Record Input/Out, Random access, Error condition, System-level Input/output.

Recommended Books/Reference Material

1. Bin Uzayr, S. (2022). Mastering C++ Programming Language: A Beginner's Guide. CRC Press.
2. Deitel, H., & Deitel, P. C. (2021). How to program. Pearson.
3. Deitel, P., & Deitel, H. (2022). C++ 20 for Programmers: An Objects-Natural Approach. Pearson.
4. Doyle, B. (2014). C# Programming: from problem analysis to program design. Cengage Learning.
5. Gaddis, T. (2008). Starting Out with Programming Logic and Design, 2/e. Pearson Education India.
6. Gregoire, M. (2021). Professional C++. John Wiley & Sons.
7. Hanly, J. R., & Koffman, E. B. (2007). Problem solving and program design in C. Pearson Education India.
8. Lafore, R. (1997). Object-oriented programming in C++. Pearson Education.

Programming Fundamentals LAB

BS-Computer Science

Course Code: CS-122L

Credit Hours: 01

Pre-requisite: Nil

Objectives

This course helps the students to understand basic knowledge of visual studio and computer programs and capable of designing different C language programs and flowcharts.

Learning Outcomes

- **Implement** fundamental knowledge and understanding of computer programming using C Language program constructs **(P2 Manipulation PLO 1)**.
- **Demonstrate** the use of software tool, Microsoft Visual Studio for program development in C Language **(P3 Precision PLO 2)**.
- **Apply** the knowledge of C programming to develop small-to-moderate scale software applications and use Visual Studio software tool for program testing and debugging **(P4 Articulation PLO 4)**.
- **Execute** module-based approach to gratify those requirements, and organize program code for implementation in teams **(P2 Manipulation PLO-6)**.

Course Outline

Unit 1. Introduction to Framework

Installation of visual studio, Variable Declaration and Initialization, Programming Syntax, Decision Control structure (if statement, Multiple Statements within if, if-else statement, Nested if-else's).

Unit 2. Loops, Statements, Functions

Loop's structure (while, do while, for loop), break statement, continue statement, go to statement, case control structure, Decisions using switch, Function, User & system defined functions, Parameters, arguments, passing values between functions, Call by value and call by reference, Recursion, Fibonacci series.

Unit 3. Arrays & Pointers

Array initialization, bounds checking, passing array elements to functions, passing an entire array to a function, More the one dimension, Initializing A 2-Dimensional array, Three Dimensional arrays, Puppeting on string, Return data from function, Pointer and array, Pointers and strings, Double indirection, Pointers to pointers.

Unit 4. Searching and Sorting

Searching Algorithms, Sorting Algorithms, Graphics in C.

Unit 5. Structures & File Handling

Declaring a structures, accessing structures elements, how structures elements are stored, Array of structures, Uses of structures, Unions, Unions of structures, Structures and pointers, Files, Standard Input/output, Binary Mode and Text Mode, Record Input/Out.

Recommended Books/Reference Material

1. Bin Uzayr, S. (2022). Mastering C++ Programming Language: A Beginner's Guide. CRC Press.
2. Deitel, P., & Deitel, H. (2022). C++ 20 for Programmers: An Objects-Natural Approach. Pearson.
3. Doyle, B. (2014). C# Programming: from problem analysis to program design. Cengage Learning.
4. Gaddis, T. (2008). Starting Out with Programming Logic and Design, 2/e. Pearson Education India.
5. Gregoire, M. (2021). Professional C++. John Wiley & Sons.
6. Hanly, J. R., & Koffman, E. B. (2007). Problem solving and program design in C. Pearson Education India.
7. Lafore, R. (1997). Object-oriented programming in C++. Pearson Education.
8. Weisfeld, M. (2008). The object-oriented thought processes. Pearson Education.
- Wu, C. T. (2006). An Introduction to object-oriented programming with Java TM. McGraw-Hill Incorporated.

Computer Organization and Assembly Language

BS-Computer Science

Course Code: CS-318

Credit Hours: 02

Pre-requisite: Digital Logic Design

Objectives

The main objective of this course is to introduce the organization of computer systems and usage of assembly language for optimization and control. Emphasis is given to expose the low-level logic employed for problem solving while using assembly language as a tool. At the end of the course the students should be able to: Identify the major components of computer architecture, and explain their purposes and interactions. Simulate the internal representation of data, and show how data is stored and accessed in memory. Explain the relationships between hardware architecture and its instruction set, and simulate micro-programs. Explain the Instruction Execution Cycle. Explain the differences and relationships among high-level, assembly, and machine languages. Write well-modularized computer programs in an assembly language, implementing decision, repetition, and procedure structures. Write moderately complex assembly language subroutines and interfacing them to any high language.

Learning Outcomes

- **Understand** the major components of a computer, basics of computer organization and the interconnection between computer modules (**C2 Understand PLO-1**).
- **Demonstrate** the functions and internal working of Central Processing unit and Assembly Language (**C3 Apply PLO-2**).
- **Analyze** the memory hierarchy, I/O modules, instruction set architecture (x86-64), addressing modes, formats and Assembly language techniques (**C4 Analyze PLO-3**).

Course Outline

Unit 1. Introduction

Introduction about computer Organization, assembly language, Comparison of low level and high level languages, Registers types (General) (16-bit): General purpose register ,Special purpose register, Introduction and usage of RAM, Processor, Registers, System Bus, Instruction Execution Cycle, Assembly and Machine Language, Assembler, Linker and Link Libraries, Programmer's View of a

Computer System, RISC and CISC architecture, Physical address calculation, Basic Memory Organization, CPU organization..

Unit 2. Top Level View of Computer Function and Interconnection, Assembler

Instruction Cycle, Execute Cycle, Interrupts, Interrupt Cycle, Memory Connection, Input/ Output Connection, CPU Connection, MASM, MIPS, Defining Data in MASM Assembler.

Unit 3. Elements of Assembly Language, Functions

Integer Constants, Integer Expressions, Real Number Constants, Character Constants, String Constants, Reserved Words, Identifiers, Directives, Instructions, The NOP (No Operation) Instruction, Adding and Subtracting Integer, INC and DEC Instructions, NEG Instruction, how to move integer number in register? Adding and subtracting numbers in registers, Declaration and initialization of variables, moving data from variable to register, Data Definition Statement, BYTE and SBYTE Data, WORD and SWORD Data, Defining DWORD and SDWORD Data, Knowledge about different data types.

Unit 4. Operations, Array & Loops

Division and Multiplication in Assembly, Jumps Based on Specific Flags, Jumps Based on Equality, Simple jump statements, Jumps based on specific condition, Some code examples, Practice on MASM in class.

Unit 5. Procedures, File Operations

Procedures: Labels in procedures, Stack, Runtime Stack, Conditional Control Flow Directives, Compound Expressions, Data Representation & Conversion.

Recommended Books/Reference Material

1. Britton, R. (2002). MIPS assembly language programming.
2. Bryant, R. E., & O'Halloran, D. R. (2011). Computer systems: a programmer's perspective. Prentice Hall.

3. Hohl, W., & Hinds, C. (2014). ARM Assembly Language: Fundamentals and Techniques.
4. Irvine, K. R. (2003). Assembly language for Intel-based computers (pp. 601-608). Prentice Hall.
5. Mano, M. M. (1993). Computer system architecture. Prentice-Hall, Inc.
6. Stallings, W. (2010). Computer organization and architecture designing for performance eighth edition.
7. Streib, J. T. (2020). Guide to assembly language: a concise introduction. Springer Nature.
8. Tanenbaum, A. S. (2016). Structured computer organization. Pearson Education India.

Computer Organization and Assembly Language LAB

BS-Computer Science

Course Code: CS-318L

Credit Hours: 01

Pre-requisite: Digital Logic Design

Objectives

The course aims to understand how device dependent programming can be performed. To understand the programming model of Intel 8086 and above processors. To be able to develop low level programs for an Intel based machine. This course includes detailed discussion on various topics, Comparison of Low Level and High Level Languages, Basic Organization of a Conceptual Computer, Organization of an Intel based Micro Computer, Programming Model of Intel 8086 and above, Memory Organization, Intel Based Computers and Addressing Modes, programs with Interactive Input and Output , utilizing of arithmetic and logical expressions ,Transfer Instructions, Unconditional & Conditional Program Transfer Instructions, Procedure and Recursion, String instruction, Software Interrupt, Intercepting Interrupts, and File operations.

Learning Outcomes

- **Demonstrate** Intel x86 Assembly Language and CPU simulator **(A3 Valuing PLO-5).**

- **Understand** the internal working of a microprocessor registers, ISA and interrupts (**C2 Understand PLO-3**).
- **Implement** Assembly Language Programming Concepts for a microprocessor **C3 Apply PLO-4**).

Course Outline

Unit 1. Introduction to Framework

Comparison of low level and high-level languages Registers types (General) (16-bit): General purpose register, Special purpose register, Introduction and usage of RAM, Processor, Registers, System Bus, Instruction Execution Cycle, Assembly and Machine Language, Assembler, Linker and Link Libraries.

Unit 2. Computer Function and Interconnection, Assembler

Instruction Cycle, Execute Cycle, Interrupts, Interrupt Cycle MASM, MIPS, Basic about MASM, Working on MASM, A sample Hello World Program, Defining Data in MASM Assembler, Practical implementation of Add Commands, Practical implementation of Subtract Commands.

Unit 3. Implementation of Functions

Adding and subtracting numbers in registers, Declaration and initialization of variables, moving data from variable to register, Data Definition Statement, BYTE and SBYTE Data, WORD and SWORD Data, Defining DWORD and SDWORD Data, Knowledge about different data types, getting input from user, Printing string on screen, getting character value form user, Displaying character value.

Unit 4. Operations, Array & Loops

Jumps Based on Specific Flags, Jumps Based on Equality, Simple jump statements, Jumps based on specific condition, Practice on MASM in class, Byte Array, Word Array, DWORD Array, LOOP, Simple LOOP, LOOPZ, LOOPE, LOOPNZ, LOOPNE.

Unit 5. Procedures, File Operations

Procedures: Labels in procedures, Stack, Runtime Stack, Conditional Control Flow Directives, Compound Expressions, Data Representation & Conversion, opening a file, closing a file, reading a file, writing a file, seeking a file.

Recommended Books/Reference Material

1. Britton, R. (2002). MIPS assembly language programming.
2. Bryant, R. E., & O'Halloran, D. R. (2011). Computer systems: a programmer's perspective. Prentice Hall.
3. Hohl, W., & Hinds, C. (2014). ARM Assembly Language: Fundamentals and Techniques.
4. Irvine, K. R. (2003). Assembly language for Intel-based computers (pp. 601-608). Prentice Hall.
5. Mano, M. M. (1993). Computer system architecture. Prentice-Hall, Inc.
6. Stallings, W. (2010). Computer organization and architecture designing for performance eighth edition.
7. Streib, J. T. (2020). Guide to assembly language: a concise introduction. Springer Nature.
8. Tanenbaum, A. S. (2016). Structured computer organization. Pearson Education India.

Object Oriented Programming

BS-Computer Science

Course Code: CS-125

Credit Hours: 03

Pre-requisite: Programming Fundamentals

Objectives

This course teaches object-oriented programming to those who have learnt basic programming concepts and are ready to learn in-depth programming. It focuses on object-oriented programming using C++. The main concepts discussed are: Objects, Data Abstraction, Data Encapsulation, Polymorphism, and Inheritance. The C++ language constructs will be taught that are used to implement these concepts. For example, Classes,

Overloaded Operators, Overridden Methods, Friend Functions, Virtual Functions, and Templates, etc.

Learning Outcomes

- **Explain** knowledge of underlying concepts of object-oriented paradigm (**C2 Understand PLO-1**).
- **Develop** an understanding of object-oriented design artifacts and their mapping to object-oriented programming (**C6 Create PLO-2**).
- **Design** and implement object-oriented solutions for small systems involving single/multiple objects (**C6 Create-PLO-4**).

Course Outline

Unit 1. Characteristics of Object-Oriented Languages, Structures & Functions

Beginning of programming, Structured programming, Object oriented programming, Objects, Classes, Inheritance, Reusability, Data abstraction, Data encapsulation, Introduction to .NET and Visual Studio, Structure basics, Structure within structures, Structures in detail, Enumerations, Simple functions, passing arguments to functions, Returning values from functions, Reference arguments, Overloaded functions, Recursion, Inline functions, Default arguments, Const function arguments.

Unit 2. Object & Classes

Basics of class and objects with real world example, with programming example, Data member and C++ objects as data types, Constructors, Destructors, Access specifier, Object as function arguments, Overloaded constructors, Member functions defined outside class, Objects as arguments, The default copy constructor, Returning objects from function, Class, object and memory, Static class data, Const and classes, Const member function, Const objects, Identifying class attributes, Array fundamentals, Array as class members, Array of objects.

Unit 3. String & Operator Overloading, Inheritance, Pointers

Standard string class, Input/output with strings, Finding & Modifying string objects, Comparing string objects, Overloading unary operator, Overloading binary operator, Data conversion, Conversion between basic types, Conversion between objects and basic types, Derived class and base class, Public, private and protected classes, Accessing base class members, The protected class specifier, Derived class constructor, Overriding member functions, Class hierarchies, Scope resolution with overridden functions, Public and private inheritance, Access combinations, Access specifier, Level of inheritance, Multiple inheritance, Ambiguity in multiple inheritance. Containership: classes within classes, Composition and aggregation, Inheritance and program development Pointer basics concepts, Addresses and pointers, The address of operator, Pointer and arrays, Pointers and functions, Pointers and c type string, Memory management, The new operator, The delete operator, Pointers to objects, Pointers to pointers.

Unit 4. Virtual Functions & Polymorphism

Normal member function accessed with and without pointer, Virtual member function accessed with and without pointer, Abstract class and pure virtual function, Late binding, Friend functions, Friend classes, Static functions, The 'this' pointer (Pointer to object, Virtual functions, Pure virtual functions, Type of polymorphism, Compile time and run time, Function overloading, Operator overloading.

Unit 5. Multi File Programs, Templates & Exceptions

Reasons for multi file programs, creating a multi file program, Function overloading, Operator overloading, Header file, Directory, Projects, Function templates, Class templates, why do we need exception, Exception syntax.

Recommended Books/Reference Material

1. Barbara, S. B. L. J. L., & Moo, E. (2013). C++ Primer.
2. Budd, T. (2008). Introduction to object-oriented programming. Pearson Education India.
3. Deitel, H., & Deitel, P. C. (2021). How to program. Pearson.
4. Deitel, P. J., & Deitel, H. M. (2018). C++ how to program: introducing the new C++ 14 standard.

5. Gaddis, T., Walters, J., & Muganda, G. (2016). Starting out with C++ early objects. Pearson.
6. Horton, I. (2011). Ivor Horton's Beginning Java. John Wiley & Sons.
Lafore, R. (1997). Object-oriented programming in C++. Pearson Education.
7. Weisfeld, M. (2008). The object-oriented thought processes. Pearson Education.

Object Oriented Programming LAB

BS-Computer Science

Course Code: CS-125L

Credit Hours: 01

Pre-requisite: Programming Fundamentals

Objectives

This course emphasis on intensive study of object-oriented programming using C++. Abstract data types, object instantiation, inheritance, polymorphism, composition, member access control, templates, overloaded operators, exception handling, use of C++ headers, and class libraries will be studied.

Learning Outcomes

- **Explain** knowledge of underlying concepts of object-oriented paradigm (**C2 Understand PLO-2**).
- **Develop** an understanding of object-oriented design artifacts and their mapping to object-oriented programming (**C6 Create PLO-3**).
- **Design** and implement object-oriented solutions for small systems involving single/multiple objects (**C6 Create PLO-5**).

Course Outline

Unit 1. Introduction to .NET and Visual Studio Framework

Objects, Classes, Inheritance, Reusability, Data abstraction, Data encapsulation, Structure basics, Structure within structures, Enumerations, Simple functions,

passing arguments to functions, Returning values from functions, Reference arguments, Overloaded functions, Recursion, Inline functions, Default arguments, Const function arguments.

Unit 2. Object & Classes

C++ objects as data types, Constructors, Destructors, Access specifier, Object as function arguments, Overloaded constructors, Member functions defined outside class, Objects as arguments, Returning objects from function, Class, object and memory, Static class data, Const and classes, Const member function, Array fundamentals.

Unit 3. String & Operator Overloading, Inheritance, Pointers

Standard string class, Input/output with strings, Finding & Modifying string objects, Comparing string objects, Overloading unary operator, Overloading binary operator, Data conversion, Conversion between basic types, Conversion between objects and basic types, Derived class and base class, Public, private and protected classes, Accessing base class members, The protected class specifier, Derived class constructor, Overriding member functions, Class hierarchies, Scope resolution with overridden functions, Public and private inheritance, Access combinations, Access specifier, Level of inheritance, Multiple inheritance, Ambiguity in multiple inheritance. Containership: classes within classes, Composition and aggregation, Inheritance and program development Pointer basics concepts, Addresses and pointers, The address of operator, Pointer and arrays, Pointers and functions, Pointers and c type string, Memory management, The new operator, The delete operator, Pointers to objects, Pointers to pointers.

Unit 4. Virtual Functions & Polymorphism

Normal member function accessed with and without pointer, Virtual member function accessed with and without pointer, Abstract class and pure virtual function, Late binding, Friend functions, Friend classes, Static functions, The 'this' pointer (Pointer to object, Virtual functions, Pure virtual functions, Type of polymorphism, Compile time and run time, Function overloading, Operator overloading.

Unit 5. Multi File Programs, Templates & Exceptions

Reasons for multi file programs, creating a multi file program, Function overloading, Operator overloading, Header file, Directory, Projects, Function templates, Class templates, why do we need exception, Exception syntax.

Recommended Books/Reference Material

1. Barbara, S. B. L. J. L., & Moo, E. (2013). C++ Primer.
2. Budd, T. (2008). Introduction to object-oriented programming. Pearson Education India.
3. Deitel, H., & Deitel, P. C. (2021). How to program. Pearson.
4. Deitel, P. J., & Deitel, H. M. (2018). C++ how to program: introducing the new C++ 14 standard.
5. Gaddis, T., Walters, J., & Muganda, G. (2016). Starting out with C++ early objects. Pearson.
6. Horton, I. (2011). Ivor Horton's Beginning Java. John Wiley & Sons.
Lafore, R. (1997). Object-oriented programming in C++. Pearson Education.
7. Weisfeld, M. (2008). The object-oriented thought processes. Pearson Education.

Data Structures

BS-Computer Science

Course Code: CS-210

Credit Hours: 03

Pre-requisite: Object Oriented Programming

Objectives

A detailed study of Basic Structures commonly used in Data Processing, Implementation (in C++) and Applications of basic data structures. A Comparative study of different Sorting and Searching Techniques. This course will focus on data structures and algorithms for manipulating them. Data structures for storing information in table's lists, stacks, queues, trees and graphs will be covered. Basic algorithms for creating, manipulating and using these structures will also be discussed. Different types of searching and sorting technique will also be introduced and will be compared. Students will carry out a number of programming

assignments, which will emphasize various aspects of data organization and manipulation process.

Learning Outcomes

- **Implement** various data structures and their algorithms (**C3 Apply PLO-1**).
- **Analyze** simple algorithms and determine their complexities (**C4 Analyze-PLO3**).
- **Apply** the knowledge of data structure to other application domains (**C3 Apply PLO-4**).
- **Design** new data structures and algorithms to solve problems (**C6 Create PLO-5**).

Course Outline

Unit 1. Introduction, Array & Stack

Introduction to Course, Review of Object-Oriented Programming Concepts, Data Structures, Abstract Data Type, Revision of arrays, Polynomial as ADT, Stack, The Stack ADT, Expressions, Postfix & Prefix Notation Infix to postfix and prefix conversion Postfix and prefix evaluation.

Unit 2. Queue, Recursion and Link List

Queue (array implementation) Variation of Queue ADT i.e. Circular and Double Ended Queue. Applications of Queues, Recursive Definition and Processes, Direct and Indirect Recursion, Binary Search and Towers of Hanoi as example, Writing Recursive Programs, conversion of recursive algorithms into iterative algorithms, Linear Single Link List, and Linked Stacks and Queues, Containers and Iterators, Linear Linked list Iterator, Linear Doubly Link List, Circular Lists: Singly and Doubly and Its Iterator.

Unit 3. List Based Data Structure, Trees & Heap

Array-based implementation of all List-based Data Structures, Overview of Composite Data Structures: Multi-Stack, Multi-Queue, Generalized List, etc. Introduction to Trees, Tree Terminology, Logical construction and Representation of Trees, Introduction to Binary Tree ADT, Mathematical properties, Array

Implementation of Binary Trees (Insertion and Traversing), Link Implementation of Binary Trees, Heaps (Minheap and Maxheap) and heaps as a priority queues, Min-Max Heap.

Unit 4. AVL Trees & Spanning Trees, Graphs

AVL trees and insertion, Deletion Operation in AVL trees, Introduction to graph and related terminology, Elementary Graph Operations, Minimum cost spanning trees, balanced search trees theoretical Comprehension of insertion/deletion.

Unit 5. Trees Insertion and Deletion, Sorting

Tree Deletion, Tree Insertion/Deletion, B-Trees Insertion/deletion, Hashing and Overflow Handling, Introduction to sorting types and Techniques.

Recommended Books/Reference Material

1. Carrano, F. (2011). Data Structures and Abstractions with Java. Prentice Hall Press.
2. Dale, N. B. (2003). C++ plus data structures. Jones & Bartlett Learning.
3. Drozdek, A. (2012). Data Structures and algorithms in C++. Cengage Learning.
4. Gottschling, P. (2021). Discovering Modern C++. Addison-Wesley Professional.
5. Hubbard, J. R. (2021). Programming with C++.
Langsam, Y., Augenstein, M. J., & Tenenbaum, A. M. (1996). Data Structures using C and C++. Prentice Hall Press.
6. Mutongwa, S. M., & Abeka, S. (2019). A Comparative Study of C, C++, C# and Java Programming Languages: Underpinning Structure Equation Modeling, Data Structures and Algorithm.
7. Parker, A. (2018). Algorithms and Data Structures in C++. Routledge.
8. Weiss, M. A. (2014). Data structures and algorithm analysis in C++, 4th Edition. Pearson.

Data Structures LAB

BS-Computer Science

Course Code: CS-210L

Credit Hours: 01

Pre-requisite: Object Oriented Programming

Objectives

Main objective of this course is to enable students to understand and implement common data structures and algorithms to manipulate those data structures using C++ techniques. Emphasis will be on a lot of practice in writing codes to implement all the major data structures.

Learning Outcomes

- **Implement** the abstract data types and algorithms related to various data structures (**P2 Manipulation PLO-2**).
- **Demonstrate** linear and non-linear data structures and related algorithms (**P3 Precision PLO-3**).
- **Organize** the experiments in the form of a LAB report (**A4 Organizing PLO-6**).

Course Outline

Unit 1. Introduction To Framework, Array & Stack

Review of Object-Oriented Programming Concepts, Data Structures, Abstract Data Type, Revision of arrays, and Polynomial as ADT, Stack, The Stack ADT, Expressions, and Postfix & Prefix Notation Infix to postfix and prefix conversion Postfix and prefix evaluation.

Unit 2. Queue, Recursion and Link List

Queue (array implementation) Variation of Queue ADT i.e. Circular and Double Ended Queue. Applications of Queues, Recursive Definition and Processes, Direct and Indirect Recursion, Binary Search and Towers of Hanoi as example, Writing Recursive Programs, conversion of recursive algorithms into iterative algorithms, Linear Single Link List, and Linked Stacks and Queues, Containers and Iterators, Linear Linked list Iterator, Linear Doubly Link List, Circular Lists: Singly and Doubly and Its Iterator.

Unit 3. List Based Data Structure, Trees & Heap

Array-based implementation of all List-based Data Structures, Overview of Composite Data Structures: Multi-Stack, Multi-Queue, Generalized List, etc., Logical construction and Representation of Trees, Introduction to Binary Tree ADT, Mathematical properties, Array Implementation of Binary Trees (Insertion and Traversing), Link Implementation of Binary Trees, Heaps (Minheap and Maxheap).

Unit 4. AVL Trees & Spanning Trees, Graphs

AVL trees and insertion, Deletion Operation in AVL trees, Introduction to graph and related terminology, Elementary Graph Operations, Minimum cost spanning trees, Balanced search trees.

Unit 5. Trees Insertion and Deletion, Sorting

Tree Deletion, Tree Insertion/Deletion, B-Trees Insertion/deletion, Hashing and Overflow Handling, Introduction to sorting types and Techniques, Review of course.

Recommended Books/Reference Material

1. Carrano, F. (2011). Data Structures and Abstractions with Java. Prentice Hall Press.
2. Dale, N. B. (2003). C++ plus data structures. Jones & Bartlett Learning.
3. Drozdek, A. (2012). Data Structures and algorithms in C++. Cengage Learning.
4. Gottschling, P. (2021). Discovering Modern C++. Addison-Wesley Professional.
5. Hubbard, J. R. (2021). Programming with C++.
Langsam, Y., Augenstein, M. J., & Tenenbaum, A. M. (1996). Data Structures using C and C++. Prentice Hall Press.
6. Mutongwa, S. M., & Abeka, S. (2019). A Comparative Study of C, C++, C# and Java Programming Languages: Underpinning Structure Equation Modeling, Data Structures and Algorithm.
7. Parker, A. (2018). Algorithms and Data Structures in C++. Routledge.
8. Weiss, M. A. (2014). Data structures and algorithm analysis in C++, 4th Edition. Pearson.

Software Engineering

BS-Computer Science

Course Code: CS-201

Credit Hours: 03

Pre-requisite: Nil

Objectives

This course aims to develop the students' knowledge of basic software terminologies, software life cycle activities, software process models and information systems. The students will also be familiarized with the UML to model software development.

Learning Outcomes

- **Describe** various software engineering processes and activates (**C2 Understand PLO-2**).
- **Apply** the system modeling techniques to model a medium size software system (**C3 Apply PLO-4**).
- **Analyze** software quality assurance and testing principles to medium size software systems (**C3 Apply PLO-3**).
- **Discuss** key principles and common methods for software project management such as scheduling, size estimation, cost estimation and risk analysis (**C2 Understand PLO-1**).

Course Outline

Unit 1. Introduction

The Scope of Software Engineering, Definition and Introduction to software engineering. History of SE, The Software: Software characteristics, Types of software, difference between S/W engineering and CS and System Engineering, Ethical responsibilities, Software Processes, CMM and its level.

Unit 2. Process Models

A layered technology, S/W Processes Models, Reuse Oriented Software Engineering. Software Process Activities, Software Specification, Software Design and Implementation. Software Validation, Software Evolution. Coping with

change. Software Requirement, Functional and nonfunctional requirement, Requirements Specification, Requirement elicitation and analysis, Requirement Evolution.

Unit 3. Introduction to UML

Software Modeling, UML Notations, Use case Diagram, Class Diagram, Activity Diagram, State machine diagram.

Unit 4. Application Architectures

Architectural Design, Architectural Views, And Architectural Patterns: Layered Systems, Repository Systems, Client Server System, And Application Architectures: Transaction Processing Systems, Information Systems, Language Processing Systems, Software Design, and Object-Oriented Design, Design Patterns.

Unit 5. Testing & Management

Project Management Concepts, Software Testing, Development Testing: Unit Testing, Component Testing, System Testing, Test Driven Development, Release Testing: Cyclomatic Complexity, Software Configuration Management, Risk Management.

Recommended Books/Reference Material

1. Foster, E., & Towle Jr, B. (2021). Software engineering: a methodical approach. Auerbach Publications.
2. Pressman, R. S. (2005). Software engineering: a practitioner's approach. Palgrave Macmillan.
3. Pressman, R. S., & Bruce R. Maxim, D. (2014). Software Engineering: A Practitioner's Approach. ISBN: 9780078022128.
4. Sommerville, I. (2015). Software engineering, 10th Edition. Pearson. ISBN: 9780133943030.

Analysis of Algorithms

BS-Computer Science

Course Code: CS-413

Credit Hours: 03

Pre-requisite: Data Structures

Objectives

Design algorithms using different algorithms design techniques i.e. Divide and Conquer, Dynamic Programming, Greedy Algorithms & Backtracking. Analyze Algorithms (estimate upper & lower bounds without coding and running the algorithms) and compare the efficiency of different algorithms for a problem. Implement and test algorithms. Logically think and develop problem solving skills.

Learning Outcomes

- **Explain** what is meant by “best”, “expected”, and “worst” case behavior of an algorithm **(C2 Understand PLO-1)**.
- **Identify** the characteristics of data and/or other conditions or assumptions that lead to different behaviors **(C2 Understand PLO-2)**.
- **Analyze** informally the time and space complexity of simple algorithms **(C3 Apply PLO-3)**.
- **Apply** strategies (brute-force, greedy, divide-and conquer, and dynamic programming) to solve an appropriate problem **(C3 Apply PLO-4)**.

Course Outline

Unit 1. Introduction

Introduction, Algorithm Design, Data Structures, Efficiency, Analysis of Algorithms, Mathematical Review, Mathematical Analysis of Algorithms, types of functions, Order of Growth and Asymptotic Notations.

Unit 2. Sorting Algorithms

Selection Sort algorithm, Insertion Sort algorithm, Divide and Conquer Algorithms, Merge Sort algorithm, Quick Sort algorithm, Bucket Sort algorithm, Radix Sort algorithm, Counting Sort algorithm. Heap Sort Algorithms, Heap operations and Heap sort Algorithm analysis, Heap insertion and deletion.

Unit 3. Binary Search Tree & Hashing

Binary Search Tree Basics, Tree Searching Algorithms and Analysis, Analysis of Insertion and Deletion, Algorithms in BST and Hashing Basics, Hash functions, Analysis of Collision Resolution Techniques in Hashing.

Unit 4. Dynamic Programming & Greedy Algorithms

Dynamic Programming – 0-1 Knap Sack, Fractional Knap Sack, Longest Common Subsequence, Shortest Path Finding, Matrix Chain Multiplication Greedy Algorithms – Prim's Algorithm and Kruskal Algorithm, Dijkstra's Algorithm, Huffman Coding.

Unit 5. NP-Completeness, Randomized Algorithms

NP-Completeness - Polynomial time verification, Reducibility, NP-Completeness Proofs. Randomized Algorithms--Particle Swarm Optimization, Genetic Algorithms, And Differential Evolution.

Recommended Books/Reference Material

1. Allen, W. M. (2007). Data structures and algorithm analysis in C++. Pearson Education India.
2. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2022). Introduction to algorithms. MIT press.
3. Levitin, A. (2008). Introduction to design and analysis of algorithms, 2/E. Pearson Education India.
4. Sedgewick, R., & Wayne, K. (2011). Algorithms (4th edn). Google Scholar Google Scholar Digital Library Digital Library.
5. Thomas H, C., Charles, E., Ronald L, R., & Clifford, S. (2009). Introduction to Algorithms Third Edition.

Artificial Intelligence

BS-Computer Science

Course Code: CS-206

Credit Hours: 02

Pre-requisite: Object Oriented Programming

Objectives

Artificial Intelligence (AI) is a constantly and actively growing and changing field. In this course, students will learn the basics of modern AI as well as some of the representative applications of AI. This course introduces students to the basic knowledge representation, problem solving, and learning methods of artificial intelligence. Upon completion, students should be able to develop intelligent systems by assembling solutions to concrete computational problems; understand the role of knowledge representation, problem solving, and learning in intelligent-system engineering; and appreciate the role of problem solving, vision, and language in understanding human intelligence from a computational perspective

Learning Outcomes

- **Understand** various AI search algorithms (tree search, uninformed, informed, and heuristic **(C2 Understand PLO-1)**).
- **Understand** different types of AI agents, and know how to build simple knowledge-based systems **(C2 Understand PLO-2)**.
- **Apply** knowledge representation, reasoning, and machine learning techniques to real-world problems **(C3 Apply PLO-4)**.

Course Outline

Unit 1. Introduction

What is AI, Major AI areas, Intelligent Agents: Agents and environments, Rationality? PEAS (Performance measure, Environment, Actuators, Sensors), Environment types, Agent Types, Problem solving through uninformed search: Breadth First Search, Depth First Search, Iterative DFS, Comparison of Search Algorithms.

Unit 2. Problem Solving Through Informed Search, Expert Systems

Problem solving through informed search: Heuristically Informed Methods, Hill Climbing, Beam Search, Best First Search, A*Procedure, Adversarial Search, Min-Max Procedure, Static Evaluation Function, Alpha Beta Pruning, Expert Systems: Knowledge Base Expert System Their Types and Application, Working of Expert Systems with its different components.

Unit 3. Neural Networks, Back Prop algorithms

Binary Expert Systems: Developing an Expert System, Identifying the problem, forward and Backward Chaining. Neural Network: Introduction to Artificial Neural Networks (ANN), ANN Applications, Topologies of ANN, Single Layer perception (SLP).

Unit 4. Genetic Algorithm, Fuzzy System, Classification

Genetic Algorithm: Introduction to Evolutionary Computing, Genetic Algorithm (GA), Genetic operators (Crossover and Mutation) and its applications. Fuzzy System: Fuzzy Set Theory, Fuzzy Inference, And Classification: Decision Tree, Bayes Classification

Unit 5. Machine Learning, Introduction to Computer Vision, Mining Frequent Patterns

Machine Learning: Introduction to Learning, Supervised Machine Learning: Unsupervised Learning, K-means Clustering Algorithm, and Introduction to Computer Vision (CV), Pattern Recognition, Mining Frequent Patterns, Association and Correlation.

Recommended Books/Reference Material

1. Finlay, J. (2020). An introduction to artificial intelligence. Crc Press.
2. Joshi, P. (2017). Artificial intelligence with python. Packt Publishing Ltd.
3. Le, D., Chung, K., Quach, S., & Thaichon, P. (2022). Introduction to artificial intelligence (AI). Artificial Intelligence for Marketing Management.

4. Luger, G. F. (2005). Artificial intelligence: structures and strategies for complex problem solving. Pearson education.
5. Mehrotra, D. (2019). Basics of artificial intelligence & machine learning. Notion Press.
6. Miller, B. N., Ranum, D. L., & Anderson, J. (2019). Python programming in context. Jones & Bartlett Learning.

Artificial Intelligence Lab

BS-Computer Science

Course Code: CS-206L

Credit Hours: 01

Pre-requisite: Object Oriented Programming

Objectives

Study the applications of AI and agent-based approach to AI and First-order predicate calculus, logical reasoning and problem-solving using Prolog language. To study and discuss various techniques and algorithms of AI used in general problem solving, optimization problems, constraint satisfaction problems, and game programming. Familiarize students with various sub-areas of AI, such as expert systems, natural language processing and machine learning.

Learning Outcomes

- **Formulate** real-world problems as state space problems, optimization problems or constraint satisfaction problems (**P4 Articulation PLO-5**).
- **Implement** appropriate algorithms and AI techniques to solve complex problems (**P2 Manipulation PLO-2**).
- **Develop** an expert system by using appropriate tools and techniques (**P4 Articulation PLO-4**).

Course Outline

Unit 1. Problem Solving

Problem solving (2 jug puzzles, 3 jug puzzles, lion man puzzles, vacuum cleaner puzzle. Implementation of 2 jug puzzles, 3 jug puzzles, lion man puzzles, vacuum cleaner puzzle using DFS and BFS.

Unit 2. Cost Search Algorithm Implementation

Implementation of A* and Uniform cost search algorithms to solve problems. Implementation of different games using game search tree algorithms

Unit 3. Game Search Algorithm Implementation

Implementation of different games using game search tree algorithm Solution of 8 queen problem using genetic algorithm.

Unit 4. 8 Queen Problem and Prolog Language

Solution of 8 queen problem using genetic algorithm. Learning Prolog language for Logic Practice of Prolog and Lisp.

Unit 5. K Means Clustering Algorithm and Neural Networks

Implementation of K mean clustering algorithm. Implementation of single layer neural network.

Recommended Books/Reference Material

1. Finlay, J. (2020). An introduction to artificial intelligence. Crc Press.
2. Joshi, P. (2017). Artificial intelligence with python. Packt Publishing Ltd.
3. Le, D., Chung, K., Quach, S., & Thaichon, P. (2022). Introduction to artificial intelligence (AI). Artificial Intelligence for Marketing Management.
4. Luger, G. F. (2005). Artificial intelligence: structures and strategies for complex problem solving. Pearson education.
5. Mehrotra, D. (2019). Basics of artificial intelligence & machine learning. Notion Press.
6. Miller, B. N., Ranum, D. L., & Anderson, J. (2019). Python programming in context. Jones & Bartlett Learning.

Digital Logic Design

BS-Computer Science

Course Code: CS-126

Credit Hours: 02

Pre-requisite: Nil

Objectives

This course will provide an introduction to the fundamental concepts and techniques underlying the construction of digital systems. The course covers design of digital systems using standard, small, and medium scale integrated circuits. The main emphasis is on the theoretical concepts and systematic synthesis techniques that can be applied to the design of practical digital systems.

Learning Outcomes

- **Discuss** knowledge related to the concepts, tools and techniques for the design of digital electronic circuits (**C2 Understand PLO-1**).
- **Demonstrate** the skills to design and analyze both combinational and sequential circuits using a variety of techniques (**C3 Apply PLO-2**).
- **Apply** the acquired knowledge to simulate and implement small-scale digital circuits (**C3 Apply PLO-4**).

Course Outline

Unit 1. Characteristics of Object-Oriented Languages, Structures & Functions

Introduction, Digital Systems and Information, Digital World, Analog Vs Digital, Number Systems; Base 2, Base 8, Base 16, Binary Conversion Between Different Bases, Two's Complement, Binary Arithmetic Codes.

Unit 2. Logic Gates, K-Map

Combinational Logic Circuits, Gates (AND, OR, XOR etc.), Combinational Logic Circuits, Boolean Algebra, Duality Principle, Combinational Logic, Standard Forms., SOP and POS Forms, Min term, Max term, Canonical SOP, Canonical POS, Multiple Level Circuit

Optimization, K-MAP, K-MAP Manipulation, Three Four Variable MAP, NAND NOR Gate Implementation, XOR Gate Implementation, Odd Function.

Unit 3. Combinational Circuits

Combinational Logic Design Using Building Blocks: Multiplexers, DE multiplexers, Decoders, Encoders, Arithmetic Functions: Adders-Sub tractors
Arithmetic Functions (continued): Binary Multiplication, Contraction, Incrementing, and Decrementing.

Unit 4. Sequential Circuits

Basic Latches, S-R Latch, and Master –Slave Flip-Flops, Edge Triggered Flip-Flops, Sequential Circuits: Flip-Flops, D FFs, and Sequential Circuits: JK and T Flip Flops, Finite State Machines: Analysis.

Unit 5. Finite State Machines

Finite State Machines: State Table, Design, State Diagram, Applications, Diagram Model, Building Blocks, Programmable Implementation of Functions: PLA, PAL, ROM, Presentation and demonstrations of course project, Revision /Future perspective of the Course.

Recommended Books/Reference Material

1. Brown, S., & Vranesic, Z. (2008). EBOOK: Fundamentals of Digital Logic. McGraw Hill.
2. Floyd, T. L. (2009). Instructor's Resource Manual to Accompany Digital Fundamentals Tenth Edition. Pearson Prentice Hall.
3. Floyd, T. L. (2015). Digital Fundamentals, by Pearson. Pearson Education India.
4. Mano, M. M. (2017). Digital logic and computer design. Pearson Education India.
5. Roth Jr, C. H., Kinney, L. L., & John, E. B. (2020). Fundamentals of logic design. Cengage Learning.
6. Tocci, R. J. (1991). Digital systems: principles and applications. Pearson Education India.

Digital Logic Design Lab

BS-Computer Science

Course Code: CS-126L

Credit Hours: 01

Pre-requisite: Nil

Objectives

This course will describe and identify fundamental concepts of digital logic design including basic and universal gates, number systems, and binary coded systems, basic components of combinational and sequential circuits. It will transform the acquired knowledge to apply techniques related to the design and analysis of digital electronic circuits including Boolean algebra and multi-variable Karnaugh map methods. It will also analyze small-scale combinational and sequential digital circuits, design small-scale combinational and synchronous sequential digital circuit using Boolean algebra and K-maps.

Learning Outcomes

- **Discuss** knowledge related to the concepts, tools and techniques for the design of digital electronic circuits (**C2 Understand PLO-2**).
- **Demonstrate** the skills to design and analyze both combinational and sequential circuits using a variety of techniques (**P3 Precision PLO-3**).
- **Perform** in team the acquired knowledge to simulate and implement small-scale digital circuits (**P2 Manipulation PLO-6**).

Course Outline

Unit 1. Introduction to Gates

Familiarization and verification of basic logic gates using ICs.

Unit 2. Verification Of Basic Identities of Boolean Algebra

Verification of basic identities of Boolean algebra: Identity Law, Null (or Dominance) Law, Idempotent Law, Inverse Law, Double Complement Law, Associative Property, Distributive Property, etc.

Unit 3. Introduction to Combinational Circuit Modeling

Introduction to Combinational Circuit Modeling & Implementation of basic and universal gates.

Unit 4. Implementation of Half Adder and Full Adder

Implementation and Verification of half adder and full adder using basic gates and using universal gates. Implementation and verification of half adder. Implementation and verification of Full adder.

Unit 5. Implementation of BCD

Implementation of BCD to seven segment converters. Implementation of BCD to excess-3 code conversion. Implementation and verification of 4 x 1 multiplexer and 1 x 4 DE multiplexer circuits. RS flip-flop and D flip-flop using NAND gates.

Recommended Books/Reference Material

1. Brown, S., & Vranesic, Z. (2008). EBOOK: Fundamentals of Digital Logic. McGraw Hill.
2. Floyd, T. L. (2009). Instructor's Resource Manual to Accompany Digital Fundamentals Tenth Edition. Pearson Prentice Hall.
3. Floyd, T. L. (2015). Digital Fundamentals, by Pearson. Pearson Education India.
4. Mano, M. M. (2017). Digital logic and computer design. Pearson Education India.
5. Roth Jr, C. H., Kinney, L. L., & John, E. B. (2020). Fundamentals of logic design. Cengage Learning.
6. Tocci, R. J. (1991). Digital systems: principles and applications. Pearson Education India.

Database Systems

BS-Computer Science

Course Code: CS-203

Credit Hours: 03

Pre-requisite: Nil

Objectives

This module introduces the basic concepts of databases and database management systems. Help students understand benefits that can be attained by using both Relational Database Management System and NoSQL. It Enable students to become comfortable in designing databases and schemas, plus writing both simple and complex queries (SQL and XPath) to manipulate database.

Learning Outcomes

- **Explain** fundamental database concepts (**C2 Understand PLO-1**).
- **Design** conceptual, logical and physical database schemas using various data models (**C6 Create PLO-4**).
- **Identify** functional dependencies & resolve database anomalies by normalizing database tables (**C2 Understand PLO-2**).

Course Outline

Unit 1. Introduction to Database Approach, Database System Models

Data, Processing & Information, The Role of Data in Business, Meta Data & Meta Data, The Database , Evaluation of Database, Types of Files, Traditional File Processing Systems, Database Approach, Advantages & Disadvantages, Components of the DBMS Environment, Centralized Database, Personal Computer Database, Client/Server database, Distributed Database, Teleprocessing, Concept and Evaluation Of Database Models, Flat file Model, Hierarchical model, Network Model, Relational Model, Object Relational Model, Object Based data Model, ANSI-SPARC Architecture: External Level, Conceptual Level, Internal Level.

Unit 2. Database Design Fact Finding Techniques

Data Modeling, Phases of Database Design, DBMS Selection, Implementation, Testing, Data Administration & Database Administration, Data Administration, Database Administration, Comparison, Database Analysis, Uses of Fact-Finding Techniques, Fact Finding Techniques, Examining Documentation, Interviewing, Observation, Research, Questionnaires, A worked Example, Logical Design,

Conceptual Database Design, Introduction to Entity-Relational model, Relationship Types: Degree of Relationship Type

Unit 3. Specialization/Generalization for EERD

Simple & Composite Attributes, Single Valued & Multi-Valued Attributes, Derived Attributes, Keys, Strong & Weak Entity Types, Attributes on Relationships, Cardinality and Participation Constraint, Super Classes & Sub Classes, Super Class / Sub Class Relationships, Attributes Inheritance, Specialization Process, Generalization Process, Constraints on, Specialization/Generalization, Aggregation, Composition, Normalization: First Normal Form, Second Normal Form: Full Functional Dependency, Third Normal Form: Transitive Dependency, Boyce-Codd Normal Form, Fourth Normal Form, Multi-valued Dependency, Fifth Normal Form (5 NF), Lossless-Join Dependency.

Unit 4. Data Integrity and overview of SQL

Types of Data integrity (Entity Integrity, Domain Integrity, Referential Integrity, User-defined Integrity), Constraints (PRIMARY KEY Constraint, UNIQUE Constraint, IDENTITY Property, DEFAULT Definition, FOREIGN Key Constraint, CHECK Constraint)

Unit 5. Transaction Management, Deadlocks

File organization and storage structure, Unordered File, Ordered File, Hash Files, Hash Functions, Types of Indexes, Indexed sequential Files, Secondary indexes, Multilevel indexes, B+ trees, Clustered, Non Clustered Indexes, Threats, Counter Measures: Authorization, Views, Backup and Recovery, Integrity, Encryption, RAID, Transaction and Scheduling, Concurrent Execution of Transactions, Serializability, Lock-Based Concurrency Control, Deadlocks, Incremental Log with Deferred Updates, Incremental Log with immediate Updates, Concurrency Control, Deadlock detection, Deadlock prevention, Time stamping, Data Warehousing & Data Mining Concepts.

Recommended Books/Reference Material

1. Date, C. J. (2019). Database design and relational theory: normal forms and all that jazz. Apress.
2. Foster, E., & Godbole, S. (2022). Database systems: a pragmatic approach. Auerbach Publications.
3. Meier, A., & Kaufmann, M. (2019). SQL & NoSQL databases. Berlin/Heidelberg, Germany: Springer Fachmedien Wiesbaden.

Database System Lab

BS-Computer Science

Course Code: CS-203L

Credit Hours: 01

Pre-requisite: Nil

Objectives

This module introduces the basic concepts of databases and database management systems. Help students understand benefits that can be attained by using both Relational Database Management System and NoSQL. It Enable students to become comfortable in designing databases and schemas, plus writing both simple and complex queries (SQL and XPath) to manipulate database

Learning Outcomes:

- **Explain** fundamental database concepts (**C2 Understand PLO-2**).
- **Analyze** conceptual, logical and physical database schemas using various data models (**C6 Create PLO-3**).
- **Apply** functional dependencies & resolve database anomalies by normalizing database tables (**C3 Apply PLO-4**).

Course Outline

Unit 1. Introduction to DBMS Tools

Overview of DBMS Tools, The Role of Data in Business, Meta Data & Meta Meta Data, The Database Limitations, Database Approach, Centralized Database, Personal Computer Database, Client/Server database, Distributed Database, Teleprocessing, Concept and Evaluation of Database Model, Flat file Model, Hierarchical model, Network Model, Relational Model, Object Relational Model, Object Based data Model

Unit 2. Database Design

Data Modeling, Phases of Database Design, DBMS Selection, Implementation, Testing, Data Administration & Database, Logical Design, Conceptual Database Design, Introduction to Entity-Relational model, Entity Types, Relationship Types: Degree of Relationship Type, Recursive Relationship.

Unit 3. Introduction to SQL

History of SQL, Importance & Environment of SQL, Categories of SQL Commands (DML, DDL, DCL), Create a Database, Creating Tables, Altering Table, Dropping Table, Creating Views, removing views, Restrictions on Views, Updating Views.

Unit 4: Implementation of SQL

The SELECT Clause, The FROM Clause, The WHERE Clause, Relational Operators, Logical Operators, Wildcard Characters, Understanding the NULL values and Expressions, ORDER BY Clause, Aggregate Functions in SQL, The GROUP BY Clause, The HAVING Clause, Sub Query, Types of Sub Query, Nested Sub query, Single row sub query, Multiple row sub query, Correlated Subquery, Parameters Queries, Multi Table Queries, Joins (Inner join, Outer Join, Left outer join, Right outer join), EXISTS and NOT EXISTS, Combining Results Tables, (UNION, INTERSECCION, EXCEPT), Changing the Content of Tables using Action Queries (The INSERT table Statement, The DELETE table Statement, The UPDATE table Statement.

Unit 5. Implementation to Physical Database Design

Basic concepts, Unordered File, Ordered File, Hash Files, Hash Functions, Types of Indexes, Indexed sequential Files, Secondary indexes, Multilevel indexes, B+ trees, Backup and Recovery, Integrity, Encryption, RAID, Lock-Based Concurrency Control, Deadlocks, Incremental Log with Deferred Updates, Concurrency Control, Deadlock detection & prevention.

Recommended Books/Reference Material

1. Date, C. J. (2019). Database design and relational theory: normal forms and all that jazz. Apress.
2. Foster, E., & Godbole, S. (2022). Database systems: a pragmatic approach. Auerbach Publications.
3. Meier, A., & Kaufmann, M. (2019). SQL & NoSQL databases. Berlin/Heidelberg, Germany: Springer Fachmedien Wiesbaden.

Computer Networks

BS-Computer Science

Course Code: CS-208

Credit Hours: 02

Pre-requisite: Nil

Objectives

To give understanding on how current flows through the p-n junction and relating this phenomenon to the characteristics and operation of the diodes, bipolar and field-effect transistors.

Learning Outcomes:

- **Explain** the layered architecture approach with reference to OSI Model (**C2 Understand PLO-1**).
- **Examine** the characteristics of different transmission media (**C4 Analyze PLO-3**).

- **Implement** the IP addressing concepts and subnetting skills **(P2 Manipulation PLO-4)**.
- **Apply** hands on experience of basic Computer Utility Tools **(C3 Understand PLO-2)**.

Course Outline:

Unit 1. Introduction to Data Communications and Computer Networks, Protocol Layering

Data Communications, Communication Tasks, Data Representation (Text, Numbers, Images, Audio, Video), Data Flow (Simplex, Half Duplex, Full Duplex), Computer Networks, Network Criteria, Connection Types, Network Types, LAN (Wired and Wireless LAN), WAN (Circuit and Packet switch), Protocols and Standards:, Protocols and Standards, Syntax, Semantics, Timing, De facto, De Jure, Some Standard Organizations, Principles of protocol layering, Logical Connections, Layered Architecture, TCP/IP Protocol Suite: Overview of TCP/IP Protocol Suite and Addressing, OSI model.

Unit 2. Fundamentals of Data and signals, Transmission Media

Analog and Digital Data, Periodic and Aperiodic Signals, Analog Signals, Sine Wave, Peak, Amplitude, Period and Frequency, Phase, Time and Frequency Domains, Composite Signals, Digital Signals, Bit Interval and Bit Rate, Analog and digital transmission, Treatment of Signals, Comparison of Digital and Analog Signals, Transmission Impairments, Attenuation, Distortion, Noise and its Types, Channel Capacity, Nyquist and Shannon Capacity Formula, Data Rate Limits, Performance, Guided Transmission Media: Twisted Pair, Coaxial Cable, Physical Structure, Connector Types, Applications, Fiber Optic physical structure, Guided and Unguided Transmission media: Fiber Optic Propagation Modes, Connector Types, Applications, Ground Propagation, Unguided Propagation, Line of sight Propagation, Wireless Transmission Waves, Radio Waves, Unguided Transmission media.

Unit 3. Conversions & Multiplexing

Digital Data, Digital Signals, Line Coding, Unipolar, Polar, Bipolar, Techniques, NRZ-L, NRZI, Bipolar-AMI, Pseudo ternary, Manchester, Differential Manchester, Analog Data, Digital Signals, Sampling, Pulse Amplitude Modulation (PAM), Pulse Code Modulation (PCM), Delta Modulation (DM), Parallel Transmission, Serial Transmission, Asynchronous and synchronous transmission, Digital Data, Analog Signals, Bit Rate and Baud Rate, Techniques, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Quadrature Amplitude Modulation (QAM), Analog Data, Analog Signals, Amplitude Modulation, Frequency Modulation, Phase Modulation, Frequency Division Multiplexing, Time Division Multiplexing, Interleaving and Bit Padding

Unit 4. Switching & Error Detection, Internetworking Devices, Internet Protocol (IP)

Circuit-Switched Networks, Datagram Networks, Virtual Circuit Networks, Types of Errors, Single bit and Burst Error, Parity Check (Single and Block Parity), Cyclic Redundancy Check (CRC), Cyclic Redundancy Check (CRC) , Checksum, Flow and Error Control, Protocols of Noiseless and Noisy Channels, Internetworking Devices, Internetworking Devices, Routers, Overview of TCP/IP Installation and Configuration of TCP/IP Protocol, Windows ,Components , Device Driver Management ,LAN Design Different Scenarios., Internet Protocol (IP), Comparison of IPv4 and IPv6 Headers, IP Addressing: Internet Address, Class full Addressing, Classes and Blocks, Masking.

Unit 5. Sub Netting, Protocols & Issues

Sub netting, Classless Addressing, Variable Length Blocks, Process-to- Process Communication, Addressing at Transport Layer, Connection Oriented Vs Connectionless Service, Reliable Vs Unreliable, User Datagram Protocol (UDP), Title , Control Protocol (TCP), Application Layer, Client-Server Model , WWW, Application Layer:, DNS, Electronic Mail, FTP, Network Security Issues:, Basic overview of Cryptography and Security in Internet, Real Time Networking of

devices using cables made in last session and file sharing and security, Wireless LAN Devices Orientation and implementation.

Recommended Books/Reference Material

1. Bertsekas, D., & Gallager, R. (2021). Data networks. Athena Scientific.
2. Dorlan, P. L. (2016). An introduction to computer networks. Autoedición.
3. Forouzan, B. A. (2012). Data Communications and Networking Global Edition 5e. McGraw Hill.
4. West, J. (2022). Data Communication and Computer Networks: A Business User's Approach. Cengage Learning.

Computer Networks (Lab)

BS-Computer Science

Course Code: CS-208L

Credit Hours: 01

Pre-requisite: Nil

Objectives

To introduce basic network devices and LAN technologies. To provide fundamental concepts of switched networks. To provide the IP addressing concepts and subnetting skills. To provide the necessary skills for LAN implementation.

Learning Outcomes:

- **Analyze** fundamental concepts of data communication and computer networks (**C3 Analyze PLO-3**).
- **Apply** in team the characteristics of different transmission media (**C3 Apply PLO-5**).
- **Implement** in team the IP addressing concepts and subnetting skills (**P2 Manipulation PLO-6**).

Course Outline:

Unit 1. Disk Management & Configuration of TCP/IP Protocol

Disk Management, Partition Magic, Data Recovery Tools, Backup Tools, Ghost Utility for Quick Installation, Deep Freeze Software, Installation and Configuration of TCP/IP Protocol, Windows Components, Device, Driver Management

Unit 2. Exploration Of System Unit Hardware

Exploration of System Unit hardware (hand on plug and play), Networking Devices Orientation and Comparisons of their Features, Cabling Using the EIA Standards, Straight, Cross over, Rollover using Twisted pair cable.

Unit 3. Orientation of Simulation Tools

Real Time Networking of devices using cables made in last session and file sharing and security, Orientation of Simulation Tools (Boson Sim/ Packet Tracer/ Opnet/ NS2/ENSP) Orientation of Simulation Tools (Boson Sim/ Packet Tracer/ Opnet/ NS2/ENSP)

Unit 4. LAN Design Different Scenarios

Network Design and Management Issues and Challenge, IT Infrastructure Basics, LAN Design Different Scenarios.

Unit 5. LAN Implementation

LAN Implementation using Ethernet Technologies, LAN Implementation using Ethernet Technologies, Wireless LAN Devices Orientation and implementation.

Recommended Books/Reference Material

1. Bertsekas, D., & Gallager, R. (2021). Data networks. Athena Scientific.
2. Dorlan, P. L. (2016). An introduction to computer networks. Autoedición.
3. Forouzan, B. A. (2012). Data Communications and Networking Global Edition 5e. McGraw Hill.
4. West, J. (2022). Data Communication and Computer Networks: A Business User's Approach. Cengage Learning.

Operating Systems

BS-Computer Science

Course Code: CS-316

Credit Hours: 02

Pre-requisite: Data Structures

Objectives

Course Description This course is about learning and understanding the overview of the Operating Systems. A computer cannot be used and operated without an operating system. There are many operating systems available now a days that can be installed and used in order to operate a system. Installing and using a particular operating system also depends on the factors, like cost, availability, hardware and usage etc. Furthermore, operating system used on mobile devices are different from the ones that we use on desktop and laptop systems. In this course, students will learn about; different operating systems available in the market, what are the major components available in an operating system, what is the significance of those components, and how they are designed and developed.

Learning Outcomes:

- **Understand** the characteristics of different structures of OS and identify the core (C2 Understand PLO-1).
- **Explain** processes and threads, process management, IPC, Process Synchronization, Scheduling, and deadlocks (C2 Understand PLO-2).
- **Evaluate** algorithms used in Memory Management, disk management and File Systems (C5 Evaluate PLO-3).

Course Outline:

Unit 1. Introduction

What Operating Systems Do, Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Distributed Systems, Special-Purpose Systems, Computing Environments

Unit 2. Operating System Structures, Processes

Operating System Services, User Operating System Interface, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, Operating System Structure, Virtual Machines, Operating System Generation, System Boot, Process Concept, Process Scheduling, Operations on Processes, Cooperating Processes, Inter-process Communication, Communication in Client-Server Systems

Unit 3. CPU Scheduling & Deadlocks

Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Thread Scheduling, Operating Systems Examples the Deadlock Problem, System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock

Unit 4. Memory Management, Threads, File System Interface

Background, Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation Example: The Intel Pentium. Threads concepts, User level threads, kernel level threads, mapping of threads, File Concept, Access Methods, Directory Structure, File-System Mounting, File Sharing, Protection

Unit 5. Security and Linux System

The Security Problem, Program Threats, System and Network Threats, Cryptography as a Security Tool, User Authentication, Firewalling to Protect Systems and Networks, Computer-Security Classifications, An Example: Windows XP, Introducing Linux, Installing Troubleshooting and Configuring Linux.

Recommended Books/Reference Material

1. Hausenblas, M. (2022). Learning modern Linux: a handbook for the Cloud native practitioner.
2. Hwang, K., Dongarra, J. J., & Fox, G. C. (2011). Distributed and cloud computing: clusters, grids, clouds, and the future internet. Morgan Kaufmann.

3. Jghef, Y. S., & Zeebaree, S. (2020). State of art survey for significant relations between cloud computing and distributed computing. International Journal of Science and Business.
4. Ruparelia, N. B. (2023). Cloud computing. Mit Press.
5. Silberschatz, A., & Galvin, P. B. (2013). Operating System Concepts.
6. Tanenbaum, A. S. (2007). Distributed systems principles and paradigms.

Operating Systems Lab

BS-Computer Science

Course Code: CS-316L

Credit Hours: 01

Pre-requisite: Data Structures

Objectives

This course is about learning and understanding the overview of the Operating Systems. A computer cannot be used and operated without an operating system. There are many operating systems available now a day that can be installed and used in order to operate a system. Installing and using a particular operating system also depends on the factors, like cost, availability, hardware and usage etc. Furthermore, operating system used on mobile devices are different from the ones that we use on desktop and laptop systems. In this course, students will learn about different operating systems available in the market, what are the major components available in an operating system, what is the significance of those components, and how they are designed and developed.

Learning Outcomes:

- **Design** Shell Scripts/ System Calls using Linux Operating System (**P3 Precision PLO-4**).
- **Execute** in team operating system concepts/ commands for various functions in Windows and Linux (**P2 Manipulation PLO-6**).
- **Combine and perform** the experimental data in the appropriate format in the form of a LAB report (**P4 Articulation PLO-5**).

Course Outline

Unit 1. Introduction to OS

Installation of Linux, configuration of Framework. Computer-System Architecture, Operating-System Structure, Operating-System Operations.

Unit 2. Operating System Structures, Processes

Operating System Services, User Operating System Interface, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, Operating System Structure, Virtual Machines, Operating System Generation, System Boot, Process Concept, Process Scheduling, Operations on Processes, Cooperating Processes, Inter-process Communication, Communication in Client-Server Systems

Unit 3. CPU Scheduling & Deadlock

Basic Concepts, Scheduling Criteria, Implementation of Scheduling Algorithms, Multiple Processor Scheduling, Real-Time Scheduling, Thread Scheduling, Operating Systems Examples. The Deadlock Problem, System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock

Unit 4. Memory Management, Threads, File System Interface

Background, Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation Example: The Intel Pentium. Threads concepts, User level threads, kernel level threads, mapping of threads, File Concept, Access Methods, Directory Structure, File-System Mounting, File Sharing, Protection

Unit 5. The Linux System

Program Threats, System and Network Threats, Cryptography as a Security Tool, User Authentication, Implementing Security Defenses, Firewalling to Protect Systems and Networks, Computer-Security Classifications, An Example: Windows XP, Introducing Linux, Installing Troubleshooting and Configuring Linux

Recommended Books/Reference Material

1. Hausenblas, M. (2022). Learning modern Linux: a handbook for the Cloud native practitioner.
2. Hwang, K., Dongarra, J. J., & Fox, G. C. (2011). Distributed and cloud computing: clusters, grids, clouds, and the future internet. Morgan Kaufmann.
3. Jghef, Y. S., & Zeebaree, S. (2020). State of art survey for significant relations between cloud computing and distributed computing. International Journal of Science and Business.
4. Ruparelia, N. B. (2023). Cloud computing. Mit Press.
5. Silberschatz, A., & Galvin, P. B. (2013). Operating System Concepts.
6. Tanenbaum, A. S. (2007). Distributed systems principles and paradigms.

Information Security

BS-Computer Science

Course Code: CS-319

Credit Hours: 02

Pre-requisite: Nil

Objectives

This course introduces students with basics of information security, in both management aspect and technical aspect. Students understand various types of security incidents and attacks, and learn methods to prevent, detect and react incidents and attacks. It also covers basics of cryptography which are one of the key technologies to implement security functions.

Learning Outcomes:

- **Explain** security services like confidentiality, Integrity and Availability as well as the related tools and technologies, security protocols and Standards **(C2 Understand PLO-1)**.
- **Apply** the appropriate techniques to tackle the problems in the discipline of information security **(C3 Apply PLO-4)**.

- Develop various security and risk management techniques for achieving information security and privacy (**C6 Create PLO-5**).

Course Outline

Unit 1. Model of Info Security, Encryption Techniques

Basic notions of confidentiality, integrity, availability, Model of Info Security, Types of Attacks, Classical Encryption Techniques, Symmetric Encryption Principals, Substitution techniques, Caesar Cipher, Monoalphabetic Ciphers, Play fair Cipher, Hill Cipher, Polyalphabetic Ciphers, Transposition Techniques

Unit 2. The Data Encryption Standard

Stream Ciphers and Block Ciphers, The Feistel Cipher, The Data Encryption Standard, The Avalanche Effect, Timing Attacks, Differential and Linear Cryptanalysis, DES Design Criteria, Design of Function F, Key Schedule Algorithm, Multiple Encryption and Triple DES, Double DES, Electronic Code Book, Cipher Block Chaining Mode

Unit 3. Modes, Cryptosystems

Cipher Feedback Mode, Output Feedback Mode, Counter Mode, Public-Key Cryptosystems, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptography, Public Key Cryptanalysis, The RSA Algorithm, Computational Aspects, The Security of RSA, Applications of Cryptographic Hash Functions, Message Authentication
Digital Signatures, Attacks and Forgeries, Direct Digital Signature

Unit 4. Authentication & Security, Intrusion detection

Symmetric Key Distribution Using Symmetric Encryption. laws, regulations, and professional organizations in information security. Role of access control in computer-based information systems, approaches to control remote and dial-up access by authenticating and authorizing users. Requirements to ensure the privacy of personnel data. categories and models of intrusion detection and prevention systems

Unit 5. Risk management

Define risk management, risk identification, and risk control. Describe how risk is identified and assessed, Log Maintenance

Recommended Books/Reference Material

1. Chitadze, N. (2023). Basic Principles of Information and Cyber Security. In Analyzing New Forms of Social Disorders in Modern Virtual Environments (pp. 193-223). IGI Global.
2. Pachghare, V. K. (2019). Cryptography and information security. PHI Learning Pvt. Ltd.
3. Smith, R. E. (2019). Elementary information security. Jones & Bartlett Learning.
4. Whitman, M. E., & Mattord, H. J. (2021). Principles of information security. Cengage learning.

Information Security Lab

BS-Computer Science

Course Code: CS-319L

Credit Hours: 01

Pre-requisite: Nil

Objectives

This course introduces students with basics of information security, in both management aspect and technical aspect. Students understand various types of security incidents and attacks, and learn methods to prevent, detect and react incidents and attacks. It also covers basics of cryptography which are one of the key technologies to implement security functions.

Learning Outcomes:

- **Explain** security services like confidentiality, Integrity and Availability as well as the related tools and technologies, security protocols and Standards (**C2 Understand PLO-2**).
- **Implement in team** the appropriate techniques to tackle the problems in the discipline of information security (**P2 Manipulation PLO-6**).

- Develop various security and risk management techniques for achieving information security and privacy (**C3 Analyze PLO-3**).

Course Outline

Unit 1. Model of Info Security, Encryption Techniques

Basic notions of confidentiality, integrity, availability, Model of Info Security, Types of Attacks, Classical Encryption Techniques, Symmetric Encryption Principals, Substitution techniques, Caesar Cipher, Monoalphabetic Ciphers, Play fair Cipher, Hill Cipher, Polyalphabetic Ciphers, Transposition Techniques

Unit 2. The Data Encryption Standard

Stream Ciphers and Block Ciphers, The Feistel Cipher, The Data Encryption Standard, The Avalanche Effect, Timing Attacks, Differential and Linear Cryptanalysis, DES Design Criteria, Design of Function F, Key Schedule Algorithm, Multiple Encryption and Triple DES, Double DES, Electronic Code Book, Cipher Block Chaining Mode

Unit 3. Modes, Cryptosystems

Cipher Feedback Mode, Output Feedback Mode, Counter Mode, Public-Key Cryptosystems, Applications for Public-Key Cryptosystems, Requirements for Public-Key Cryptography, Public Key Cryptanalysis, The RSA Algorithm, Computational Aspects, The Security of RSA, Applications of Cryptographic Hash Functions, Message Authentication, Digital Signatures, Attacks and Forgeries, Direct Digital Signature

Unit 4. Authentication & Security, Intrusion Detection

Symmetric Key Distribution Using Symmetric Encryption. laws, regulations, and professional organizations in information security. Role of access control in computer-based information systems, approaches to control remote and dial-up access by authenticating and authorizing users. Requirements to ensure the privacy of personnel data. categories and models of intrusion detection and prevention systems

Unit 5. Risk management

Define risk management, risk identification, and risk control. Describe how risk is identified and assessed, Log Maintenance

Recommended Books/Reference Material

1. Chitadze, N. (2023). Basic Principles of Information and Cyber Security. In Analyzing New Forms of Social Disorders in Modern Virtual Environments (pp. 193-223). IGI Global.
2. Pachghare, V. K. (2019). Cryptography and information security. PHI Learning Pvt. Ltd.
3. Smith, R. E. (2019). Elementary information security. Jones & Bartlett Learning.
- Whitman, M. E., & Mattord, H. J. (2021). Principles of information security. Cengage learning.

17. List of Domain Core Courses of IT

Sr. No.	Course Code	Course Title	Pre-Requisite	Credit Hours
1	IT-310	Web Technologies		2
2	IT-310L	Web Technologies (Lab)		1
3	IT-311	Cyber Security		2
4	IT-311L	Cyber Security (Lab)		1
5	IT-318	DB Administration and Management	Database Systems	2
6	IT-318L	DB Administration and Management (Lab)	Database Systems	1
7	IT-405	System and Network Administration	Operating System	2
8	IT-405L	System and Network Administration (Lab)	Operating System	1
9	IT-312	Information Technology Infrastructure	NIL	2
10	IT-312L	Information Technology Infrastructure (Lab)	NIL	1
11	IT-406	Parallel and Distributed Computing	Operating System	2
12	IT-406L	Parallel and Distributed Computing (Lab)	Operating System	1

18. Course Outlines for Domain Core Courses

Web Technologies

BS-IT

Course Code: IT-310

Credit Hours: 2

Pre-requisite: Nil

Objectives

This course is designed to provide the student with foundational web programming knowledge and skills for interactive and dynamic website building. The student will learn about the web programming as a development platform through the use of popular front-end technologies: HTML, CSS, JavaScript, Bootstrap, jQuery and ReactJs. Moreover, the student will learn to plan, design, construct, and integrate server-side components of modern web applications. For back-end the students will learn PHP with MVC based framework such as Laravel. This will allow students to create websites that store, access, and use data which is stored in the database by exploring SQL queries and Object–relational mapping (ORM). By the end of this course a strong foundation will be laid for full-stack development in the carrier of the student.

Learning Outcomes

- **understand** interactive and responsive website using front-end technologies **(C3 Apply PLO-2)**.
- **Apply** server-side technologies for handling information **(C3 Apply PLO-4)**.
- **Analyze** modern frameworks to increase the efficient and productivity **(C4 Analyze PLO-3)**.

Course Outline

Unit 1. HTML

Introduction to Web Applications, TCP/IP Application Services. Web Servers: Basic Operation, Virtual hosting, Chunked transfers, Caching support, Extensibility. SGML, HTML5, CSS3. XML Languages and Applications: Core

XML, XHTML, XHTML MP. Web Service: SOAP, REST, WML, XSL. Web Services: Operations, Processing HTTP Requests, Processing HTTP Responses, Cookie Coordination, Privacy and P3P, Complex HTTP Interactions, Dynamic Content Delivery. Server Configuration. Server Security. Web Browsers Architecture and Processes.

Unit 2. CSS and JavaScript

Active Browser Pages: JavaScript, DHTML, AJAX. JSON, Approaches to Web Application Development. Programming in any Scripting language. Search Technologies. Search Engine Optimization. XML Query Language, Semantic Web, Future Web Application Framework.

Unit 3. PHP

Introduction to Bootstrap.

Unit 4. Bootstrap

Introduction to Bootstrap.

Unit 5. Laravel and ReactJs

Introduction to Laravel, Routes and Controllers. Views in Laravel and Blade templating engine. Databases, Eloquent, Models, Migrations, Seeders and Faker Factory. User authentication and authorization. Laravel - RESTful APIs authentication. React Basics, React DOM and JSX. Props, States and Components. Redux. React Router. Consuming RESTful APIs created in Laravel.

Recommended Books/Reference Material:

1. Meloni, J. C. (2016). Sams teach yourself HTML, CSS, and JavaScript all in one. Pearson Education India.
2. Stauffer, M. (2023). Laravel: Up & Running. " O'Reilly Media, Inc.".
3. Tatroe, K., & MacIntyre, P. (2020). Programming PHP: Creating dynamic web pages. O'Reilly Media.

Web Technologies (Lab)

BS-IT

Course Code: IT-310L

Credit Hours: 1

Pre-requisite: Nil

Objectives

This course is designed to provide the student with foundational web programming knowledge and skills for interactive and dynamic website building. The student will learn about the web programming as a development platform through the use of popular front-end technologies: HTML, CSS, JavaScript, Bootstrap, jQuery and ReactJs. Moreover, the student will learn to plan, design, construct, and integrate server-side components of modern web applications. For back-end the students will learn PHP with MVC based framework such as Laravel. This will allow students to create websites that store, access, and use data which is stored in the database by exploring SQL queries and Object–relational mapping (ORM). By the end of this course a strong foundation will be laid for full-stack development in the carrier of the student.

Learning Outcomes

- **Design** interactive and responsive website using front-end technologies (**C3 Apply PLO-5**).
- **Implement** in team server-side technologies for handling information (**C6 Create PLO-6**).
- **Apply** modern frameworks to increase the efficient and productivity (**C3 Apply PLO-4**).

Course Outline

Unit 1. HTML

Creating development environment setup. Learning the following HTML tags for web pages required for front-end. HTML5 page structure. HTML headings. Anchor link, Line break Paragraph Image Div. Ordered and unordered list tags. Learn to create tables using HTML. Designing registration form using HTML.

Unit 2. CSS and JavaScript

Designing first page of website using HTML and CSS. Design the navigation bar using CSS property display: flex. Enhance the cosmetic look of HTML table using CSS. Design a contact form by customizing HTML form with input controls. Add alignment of form: In center vertically and horizontally regard less of screen size.

Unit 3. PHP

Create a PHP MySQL CRUD application using MySQL. Create an Object-Oriented Programming based PHP MySQL CRUD application using PDOs.

Unit 4. Bootstrap

Design responsive layout using Bootstrap grid, card, and helper classes. Design a pop-up contact us form using Bootstrap form controls, modal, and helper classes. Use Bootstrap carousel with controls, indicators and captions to display a company's portfolio in shape of images and text on them.

Unit 5. Laravel and ReactJs

Use Laravel code first approach to create CRUD application using MySQL and Blade templating engine. Use Laravel code first approach to create CRUD application using MySQL and Blade templating engine. Create RESTful APIs for tasks table having columns id, text, day and reminder using Laravel. Consuming GET API to display data in React application. Using POST and DELETE APIs in React application

Recommended Books/Reference Material:

- 1.Meloni, J. C. (2016). Sams teach yourself HTML, CSS, and JavaScript all in one. Pearson Education India.
- 2.Stauffer, M. (2023). Laravel: Up & Running. " O'Reilly Media, Inc."
- 3.Tatroe, K., & MacIntyre, P. (2020). Programming PHP: Creating dynamic web pages. O'Reilly Media.

Cyber Security

BS-IT

Course Code: IT-311

Credit Hours: 2

Pre-requisite: Nil

Objectives

To develop experts that can plan, implement, and monitor cyber security mechanisms to help ensure the protection of information technology assets. To develop graduates that can identify, analyze, and remediate computer security breaches.

Learning Outcomes

- **Understand** malware, social engineering, and advanced persistent threats (APTs) (**C2 Understand PLO-2**).
- **Analyze** a comprehensive understanding of key cybersecurity technologies and best practices, including network security, cryptography, identity and access management, and cloud security (**C4 Analyze PLO-3**).
- **Apply** this knowledge to real-world scenarios, such as securing web applications and mobile devices (**C3 Apply PLO-4**).

Course Outline

Unit 1. Introduction to Cybersecurity

Introduction to Cybersecurity, Cyber security Importance, Differences between Information security and cybersecurity, Ethical hacking concepts and scope, Evolution of cyber-attacks, Types of cyber-attacks, Impact of cyber-attacks on individuals and organizations, penetration testing process.

Unit 2. Information Security & Cybersecurity

Virtual Private Networks (VPNs), Cryptography, Symmetric and Asymmetric key encryption, public key infrastructure (PKI). Information security frameworks, Web

and Web application security threats, Secure web protocols (HTTPS, SSL/TLS), Cross-site scripting (XSS) and SQL injection attacks, Secure coding practices.

Unit 3. Introduction to Security Threats

Introduction to cloud computing, Cloud security threats and vulnerabilities, Cloud security models (SaaS, PaaS, IaaS), Cloud security technologies and tools. Mobile device security threats, Mobile device management (MDM), Secure mobile application development, Mobile data encryption.

Unit 4. Threat Intelligence and Hunting

Identity and access management (IAM) overview, IAM components (authentication, authorization, etc.), Single sign-on (SSO), Identity federation and trust models. Introduction to threat intelligence and hunting, Threat intelligence sources and collection techniques, Threat hunting strategies and tools, Cybersecurity threat sharing and collaboration.

Unit 5. Cyber Security Ethics in Emerging Trends

Cybersecurity governance frameworks, Cybersecurity risk management, Cybersecurity metrics and measurements, Cybersecurity incident response planning. Overview of emerging trends and technologies in cybersecurity, Artificial intelligence and machine learning in cybersecurity, Blockchain and cybersecurity, Internet of Things (IoT) security. Ethics in cybersecurity decision-making, Ethical hacking and penetration testing, Legal and regulatory issues in cybersecurity, Intellectual property and copyright laws in cybersecurity, Liability and responsibility in cybersecurity incidents.

Unit 6. Cybersecurity Risk Management

Cyber security governance frameworks, Cyber security risk management, Cyber security metrics and measurements, Cyber security incident response planning. Overview of emerging trends and technologies in cyber security, Artificial

intelligence and machine learning in cyber security, Block chain and cyber security, Internet of Things (IoT) security. Ethics in cyber security decision-making, Ethical hacking and penetration testing, Legal and regulatory issues in cyber security, Intellectual property and copyright laws in cyber security, Liability and responsibility in cyber security.

Recommended Books/Reference Material:

1. Jahankhani, H. (Ed.). (2023). Cybersecurity in the Age of Smart Societies: Proceedings of the 14th International Conference on Global Security, Safety and Sustainability, London, September 2022. Springer Nature.
2. Shoemaker, D., Sigler, K., & Shoemaker, T. (2023). Teaching Cybersecurity: A Handbook for Teaching the Cybersecurity Body of Knowledge in a Conventional Classroom. CRC Press.
3. Whitman, M. E., & Mattord, H. J. (2021). Principles of information security. Cengage learning.

Cyber Security (Lab)

BS-IT

Course Code: IT-311L

Credit Hours: 1

Pre-requisite: Nil

Objectives

To develop experts that can plan, implement, and monitor cyber security mechanisms to help ensure the protection of information technology assets. To develop graduates that can identify, analyze, and remediate computer security breaches.

Learning Outcomes

- **Understand** malware, social engineering, and advanced persistent threats (APTs) (C2 Understand PLO-1).
- **Develop** a comprehensive understanding of key cybersecurity technologies and best practices, including network security, cryptography, identity and access management, and cloud security (C6 Create PLO-5).

- **Apply in team** this knowledge to real-world scenarios, such as securing web applications and mobile devices (**C3 Apply PLO-6**).

Course Outline

Unit 1. Introduction to Cybersecurity

Introduction to Cybersecurity, Cyber security Importance, Differences between Information security and cybersecurity, Ethical hacking concepts and scope, Evolution of cyber-attacks, Types of cyber-attacks, Impact of cyber-attacks on individuals and organizations, penetration testing process.

Unit 2. Information Security & Cybersecurity

Virtual Private Networks (VPNs), Cryptography, Symmetric and Asymmetric key encryption, public key infrastructure (PKI). Information security frameworks, Web and Web application security threats, Secure web protocols (HTTPS, SSL/TLS), Cross-site scripting (XSS) and SQL injection attacks, Secure coding practices.

Unit 3. Introduction to Security Threats

Introduction to cloud computing, Cloud security threats and vulnerabilities, Cloud security models (SaaS, PaaS, IaaS), Cloud security technologies and tools. Mobile device security threats, Mobile device management (MDM), Secure mobile application development, Mobile data encryption.

Unit 4. Threat Intelligence and Hunting

Identity and access management (IAM) overview, IAM components (authentication, authorization, etc.), Single sign-on (SSO), Identity federation and trust models. Introduction to threat intelligence and hunting, Threat intelligence sources and collection techniques, Threat hunting strategies and tools, Cybersecurity threat sharing and collaboration.

Unit 5. Cyber Security Ethics in Emerging Trends

Cybersecurity governance frameworks, Cybersecurity risk management, Cybersecurity metrics and measurements, Cybersecurity incident response planning. Overview of emerging trends and technologies in cybersecurity, Artificial intelligence and machine learning in cybersecurity, Blockchain and cybersecurity, Internet of Things (IoT) security. Ethics in cybersecurity decision-making, Ethical hacking and penetration testing, Legal and regulatory issues in cybersecurity, Intellectual property and copyright laws in cybersecurity, Liability and responsibility in cybersecurity incidents.

Unit 6. Cybersecurity Risk Management

Cyber security governance frameworks, Cyber security risk management, Cyber security metrics and measurements, Cyber security incident response planning. Overview of emerging trends and technologies in cyber security, Artificial intelligence and machine learning in cyber security, Block chain and cyber security, Internet of Things (IoT) security. Ethics in cyber security decision-making, Ethical hacking and penetration testing, Legal and regulatory issues in cyber security, Intellectual property and copyright laws in cyber security, Liability and responsibility in cyber security.

Recommended Books/Reference Material:

1. Jahankhani, H. (Ed.). (2023). Cybersecurity in the Age of Smart Societies: Proceedings of the 14th International Conference on Global Security, Safety and Sustainability, London, September 2022. Springer Nature.
2. Shoemaker, D., Sigler, K., & Shoemaker, T. (2023). Teaching Cybersecurity: A Handbook for Teaching the Cybersecurity Body of Knowledge in a Conventional Classroom. CRC Press.
3. Whitman, M. E., & Mattord, H. J. (2021). Principles of information security. Cengage learning.

Database Administration and Management

BS-IT

Course Code: IT-318

Credit Hours: 2

Pre-requisite: Database Systems

Objectives

This course provides students an Introduction to advance data models such as object relational, object oriented. File organizations concepts, Transactional processing and Concurrency control techniques, Recovery techniques, Query processing and optimization, Database Programming, Integrity and security, Database Administration, Physical database design and tuning, Distributed database systems, Emerging research trends in database systems.

Learning Outcomes

- **Understand** advance data models, technologies and approaches for building distributed database systems **(C2 Understand PLO-1)**.
- **Analyze** query processing and optimization procedures **(C4 Analyze PLO-3)**.
- **Design, develop** and test database auditing procedures **(C6 Create PLO-4)**.

Course Outline

Unit 1. Introduction to Database System

Course introduction, Recap of Database systems

Unit 2. Relational Database Model

Record Storage and Primary File Organizations, Index Structures for Files. The Relational Data Model, Relational Constraints, and the Relational Algebra. Concepts for Object-Oriented Databases, Object Relational and Extended Relational Database Systems, Practical Database Design and Tuning, Query Processing and Optimization.

Unit 3. Cryptography

Virtual Private Networks (VPNs), Cryptography, Symmetric and Asymmetric key encryption, public key infrastructure (PKI).

Unit 4. Query Processing and Optimization

Distributed Databases and Client-Server Architecture.

Unit 5. Transaction Processing Concepts

Mobile device security threats, Mobile device management (MDM), secure mobile application development, Mobile data encryption.

Recommended Books/Reference Material:

1. Connolly, T. M., & Begg, C. E. (2005). Database systems: a practical approach to design, implementation, and management. Pearson Education.
2. Garcia-Molina, H. (2018). Database systems: the complete book. Pearson Education India.
3. Ramakrishnan, R., Gehrke, J., Derstadt, J., Selikoff, S., & Zhu, L. (2021). Database Management Systems Solutions Manual Third Edition.
4. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2021). Database system concepts.

Database Administration and Management Lab

BS-IT

Course Code: IT-318L

Credit Hours: 1

Pre-requisite: Database Systems

Objectives

This course provides students an Introduction to advance data models such as object relational, object oriented. File organizations concepts, Transactional processing and Concurrency control techniques, Recovery techniques, Query processing and optimization, Database Programming, Integrity and security, Database Administration, Physical database

design and tuning, Distributed database systems, Emerging research trends in database systems.

Learning Outcomes

- **Understand** advance data models, technologies and approaches for building distributed database systems (**C2 Understand PLO-2**).
- **Design in team** query processing and optimization procedures (**C4 Analyze PLO-6**).
- **Design, develop** and test database auditing procedures (**C6 Create PLO-5**).

Course Outline

Unit 1. Introduction to Database System

Course introduction, Recap of Database systems

Unit 2. Relational Database Model

Record Storage and Primary File Organizations, Index Structures for Files. The Relational Data Model, Relational Constraints, and the Relational Algebra. Concepts for Object-Oriented Databases, Object Relational and Extended Relational Database Systems, Practical Database Design and Tuning, Query Processing and Optimization.

Unit 3. Database Security and Authorization

Virtual Private Networks (VPNs), Cryptography, Symmetric and Asymmetric key encryption, public key infrastructure (PKI).

Unit 4. Query Processing and Optimization

Distributed Databases

Unit 5. Transaction Processing Concepts

Client-Server Architecture

Recommended Books/Reference Material:

1. Connolly, T. M., & Begg, C. E. (2005). Database systems: a practical approach to design, implementation, and management. Pearson Education.
2. Garcia-Molina, H. (2018). Database systems: the complete book. Pearson Education India.
3. Ramakrishnan, R., Gehrke, J., Derstadt, J., Selikoff, S., & Zhu, L. (2021). Database Management Systems Solutions Manual Third Edition.
4. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2021). Database system concepts.

System and Network Administration

BS-IT

Course Code: IT-405

Credit Hours: 2

Pre-requisite: Operating System

Objectives

This course will give an overview of systems and network administration based on both Windows and Linux environments. The objective are common system and network administration tasks and practices and how to implement and maintain standard services like email, file sharing, DNS and similar.

Learning Outcomes

- **Demonstrate** knowledge about the practical aspects of System and network administration **(C2 Understand PLO-2)**.
- **Apply** tools and techniques to solve problems by applying concepts of system and network administration **(C3 Apply PLO-4)**.
- **Analyze** the outcome of an experiment/task in standard format **(C4 Analyze PLO-3)**.

Course Outline

Unit 1. Network Administration Foundations

Workstations, The Basics, Loading the OS, Updating the System Software and Applications, Network Configuration, Avoid Using Dynamic DNS with DHCP, The Icing, High Confidence in Completion, Involve Customers in the Standardization Process, A Variety of Standard Configurations.

Unit 2. Servers

Servers, The Basics, Buy Server Hardware for Servers, Choose Vendors Known for Reliable Products, Understand the Cost of Server Hardware, Consider Maintenance Contracts and Spare Parts, Maintaining Data Integrity, Put Servers in the Data Center, Client Server OS Configuration, Provide Remote Console Access, Mirror Boot Disks, The Icing, Enhancing Reliability and Service Ability, An Alternative: Many Inexpensive Servers.

Unit 3. Centralization of Standards

Services, The Basics, Customer Requirements, Operational Requirements, Open Architecture, Simplicity, Vendor Relations, Machine Independence, Environment, Restricted Access, Reliability, Single or Multiple Servers, Centralization and Standards, Performance, Monitoring, Service Rollout, The Icing, Dedicated Machines, Full Redundancy, Dataflow Analysis for Scaling.

Unit 4. Data Centers

Data Centers, The Basics, Location, Access, Security, Power and Cooling, Fire Suppression, Racks, Wiring, Labeling, Communication, Console Access, Workbench, Tools and Supplies, Parking Spaces, The Icing, Greater Redundancy, More Space, Ideal Data Centers, Tom's Dream Data Center, Christine's Dream Data Center.

Unit 5. Advance Monitoring

Email Service, The Basics, Privacy Policy, Namespaces, Reliability, Simplicity, Spam and Virus Blocking, Generality, Automation, Basic Monitoring, Redundancy, Scaling, Security Issues, Communication, The Icing, Encryption, Email Retention Policy, Advanced Monitoring, High-Volume List Processing.

Unit 6. RAID Optimization

Data Storage, the Basics, Terminology, Managing Storage, Storage as a Service, Performance, Evaluating New Storage Solutions, Common Problems, The Icing, Optimizing RAID Usage by Applications, Storage Limits: Disk Access Density Gap, Continuous Data Protection.

Unit 7. Web Services

Web Services, The Basics, Web Service Building Blocks, The Webmaster Role, Service-Level Agreements, Web Service Architectures, Monitoring.

Recommended Books/Reference Material:

1. Limoncelli, T. A., Limoncelli, T., Hogan, C. J., & Chalup, S. R. (2007). The practice of system and network administration. Pearson Education.
2. Linux, R. H. E. (2010). Red Hat Enterprise Linux 6.
3. Studyguide for Practice of System and Network Administration by Thomas A. Limoncelli, Cram101; 2nd Edition.
4. Uysal, E., Kaya, O., Ephremides, A., Gross, J., Codreanu, M., Popovski, P., ... & Johansson, K. H. (2022). Semantic communications in networked systems: A data significance perspective. IEEE Network.
5. Usmonov, M. T. O. G. L. (2021). Authentication, authorization and administration. Science and Education.

System and Network Administration Lab

BS-IT

Course Code: IT-405L

Credit Hours: 1

Pre-requisite: Operating System

Objectives

This course will give an overview of systems and network administration based on both Windows and Linux environments. The objective are common system and network

administration tasks and practices and how to implement and maintain standard services like email, file sharing, DNS and similar.

Learning Outcomes

- **Demonstrate** knowledge about the practical aspects of System and network administration **(P3 Precision PLO-1)**.
- **Manipulate** tools and techniques to solve problems by applying concepts of system and network administration **(P2 Manipulation PLO-5)**.
- **Report in team** the outcome of an experiment/task in standard format **(A2 Respond PLO-6)**.

Course Outline

Unit 1. Network Administration Foundations

Workstations, The Basics, Loading the OS, Updating the System Software and Applications, Network Configuration, Avoid Using Dynamic DNS with DHCP, The Icing, High Confidence in Completion, Involve Customers in the Standardization Process, A Variety of Standard Configurations.

Unit 2. Servers

Servers, The Basics, Buy Server Hardware for Servers, Choose Vendors Known for Reliable Products, Understand the Cost of Server Hardware, Consider Maintenance Contracts and Spare Parts, Maintaining Data Integrity, Put Servers in the Data Center, Client Server OS Configuration, Provide Remote Console Access, Mirror Boot Disks, The Icing, Enhancing Reliability and Service Ability, An Alternative: Many Inexpensive Servers.

Unit 3. Centralization of Standards

Services, The Basics, Customer Requirements, Operational Requirements, Open Architecture, Simplicity, Vendor Relations, Machine Independence, Environment, Restricted Access, Reliability, Single or Multiple Servers, Centralization and Standards, Performance, Monitoring, Service Rollout, The Icing, Dedicated Machines, Full Redundancy, Dataflow Analysis for Scaling.

Unit 4. Data Centers

Data Centers, The Basics, Location, Access, Security, Power and Cooling, Fire Suppression, Racks, Wiring, Labeling, Communication, Console Access, Workbench, Tools and Supplies, Parking Spaces, The Icing, Greater Redundancy, More Space, Ideal Data Centers, Tom's Dream Data Center, Christine's Dream Data Center.

Unit 5. Advance Monitoring

Email Service, The Basics, Privacy Policy, Namespaces, Reliability, Simplicity, Spam and Virus Blocking, Generality, Automation, Basic Monitoring, Redundancy, Scaling, Security Issues, Communication, The Icing, Encryption, Email Retention Policy, Advanced Monitoring, High-Volume List Processing.

Unit 6. RAID Optimization

Data Storage, he Basics, Terminology, Managing Storage, Storage as a Service, Performance, Evaluating New Storage Solutions, Common Problems, The Icing, Optimizing RAID Usage by Applications, Storage Limits: Disk Access Density Gap, Continuous Data Protection.

Unit 7. Web Services

Web Services, The Basics, Web Service Building Blocks, The Webmaster Role, Service-Level Agreements, Web Service Architectures, Monitoring.

Recommended Books/Reference Material:

1. Limoncelli, T. A., Limoncelli, T., Hogan, C. J., & Chalup, S. R. (2007). The practice of system and network administration. Pearson Education.
2. Linux, R. H. E. (2010). Red Hat enteRpRise Linux 6.
3. Studyguide for Practice of System and Network Administration by Thomas A. Limoncelli, Cram101; 2nd Edition.
4. Uysal, E., Kaya, O., Ephremides, A., Gross, J., Codreanu, M., Popovski, P., ... & Johansson, K. H. (2022). Semantic communications in networked systems: A data significance perspective. IEEE Network.

5. Usmonov, M. T. O. G. L. (2021). Autentification, authorization and administration. Science and Education.

Information Technology Infrastructure

BS-IT

Course Code: IT-312

Credit Hours: 2

Pre-requisite: Nil

Objectives

This course will give an overview of Infrastructure management activities, Evolutions of Systems since 1960s (Mainframes-to-Midrange-to-PCs-to-Client-server computing-to-new age systems) and their Management, growth of internet, current business demands and IT systems issues, complexity of today's computing environment, Total cost of complexity issues, Value of Systems management for business. Factors to consider in designing IT organizations and IT infrastructure. Determining customer's Requirements, Identifying System Components to manage, Exist Processes, Data, applications, Tools and their integration, Patterns for IT systems management, Introduction to the design process for information systems.

Learning Outcomes

- **Understand** the foundation of IT Infrastructure and its Availability (**C2 Understand PLO-1**).
- **Analyze** various infrastructure building blocks (**C4 Analyze PLO-3**).
- **Apply** the Infrastructure Principles (**C3 Apply PLO-2**).

Course Outline

Unit 1. Introduction to IT Infrastructure

Introduction to IT infrastructure and the infrastructure model

Unit 2. IT Building Blocks

IT building blocks, Processes / Information building block, Applications building block, Application Platform building block, Infrastructure building blocks.

Unit 3. Performance Concepts

Performance Concepts, Introduction, Perceived performance, Performance during infrastructure design.

Unit 4. Storage Building Blocks

Storage building blocks, Availability, Performance, Security.

Unit 5. End User Device

End user device availability, End user device performance and End user device security.

Unit 6. Deployment

Deploying the infrastructure.

Unit 7. Maintenance

Maintaining the infrastructure.

Recommended Books/Reference Material:

1. Frank, U., Kaczmarek-Heß, M., & de Kinderen, S. (2021). IT Infrastructure Modeling Language (ITML): a DSML for Supporting IT Management (No. 72). ICB-Research Report.
2. Furda, R., Molnar, E., & Greguš, M. (2022). Information Technology Architects in Agile Organizations. In Developments in Information & Knowledge Management for Business Applications, Cham: Springer International Publishing.
3. K. Surendra Keshari, N. Kumar (2013) IT Infrastructure & Management, I.K. International Publishing House.
4. Ying, J., Zhang, X., Zhang, Y., & Bilan, S. (2022). Green infrastructure: Systematic literature review. Economic research-Ekonomska istraživanja.

Information Technology Infrastructure Lab

BS-IT

Course Code: IT-312L

Credit Hours: 1

Pre-requisite: Nil

Objectives

This course will give an overview of Infrastructure management activities, Evolutions of Systems since 1960s (Mainframes-to-Midrange-to-PCs-to-Client-server computing-to-new age systems) and their Management, growth of internet, current business demands and IT systems issues, complexity of today's computing environment, Total cost of complexity issues, Value of Systems management for business. Factors to consider in designing IT organizations and IT infrastructure. Determining customer's Requirements, Identifying System Components to manage, Exist Processes, Data, applications, Tools and their integration, Patterns for IT systems management, Introduction to the design process for information systems.

Learning Outcomes

- **Apply** the foundation of IT Infrastructure and its Availability (C3 **Apply PLO-5**).
- **Design** various infrastructure building blocks (C5 **Create PLO-5**).
- **Apply in team** the Infrastructure Principles (C3 **Apply PLO-6**).

Course Outline

Unit 1. Introduction to IT Infrastructure

Introduction to IT infrastructure and the infrastructure model

Unit 2. IT Building Blocks

IT building blocks, Processes / Information building block, Applications building block, Application Platform building block, Infrastructure building blocks.

Unit 3. Performance Concepts

Performance Concepts, Introduction, Perceived performance, Performance during infrastructure design.

Unit 4. Storage Building Blocks

Storage building blocks, Availability, Performance, Security.

Unit 5. End User Device

End user device availability, End user device performance and End user device security.

Unit 6. Deployment

Deploying the infrastructure.

Unit 7. Maintenance

Maintaining the infrastructure.

Recommended Books/Reference Material:

1. Frank, U., Kaczmarek-Heß, M., & de Kinderen, S. (2021). IT Infrastructure Modeling Language (ITML): a DSML for Supporting IT Management (No. 72). ICB-Research Report.
2. Furda, R., Molnar, E., & Greguš, M. (2022). Information Technology Architects in Agile Organizations. In Developments in Information & Knowledge Management for Business Applications, Cham: Springer International Publishing.
3. K. Surendra Keshari, N. Kumar (2013) IT Infrastructure & Management, I.K. International Publishing House.
4. Ying, J., Zhang, X., Zhang, Y., & Bilan, S. (2022). Green infrastructure: Systematic literature review. Economic research-Ekonomska istraživanja.

Parallel and Distributed Computing

BS-IT

Course Code: IT-406

Credit Hours: 2

Pre-requisite: Operating systems

Objectives

This course focuses on algorithms and techniques for developing parallel and distributed applications and their architectures and systems. Parallel computing on a single computer uses multiple processors to process tasks in parallel, whereas distributed parallel computing uses multiple computing devices to process those tasks. In this course, students will explore distributed consensus, the CAP theorem, logical time, multicast, mutex, garbage collection, snapshots, deadlock detection, web caching, resource looking up in the P2P system, blockchain, multiprocessor scheduling, and multiprocessor caching.

Learning Outcomes

- **Discuss** about parallel and distributed computers (**C2 Understand PLO-1**).
- **Develop** portable programs for parallel or distributed - architectures using Message-Passing Interface (MPI) Library (**C6 Create PLO-4**).
- **Analyze** complex problems with shared memory programming with OpenMP (**C4 Analyze PLO-3**).

Course Outline

Unit 1. Introduction

Introduction to Parallel and Distributed Computing

Unit 2. Flynn's Taxonomy

Flynn's Taxonomy, Introduction to Multi-Threading

Unit 3. Parallel algorithms

Parallel algorithms & architectures, parallel I/O

Unit 4. Programming models

Programming models (data-parallel, task-parallel, process-centric, shared/distributed memory).

Unit 5. OpenMP

Introduction to Parallel Programming using OpenMP

Unit 6. Performance

Performance analysis and tuning, scalability and performance studies.

Unit 7. Advanced topics in parallel and Distributed computing

Advanced topics in parallel and Distributed computing

Unit 8. OpenCL

GPU architecture and programming, heterogeneity, Introduction to OpenCL

Recommended Books/Reference Material:

1. Hwang, K., Dongarra, J. J., & Fox, G. C. (2011). Distributed and cloud computing: clusters, grids, clouds, and the future internet. Morgan Kaufmann.
2. Jghef, Y. S., & Zeebaree, S. (2020). State of art survey for significant relations between cloud computing and distributed computing. International Journal of Science and Business.
3. Ruparelia, N. B. (2023). Cloud computing. Mit Press.
4. Tanenbaum, A. S. (2007). Distributed systems principles and paradigms.

Parallel and Distributed Computing Lab

BS-IT

Course Code: IT-406L

Credit Hours: 1

Pre-requisite: Operating systems

Objectives

This course focuses on algorithms and techniques for developing parallel and distributed applications and their architectures and systems. Parallel computing on a single computer uses multiple processors to process tasks in parallel, whereas distributed parallel computing uses multiple computing devices to process those tasks. In this course, students will explore distributed consensus, the CAP theorem, logical time, multicast, mutex, garbage collection, snapshots, deadlock detection, web caching, resource looking up in the P2P system, blockchain, multiprocessor scheduling, and multiprocessor caching.

Learning Outcomes

- **Discuss** about parallel and distributed computers (**C2 Understand PLO-2**).
- **Develop** portable programs for parallel or distributed - architectures using Message-Passing Interface (MPI) Library (**C6 Create PLO-5**).
- **Apply in team** complex problems with shared memory programming with OpenMP (**C3 Apply PLO-6**).

Course Outline

Unit 1. Introduction

Introduction to Parallel and Distributed Computing

Unit 2. Flynn's Taxonomy

Flynn's Taxonomy, Introduction to Multi-Threading

Unit 3. Parallel algorithms

Parallel algorithms & architectures, parallel I/O

Unit 4. Programming models

Programming models (data-parallel, task-parallel, process-centric, shared/distributed memory).

Unit 5. OpenMP

Introduction to Parallel Programming using OpenMP

Unit 6. Performance

Performance analysis and tuning, scalability and performance studies.

Unit 7. Advanced topics in parallel and Distributed computing

Advanced topics in parallel and Distributed computing

Unit 8. OpenCL

GPU architecture and programming, heterogeneity, Introduction to OpenCL

Recommended Books/Reference Material:

1. Hwang, K., Dongarra, J. J., & Fox, G. C. (2011). Distributed and cloud computing: clusters, grids, clouds, and the future internet. Morgan Kaufmann.
2. Jghef, Y. S., & Zeebaree, S. (2020). State of art survey for significant relations between cloud computing and distributed computing. International Journal of Science and Business.
3. Ruparelia, N. B. (2023). Cloud computing. Mit Press.
4. Tanenbaum, A. S. (2007). Distributed systems principles and paradigms.

19. List of Domain Elective Courses of IT

Sr. No.	Course Code	Course Title	Pre-Requisite	Credit hour
1	IT-313	Virtual Systems and Services	Programming Fundamentals	2
2	IT-313L	Virtual Systems and Services (Lab)	Programming Fundamentals	1
3	CS-321	Computer Architecture	Computer Organization and Assembly Language	2
4	CS-321L	Computer Architecture (Lab)	Computer Organization and Assembly Language	1
5	IT-314	Network Security		2
6	IT-314L	Network Security (Lab)		1
7	IT-315	Enterprise Systems		2
8	IT-315L	Enterprise Systems (Lab)		1
9	CS-407	Web Engineering		2
10	CS-407L	Web Engineering (Lab)		1
11	CS-317	Theory of Automata		2
12	CS-322	HCI and Computer Graphics		2
13	CS-322L	HCI and Computer Graphics (Lab)		1
14	IT-316	Software Project Management	Software Engineering	2
15	IT-316L	Software Project Management (Lab)	Software Engineering	2
16	CS-324	Cloud Computing		2
17	CS-324L	Cloud Computing (Lab)		1
18	IT-317	Software Requirement Engineering	Software Engineering	2
19	IT-317L	Software Requirement Engineering (Lab)	Software Engineering	1
20	CS-408	Mobile Application Development		2
21	CS-408L	Mobile Application Development (Lab)		1
22	IT-407	Web Security and Forensics	Information Security	2
23	IT-407L	Web Security and Forensics (Lab)	Information Security	1

24	IT-408	Object-Oriented Analysis and Design	Object-Oriented Programming	3
25	IT-409	Natural Language Processing	Programming Fundamentals	2
26	IT-409L	Natural Language Processing (Lab)	Programming Fundamentals	1
27	IT-410	Machine Learning	Programming Fundamentals	2
28	IT-410	Machine Learning (Lab)	Programming Fundamentals	1
29	IT-411	Internet of Things	Computer Networks	2
30	IT-411	Internet of Things (Lab)	Computer Networks	1
31	CS-308	Game Development	Nil	3
32	CS-309	Visual Programming	Object Oriented Programming	3
33	CS-311	Data Mining	Nil	3
34	CS-315	Digital Image Processing	Nil	3
35	CS-404	Data Science	Nil	3

20.Course Outlines for Domain Elective Courses

Virtual Systems and Services

BS-IT

Course Code: IT-313

Credit Hours: 2

Pre-requisite: Nil

Objectives

Virtualization has become a critically important focus of the IT world in recent years. Virtualization technologies are used by countless thousands of companies to consolidate their workloads and to make their IT environments scalable and more flexible. If you want to learn cloud computing, you'll simply have to absorb the basic virtualization technology concepts at some point.

Learning Outcomes

- **Demonstrate** and optimize resources in virtualized environments using tools like VMware vCenter and Distributed Resource Scheduler **(C3 Apply)**.
- **Manipulate** and deploy multi- service applications by using Docker **(P2 Manipulate)**.
- **Implement** container orchestration using Docker Swarm and manage containers at scale **(C3 Apply)**.

Course Outline

Unit 1. Introduction

Practical implementation of virtual machines concepts - VMware .how to create
Creating a Virtual Machine . Installing Windows/Linux on a Virtual Machine,
Clones: Understanding the concept of cloning virtual machines in VMware, ESXi
and vCenter Permission Model: Exploring the permission model in VMware ESXi
and vCenter. Managing CPUs for a Virtual Machine, Resource Management and
Resource Pools: Managing resources and creating resource pools in VMware.

Unit 2. VM Hot and Cold Migration

Understanding the migration process of virtual machines in VMware, both hot and cold migration, Load Balancing with Distributed Resource Scheduler: Exploring the Distributed Resource Scheduler (DRS) and its role in load balancing, Managing Scalability and Performance: Best practices for managing scalability and performance in virtualized environments. Managing Storage for a Virtual Machine, Managing Networking for a Virtual Machine . Recap of core Docker concepts, including images, containers, and container orchestration. Kubernetes Installation/ Setting Up a Single Node Kubernetes Cluster Using Minikub.

Unit 3. XEN: Introduction To XEN Virtualization

Overview of XEN virtualization technology and its features., XEN: Virtual machine management - Using native XEN utilities: Exploring the native utilities for managing virtual machines in XEN. Hyper-V: Introduction to Hyper-V virtualization: Overview of Microsoft Hyper-V virtualization technology and its features, Configure and manage Hyper-V virtual machines: Step-by-step guide on configuring and managing virtual machines in Hyper-V .

Unit 4. Hyper-V: Securing Workloads

Best practices for securing workloads in Hyper-V. Configuring Host Guardian Services (HGS): Introduction to Host Guardian Services and its role in securing virtual machines, Introduction to Replica: Overview of Hyper- V Replica and its use for disaster recovery. Configuring and implementing Replica: Step-by-step guide on configuring and implementing Hyper-V Replica, Virtualization vs. containerization: Understanding the differences between virtualization and containerization

Unit 5. Dockers Orientation and Setup

Docker Commands, Dockers: Overview of Docker containerization platform and its features, Benefits of containers: Understanding the advantages of using containers in modern software development (Discussion) Getting Started with Docker: Setting up Docker environment and understanding the basic Docker commands, Docker Orientation and setup: Introduction to Docker's architecture and how to set up Docker on different platforms. Basic Docker Commands: Exploring essential Docker commands for managing containers, images, and networks, Docker compose / stacks: Deploying multi- container applications using Docker Compose and Docker stacks.

Recommended Books/Reference Material:

1. Savola, A. (2021). Server virtualization with VMware.
2. Shackleford, D. (2021). Virtualization security: protecting virtualized environments. John Wiley & Sons.
3. Smith, J., & Nair, R. (2019). Virtual machines: versatile platforms for systems and processes. Elsevier.
4. Segeč, P., Moravčík, M., Kontšek, M., Papán, J., Uramová, J., & Yeremenko, O. (2019, November). Network virtualization tools–analysis and application in higher education. In 2019 17th International Conference on Emerging eLearning Technologies and Applications (ICETA). IEEE.

Virtual Systems and Services Lab

BS-IT

Course Code: IT-313L

Credit Hours: 1

Pre-requisite: Nil

Objectives

Virtualization has become a critically important focus of the IT world in recent years. Virtualization technologies are used by countless thousands of companies to consolidate their workloads and to make their IT environments scalable and more flexible. If you want to learn cloud computing, you'll simply have to absorb the basic virtualization technology concepts at some point.

Learning Outcomes

- **Demonstrate** and optimize resources in virtualized environments using tools like VMware vCenter and Distributed Resource Scheduler (**C3 Apply**).
- **Manipulate** and deploy multi- service applications by using Docker (**P2 Manipulate**).
- **Implement** container orchestration using Docker Swarm and manage containers at scale (**C3 Apply**).

Course Outline

Unit 1. Introduction

Practical implementation of virtual machines concepts - VMware .how to create Creating a Virtual Machine . Installing Windows/Linux on a Virtual Machine, Clones: Understanding the concept of cloning virtual machines in VMware, ESXi and vCenter Permission Model: Exploring the permission model in VMware ESXi and vCenter. Managing CPUs for a Virtual Machine, Resource Management and Resource Pools: Managing resources and creating resource pools in VMware.

Unit 2. VM Hot and Cold Migration

Understanding the migration process of virtual machines in VMware, both hot and cold migration, Load Balancing with Distributed Resource Scheduler: Exploring the Distributed Resource Scheduler (DRS) and its role in load balancing, Managing Scalability and Performance: Best practices for managing scalability and performance in virtualized environments. Managing Storage for a Virtual Machine, Managing Networking for a Virtual Machine . Recap of core Docker concepts,

including images, containers, and container orchestration. Kubernetes Installation/ Setting Up a Single Node Kubernetes Cluster Using Minikub.

Unit 3. XEN: Introduction To XEN Virtualization

Overview of XEN virtualization technology and its features., XEN: Virtual machine management - Using native XEN utilities: Exploring the native utilities for managing virtual machines in XEN. Hyper-V: Introduction to Hyper-V virtualization: Overview of Microsoft Hyper-V virtualization technology and its features, Configure and manage Hyper-V virtual machines: Step-by-step guide on configuring and managing virtual machines in Hyper-V .

Unit 4. Hyper-V: Securing Workloads

Best practices for securing workloads in Hyper-V. Configuring Host Guardian Services (HGS): Introduction to Host Guardian Services and its role in securing virtual machines, Introduction to Replica: Overview of Hyper- V Replica and its use for disaster recovery. Configuring and implementing Replica: Step-by-step guide on configuring and implementing Hyper-V Replica, Virtualization vs. containerization: Understanding the differences between virtualization and containerization

Unit 5. Dockers Orientation and Setup

Docker Commands, Dockers: Overview of Docker containerization platform and its features, Benefits of containers: Understanding the advantages of using containers in modern software development (Discussion) Getting Started with Docker: Setting up Docker environment and understanding the basic Docker commands, Docker Orientation and setup: Introduction to Docker's architecture and how to set up Docker on different platforms. Basic Docker Commands: Exploring essential Docker commands for managing containers, images, and networks, Docker compose / stacks: Deploying multi- container applications using Docker Compose and Docker stacks.

Recommended Books/Reference Material:

1. Savola, A. (2021). Server virtualization with VMware.
2. Shackleford, D. (2021). Virtualization security: protecting virtualized environments. John Wiley & Sons.
3. Smith, J., & Nair, R. (2019). Virtual machines: versatile platforms for systems and processes. Elsevier.
4. Segeč, P., Moravčík, M., Kontšek, M., Papán, J., Uramová, J., & Yeremenko, O. (2019, November). Network virtualization tools–analysis and application in higher education. In 2019 17th International Conference on Emerging eLearning Technologies and Applications (ICETA). IEEE.

Computer Architecture

BS-IT

Course Code: CS-321

Credit Hours: 2

Pre-requisite: Computer Organization and Assembly language

Objectives

This course deals with computer architecture as well as computer organization and design. Computer architecture is concerned with the structure and behavior of the various functional modules of the computer and how they interact to provide the processing needs of the user. Computer organization is concerned with the way the hardware components are connected together to form a computer system. Computer design is concerned with the development of the hardware for the computer taking into consideration a given set of specifications. The aim is to explain and learn the architecture of basic computer and microprogrammed control unit.

Learning Outcomes

- **Understand** the digital components of a computer system (registers, memory, bus), their general organization, interconnection along with the arithmetic and logic microoperations **(C2 Understand)**.
- **Understand** the underlying concepts of instructions working with registers and memory, along with RISC and CISC characteristics **(C2 Understand)**.
- **Demonstrate** the ability to implement and verify designs of varying complexity at the register-transfer-level, ability to design a basic computer **(C3 Apply)**.

Course Outline

Unit 1. Introduction to Digital Components

Introduction of Digital Components (Integrated Circuits, Decoders, Encoders, MUX, Registers [Registers with Parallel Load], Shift Registers [Bidirectional Shift Registers with Parallel Load])

Unit 2. Register Transfer and Microoperations

Register Transfer and Microoperations (Register Transfer Language, Register Transfer, Bus and Memory Transfers [Three-State Bus Buffers, Memory Read, Memory Write], Arithmetic Microoperations [Binary Adder, Binary Adder-Subtractor, Binary Incrementor, Arithmetic Circuit], Logic Microoperations [List of Logic Microoperations, Hardware Implementation, Some Applications], Shift Microoperations [Hardware Implementation], Arithmetic Logic Shift Unit)

Unit 3. Design and Control of Basic Computer

Basic Computer Organization and Design (Instruction Codes [Stored Program Organization, Indirect Address], Computer Registers [Common Bus System], Computer Instructions [Instruction Set Completeness], Timing and Control, Instruction Cycle [Fetch and Decode, Determine the Type of Instruction, Register Reference Instructions], Memory Reference Instructions [AND to AC, ADD to AC,

LDA: Load to AC, STA: Store AC, BUN: Branch Unconditionally, BSA: Branch and Save Return Address, ISZ: Increment and Skip If Zero. Control Flowchart]), Design of Basic Computer [Control Logic Gates, Control of Registers and Memory, Control of Single Flip Flops, Control of Common Bus]

Unit 4. Instruction Set Architecture

Central Processing Unit, General Register Organization [Control Word, Examples of Microoperations], Stack Organization [Register Stack, Memory Stack, Reverse Polish Notation], Instruction Formats [Three-Address Instructions, Two-Address Instructions, One-Address Instructions, Zero-Address Instructions, RISC Instructions], Reduced Instruction Set Computer (RISC), CISC Characteristics, RISC Characteristics

Unit 5. Overview of Pipeline

Overview of Pipeline and Vector Processing, Throughput, multiple functional Units, SIMD, MIMD Instruction Pipeline [Example: Four-Segment Instruction Pipeline], Vector Operations.

Recommended books/reference material

1. Computer System Architecture. (2007). India: Pearson Education.
2. DUMAS II, J. D., Dumas, J. D. (2021). Computer Architecture: Fundamentals and Principles of Computer Design, Second Edition. United Kingdom: CRC Press.
3. Faroughi, N. (2014). Digital Logic Design and Computer Organization with Computer Architecture for Security. United Kingdom: McGraw-Hill Education.
4. Heuring, V. P., Jordan, H. F., Murdocca, M. (1997). Computer Systems Design and Architecture. United Kingdom: Addison-Wesley.
5. Mano, M. M., Kime, C. R. (2004). Logic and Computer Design Fundamentals. United Kingdom: Pearson/Prentice Hall.
6. Patterson, D. A., Hennessy, J. L. (2012). Computer Organization and Design: The Hardware/Software Interface. Germany: Elsevier Science.

7. Pedroni, V. A. (2020). Circuit Design with VHDL. United Kingdom: MIT Press.
8. Wang, S. P. (2021). Computer Architecture and Organization: Fundamentals and Architecture Security. Singapore: Springer Nature Singapore.
9. Yadin, A. (2020). Computer Systems Architecture. United Kingdom: CRC Press LLC.

Computer Architecture (Lab)

BS-Computer Science

Course Code: CS-321L

Credit Hours: 01

Pre-requisite: Computer Organization and Assembly Language

Objectives

This course is designed to understand the hardware operation of digital computers. The course aims to simulate the working of various digital components used in the organization and design of digital computers. The experiments simulated in the lab show the detailed steps that a designer must go through in order to design an elementary basic computer. The goal is to understand the role of each major hardware component of a computer system and their synergistic interaction with each other.

Learning Outcomes

- **Apply** the fundamental concepts of digital logic design to simulate the hardware operations of various digital components used in the organization and design of digital computers (**P4 Articulation**).
- **Execute** the steps that a designer must go through in order to design an elementary basic computer. Simulation of microoperations to understanding the working of instructions with registers, computer bus and memory (**P2 Manipulation**).
- **Contribute** individually or as a team member to work effectively (**A2 Respond**).

- Write concise yet comprehensive technical reports that describe designs implemented at the register-transfer-level, and explain the testing strategy used to verify functionality (A2 Respond).

Course Outline

Unit 1. Introduction to Model Sim

To learn the basic simulator environment and components available. Common Bus System for 4 Registers: Simulating the common bus system for 4 registers to transfer the information between the registers using multiplexers. Common Bus System for 4 Registers: Bus Line with three-state Buffers. Simulating the bus system with three-state gates instead of multiplexers.

Unit 2. Arithmetic Microoperations

Simulating the arithmetic binary operations which include 4-bit binary Adder, Adder Subtractor/ 4-bit binary Incrementor. 5 4-bit Arithmetic Circuit Simulating the arithmetic microoperations (4-bit binary Adder, Adder-Subtractor/ 4-bit binary Incrementor done in previous lab) in one composite arithmetic circuit. Logic Microoperations Simulating one stage of a logic circuit that generates the four basic logic microoperation AND, OR, XOR, Compliment.

Unit 3. Shift Microoperations

Simulating 4-bit combinational circuit shifter with multiplexers. Simulating one stage of arithmetic logic shift unit that uses one stage of 4-bit arithmetic circuit and one stage of logic circuit

Unit 4. Control of AR, Flipflop, 16-Bit Common Bus Register

Simulating the control of Address Register (AR) with control inputs Load (LD), Increment (INR) and Clear (CLR). Simulating the control inputs for Interrupt

Enable (IEN) using JK flip-flop. Control of 16-bit Common Bus Register selection for 16-bit common bus using encoders

Unit 5. Design of Adder and Logic Circuit

Simulating the gate structure for controlling the Load (LD), Increment (INR) and Clear (CLR) of Accumulator Register (AC). Design of Adder and Logic Circuit
Simulating one stage of adder and logic circuit corresponding to one bit of AC

Recommended books/reference material

1. Computer System Architecture. (2007). India: Pearson Education.
2. DUMAS II, J. D., Dumas, J. D. (2021). Computer Architecture: Fundamentals and Principles of Computer Design, Second Edition. United Kingdom: CRC Press.
3. Faroughi, N. (2014). Digital Logic Design and Computer Organization with Computer Architecture for Security. United Kingdom: McGraw-Hill Education.
4. Heuring, V. P., Jordan, H. F., Murdocca, M. (1997). Computer Systems Design and Architecture. United Kingdom: Addison-Wesley.
5. Mano, M. M., Kime, C. R. (2004). Logic and Computer Design Fundamentals. United Kingdom: Pearson/Prentice Hall.
6. Patterson, D. A., Hennessy, J. L. (2012). Computer Organization and Design: The Hardware/Software Interface. Germany: Elsevier Science.
7. Pedroni, V. A. (2020). Circuit Design with VHDL. United Kingdom: MIT Press.
8. Wang, S. P. (2021). Computer Architecture and Organization: Fundamentals and Architecture Security. Singapore: Springer Nature Singapore.
9. Yadin, A. (2020). Computer Systems Architecture. United Kingdom: CRC Press LLC.

Network Security

BS-IT

Course Code: IT-314

Credit Hours: 2

Pre-requisite: Nil

Objective

This course introduces students with basics of information security, in both management aspect and technical aspect. Students understand various types of security incidents and attacks, and learn methods to prevent, detect and react incidents and attacks. It also covers basics of cryptography which are one of the key technology to implement security functions

Learning Outcomes

- **Explain** security services like confidentiality, Integrity and Availability as well as the related tools and technologies, security protocols and Standards **(C2 Understand)**.
- **Use** the appropriate techniques to tackle the problems in the discipline of information security **(C3 Apply)**.
- **Develop** various security and risk management techniques for achieving information security and privacy **(C6 Create)**.

Course Outline

Unit 1. Introduction to Information Security

Cryptography, Exhaustive Key search, Principles of Counting, Classical Encryption Techniques. Modular arithmetic, Ceaser Cipher, Mono alphabetic Ciphers, Frequency analysis attacks, Classical Encryption Techniques: Substitution Techniques: Poly alphabetic ciphers, one-time Pad.

Unit 2. Secret Key Cryptography

Secret Key Cryptography, History and implementation of AES, Secret Key Cryptography. Traffic confidentiality and placement of encryption function tools, Principles of public-key cryptography RSA algorithm.

Unit 3. Digital signatures and certificates Digital signatures

Placement of Encryption Function End to end, Link to Link, Key Distribution and Management Key distribution using Secret key cryptography, For link encryption, For E2E encryption, Key Management, Diffie-Hellman Key Exchange.

Unit 4. Authentication Mechanisms and Attacks

Authentication Mechanisms, Passwords, Hashing and Salting techniques, Biometrics, Security Tokens, Two Factor Authentication, Authentication Protocols: Kerberos, X.509 Certificates . Access Control, Types of Access Controls, Discretionary , Mandatory Access Control, Bell La Padula, Access Biba . Attacks and Malicious Software Sniffing, Spoofing, Replay attacks, TCP/IP Hijacking, Attacks on Encryption, Password Guessing, Software Exploitation, Social Engineering, Distributed Denial of Service Attacks Malware, Anti-Virus Software . Firewalls, Types of Firewalls, Attacks and Countermeasures, Application Level Gateways, Bastion Host, Configuration DMZ Network, Intrusion Detection & Response

Unit 5. Software Vulnerabilities

Software Vulnerabilities, buffer overflow, stack buffer overflow working, shell code, defenses Database Security Threats, computer-based-controls, security in Oracle/MS Access DBMSs And Web Security, SQL Injection Attack Risk Management What is Risk Management, Business Risks, Risk Management Models Qualitative Vs. Quantitative Risk Management, Tools. Privacy and Anonymity of Data

Recommended Books/Reference Material

1. Pachghare, V. K. (2019). Cryptography and information security. PHI Learning Pvt. Ltd..
Network Security

2. Savant, V. B., & Kasar, R. D. (2021). A review on network security and cryptography. Research Journal of Engineering and Technology.
3. Sharma, A. K., & Mittal, S. K. (2019, January). Cryptography & network security hash function applications, attacks and advances: A review. In 2019 Third International Conference on Inventive Systems and Control (ICISC). IEEE.
4. Waqas, M., Tu, S., Halim, Z., Rehman, S. U., Abbas, G., & Abbas, Z. H. (2022). The role of artificial intelligence and machine learning in wireless networks security: Principle, practice and challenges. Artificial Intelligence Review.

Network Security Lab

BS-IT

Course Code: IT-314L

Credit Hours: 1

Pre-requisite: Nil

Objective

This course introduces students with basics of information security, in both management aspect and technical aspect. Students understand various types of security incidents and attacks, and learn methods to prevent, detect and react incidents and attacks. It also covers basics of cryptography which are one of the key technologies to implement security functions

Learning Outcomes

- **Explain** security services like confidentiality, Integrity and Availability as well as the related tools and technologies, security protocols and Standards **(C2 Understand)**.
- **Use** the appropriate techniques to tackle the problems in the discipline of information security **(C3 Apply)**.
- **Develop** various security and risk management techniques for achieving information security and privacy **(C6 Create)**.

Course Outline

Unit 1. Introduction to Information Security

Cryptography, Exhaustive Key search, Principles of Counting, Classical Encryption Techniques. Modular arithmetic, Ceaser Cipher, Mono alphabetic Ciphers, Frequency analysis attacks, Classical Encryption Techniques: Substitution Techniques: Poly alphabetic ciphers, one-time Pad.

Unit 2. Secret Key Cryptography

Secret Key Cryptography, History and implementation of AES, Secret Key Cryptography. Traffic confidentiality and placement of encryption function tools, Principles of public-key cryptography RSA algorithm.

Unit 3. Digital signatures and certificates Digital signatures

Placement of Encryption Function End to end, Link to Link, Key Distribution and Management Key distribution using Secret key cryptography, For link encryption, For E2E encryption, Key Management, Diffie-Hellman Key Exchange.

Unit 4. Authentication Mechanisms and Attacks

Authentication Mechanisms, Passwords, Hashing and Salting techniques, Biometrics, Security Tokens, Two Factor Authentication, Authentication Protocols: Kerberos, X.509 Certificates . Access Control, Types of Access Controls, Discretionary , Mandatory Access Control, Bell La Padula, Access Biba . Attacks and Malicious Software Sniffing, Spoofing, Replay attacks, TCP/IP Hijacking, Attacks on Encryption, Password Guessing, Software Exploitation, Social Engineering, Distributed Denial of Service Attacks Malware, Anti-Virus Software . Firewalls, Types of Firewalls, Attacks and Countermeasures, Application Level Gateways, Bastion Host, Configuration DMZ Network, Intrusion Detection & Response

Unit 5. Software Vulnerabilities

Software Vulnerabilities, buffer overflow, stack buffer overflow working, shell code, defenses Database Security Threats, computer-based-controls, security in Oracle/MS Access DBMSs And Web Security, SQL Injection Attack Risk Management What is Risk Management?, Business Risks, Risk Management Models Qualitative Vs. Quantitative Risk Management, Tools. Privacy and Anonymity of Data

Recommended Books/Reference Material

1. Pachghare, V. K. (2019). Cryptography and information security. PHI Learning Pvt. Ltd.. Network Security
2. Savant, V. B., & Kasar, R. D. (2021). A review on network security and cryptography. Research Journal of Engineering and Technology.
3. Sharma, A. K., & Mittal, S. K. (2019, January). Cryptography & network security hash function applications, attacks and advances: A review. In 2019 Third International Conference on Inventive Systems and Control (ICISC). IEEE.
4. Waqas, M., Tu, S., Halim, Z., Rehman, S. U., Abbas, G., & Abbas, Z. H. (2022). The role of artificial intelligence and machine learning in wireless networks security: Principle, practice and challenges. Artificial Intelligence Review.

Enterprise System

BS-IT

Course Code: IT-315

Credit Hours: 2

Pre-requisite: Nil

Objectives

The main goal of these systems is to allow an organization to have wide access to knowledge, employee's productivity and to minimize duplication of data. They also aim to reduce

organizational costs in information technology and increase data quality by reducing the manual input of data.

Learning Outcomes

- **Explain** the fundamental concepts and scope of common enterprise systems in IT (**C2 Understand**).
- **Analyze** challenges associated with implementing IT enterprise systems and their impact on organization (**C4 Analyze**).
- **Use** a leading Enterprise System package (Oracle/SAP) to support business operations and decision making (**C3 Apply**).

Course Outline

Unit1. Overview Of Enterprise Systems

Overview of enterprise systems and their significance in modern organizations, Benefits and challenges of implementing enterprise systems, ERP (Enterprise Resource Planning) systems and their key functionalities . Different approaches to ERP implementation (e.g., phased, big bang, modular), Challenges and risks associated with ERP implementation, Best practices for successful ERP. ERP modules, such as finance, human resources, supply chain management, and customer relationship management, Understanding how these modules integrate and support business process.

Unit 2. Introduction To BPM And Its Importance In Enterprise Systems

Introduction to BPM and its importance in enterprise systems, Distinction between tasks and processes, Mapping and documenting business processes, Identifying areas for process improvement. Customization options available within an ERP system, Configuration of ERP modules to align with organizational requirements, Balancing customization with the need for standardization . Data modeling and design principles, Data integration and data warehousing, Data quality and governance in enterprise system . Understanding the role of SCM in enterprise

systems, Managing supplier relationships and procurement processes, Supply Chain Management (SCM) in ERP Inventory management and demand forecasting. Alignment of enterprise systems with organizational strategy and goals, Using enterprise systems to gain competitive advantage, Evaluating the strategic impact of enterprise system investments

Unit 3. Setting Performance Goals And Metrics

Setting performance goals and metrics, Performance measurement and monitoring using ERP systems, Using EPM to drive organizational improvement . Introduction to business intelligence (BI) and analytics, extracting insights from ERP data using reporting and analytics tools, Data visualization techniques for effective decision-making . Mobile applications and their integration with ERP systems, Cloud-based ERP solutions and their benefits, Security and privacy considerations in mobile and cloud-based enterprise systems .The impact of ERP implementation on organizational culture and structure, Change management strategies for successful ERP adoption, Training and user adoption of new systems .

Unit4. Global Considerations and Challenges in Implementing Enterprise Systems

Global considerations and challenges in implementing enterprise systems, Localization and multi-language support in ERP systems. Cultural and regulatory factors affect in enterprise system deployments . Analysis of real-world enterprise system implementations, Examining successful and unsuccessful case studies, industry Enterprise Systems Case Studies examples.

Unit5. Data Analytics and Key Performance Indicators

Designing reports and performing data analytics, Utilizing KPIs and dashboards for performance monitoring . Exploring emerging technologies and trends in enterprise systems, Predictive analytics and machine learning in ERP systems, The role of enterprise systems in Industry 4.0 and digital transformation . Testing and Go-Live Phases, Current trends and future prospects of enterprise systems.

Recommended Books/Reference Material:

1. Hair Jr, J., Page, M., & Brunsveld, N. (2019). Essentials of business research methods. Routledge.
2. Javidroozi, V., Shah, H., & Feldman, G. (2020). A framework for addressing the challenges of business process change during enterprise systems integration. Business Process Management Journal.
3. LUBIS, I. T., LUBIS, P. D. K., Muda, I., & Nedelea, A. M. (2021). Management Process Administration in Enterprise Resources Planning (ERP) Systems Applications and Products in Data Processing (SAP) in PTPN III SEI Dadap. Ecoforum Journal.
4. Sternal Zabukovšek, S., Picek, R., Bobek, S., Šišovska Klančnik, I., & Tominc, P. (2019). Technology acceptance model-based study of students' attitudes toward use of enterprise resource planning solutions. Journal of Information and Organizational Sciences.

Enterprise System Lab

BS-IT

Course Code: IT-315L

Credit Hours: 1

Pre-requisite: Nil

Objectives

The main goal of these systems is to allow an organization to have wide access to knowledge, employee's productivity and to minimize duplication of data. They also aim to reduce organizational costs in information technology and increase data quality by reducing the manual input of data.

Learning Outcomes

- **Explain** the fundamental concepts and scope of common enterprise systems in IT (**C2 Understand**).

- **Analyze** challenges associated with implementing IT enterprise systems and their impact on organization **(C4 Analyze)**.
- **Use** a leading Enterprise System package (Oracle/SAP) to support business operations and decision making **(C3 Apply)**.

Course Outline

Unit1. Overview Of Enterprise Systems

Overview of enterprise systems and their significance in modern organizations, Benefits and challenges of implementing enterprise systems, ERP (Enterprise Resource Planning) systems and their key functionalities . Different approaches to ERP implementation (e.g., phased, big bang, modular), Challenges and risks associated with ERP implementation, best practices for successful ERP. ERP modules, such as finance, human resources, supply chain management, and customer relationship management, understanding how these modules integrate and support business process.

Unit 2. Introduction To BPM And Its Importance in Enterprise Systems

Introduction to BPM and its importance in enterprise systems, Distinction between tasks and processes, Mapping and documenting business processes, Identifying areas for process improvement. Customization options available within an ERP system, Configuration of ERP modules to align with organizational requirements, Balancing customization with the need for standardization . Data modeling and design principles, Data integration and data warehousing, Data quality and governance in enterprise system . Understanding the role of SCM in enterprise systems, Managing supplier relationships and procurement processes, Supply Chain Management (SCM) in ERP Inventory management and demand forecasting . Alignment of enterprise systems with organizational strategy and goals, using enterprise systems to gain competitive advantage, Evaluating the strategic impact of enterprise system investments

Unit 3. Setting Performance Goals and Metrics

Setting performance goals and metrics, Performance measurement and monitoring using ERP systems, Using EPM to drive organizational improvement . Introduction to business intelligence (BI) and analytics, extracting insights from ERP data using reporting and analytics tools, Data visualization techniques for effective decision-making . Mobile applications and their integration with ERP systems, Cloud-based ERP solutions and their benefits, Security and privacy considerations in mobile and cloud-based enterprise systems .The impact of ERP implementation on organizational culture and structure, Change management strategies for successful ERP adoption, Training and user adoption of new systems .

Unit4. Global Considerations and Challenges in Implementing Enterprise Systems

Global considerations and challenges in implementing enterprise systems, Localization and multi-language support in ERP systems. Cultural and regulatory factors affect in enterprise system deployments . Analysis of real-world enterprise system implementations, Examining successful and unsuccessful case studies, industry Enterprise Systems Case Studies examples. Designing reports and performing data analytics, Utilizing KPIs and dashboards for performance monitoring . Exploring emerging technologies and trends in enterprise systems, Predictive analytics and machine learning in ERP systems, The role of enterprise systems in Industry 4.0 and digital transformation . Testing and Go-Live Phases, Current trends and future prospects of enterprise systems.

Unit5. Data Analytics and Key Performance Indicators

Designing reports and performing data analytics, Utilizing KPIs and dashboards for performance monitoring . Exploring emerging technologies and trends in enterprise systems, Predictive analytics and machine learning in ERP systems, The role of enterprise systems in Industry 4.0 and digital transformation . Testing and Go-Live Phases, Current trends and future prospects of enterprise systems.

Recommended Books/Reference Material:

1. Hair Jr, J., Page, M., & Brunsveld, N. (2019). Essentials of business research methods. Routledge.
2. Javidroozi, V., Shah, H., & Feldman, G. (2020). A framework for addressing the challenges of business process change during enterprise systems integration. Business Process Management Journal.
3. LUBIS, I. T., LUBIS, P. D. K., Muda, I., & Nedelea, A. M. (2021). Management Process Administration in Enterprise Resources Planning (ERP) Systems Applications and Products in Data Processing (SAP) in PTPN III SEI Dadap. Ecoforum Journal.
4. Sternad Zabukovšek, S., Picek, R., Bobek, S., Šišovska Klančnik, I., & Tominc, P. (2019). Technology acceptance model-based study of students' attitudes toward use of enterprise resource planning solutions. Journal of Information and Organizational Sciences.

Web Engineering

BS-IT

Course Code: CS-407

Credit Hours: 2

Pre-requisite: Nil

Objectives

Web engineering focuses on the methodologies, techniques, and tools that are the foundation of Web application development and which support their design, development, evolution, and evaluation.

Learning Outcomes

- **Discuss** how web standards impact software development (**C2 Understand**).
- **Describe** the constraints that the web puts on developers (**C2 Understand**).
- **Design** a simple web application (**C6 Create**).
- **Support** an existing web application against a current web standard (**C5 Evaluate**).

Course Outline

Unit 1. Introduction

Introduction to Web programming languages (e.g., HTML5, CSS 3, Java Script, PHP/JSP/ASP.Net),

Unit 2. Design Principles of Web Based Applications

Design principles of Web based applications ,Web platform constraints, Software as a Service (SaaS), Web standards, Responsive Web Design.

Unit 3. Web Applications

Web Applications, Browser/Server Communication, Storage Tier, Cookies and Sessions, Input Validation, Full stack state management, Web App Security - Browser Isolation,

Unit 4. Network Attacks

Network attack, Session Attacks, Large scale applications, Performance of Web Applications, Data Centers, Web Testing and Web Maintenance.

Unit 5. Laravel and ReactJs

Introduction to Laravel, Routes and Controllers. Views in Laravel and Blade templating engine. Databases, Eloquent, Models, Migrations, Seeders and Faker Factory. User authentication and authorization. Laravel - RESTful APIs authentication. React Basics, ReactDOM and JSX. Props, States and Components. Redux. React Router. Consuming RESTful APIs created in Laravel.

Recommended Books/Reference Material:

1. Khurana, A. (2020). Role of Web Engineering in the growth of the Internet. In Papers of Canadian International Conference on Advances in Education, Teaching & Technology.
2. Pressman, R., & Lowe, D. (2008). *Web Engineering: A PR actioner's approach*. McGraw-Hill, Inc.
3. Rd Erwin Gunadhi, M. T., Nasrulloh, M. R., Kom, M., & Rizaludin, E. M. (2022). A Design and Build a Website for Catering Sales and Orders Using Web Engineering. *Ultimatics: Jurnal Teknik Informatika*.

Web Engineering LAB

BS-IT

Course Code: CS-407L

Credit Hours: 1

Pre-requisite: Nil

Objectives

Web engineering focuses on the methodologies, techniques, and tools that are the foundation of Web application development and which support their design, development, evolution, and evaluation.

Learning Outcomes

- **Discuss** how web standards impact software development (**C2 Understand**).
- **Describe** the constraints that the web puts on developers (**C2 Understand**).
- **Design** a simple web application (**C6 Create**).
- **Support** an existing web application against a current web standard (**C5 Evaluate**).

Course Outline

Unit 1. Introduction

Introduction to Web programming languages (e.g., HTML5, CSS 3, Java Script, PHP/JSP/ASP.Net),

Unit 2. Design Principles of Web Based Applications

Design principles of Web based applications ,Web platform constraints, Software as a Service (SaaS), Web standards, Responsive Web Design.

Unit 3. Web Applications

Web Applications, Browser/Server Communication, Storage Tier, Cookies and Sessions, Input Validation, Full stack state management, Web App Security - Browser Isolation,

Unit 4. Network Attacks

Network attack, Session Attacks, Large scale applications, Performance of Web Applications, Data Centers, Web Testing and Web Maintenance.

Unit 5. Laravel and ReactJs

Introduction to Laravel, Routes and Controllers. Views in Laravel and Blade templating engine. Databases, Eloquent, Models, Migrations, Seeders and Faker Factory. User authentication and authorization. Laravel - RESTful APIs authentication. React Basics, ReactDOM and JSX. Props, States and Components. Redux. React Router. Consuming RESTful APIs created in Laravel.

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2. Pressman, R., & Lowe, D. (2008). *Web Engineering: A practioner's approach*. McGraw-Hill, Inc..
3. Rd Erwin Gunadhi, M. T., Nasrulloh, M. R., Kom, M., & Rizaludin, E. M. (2022). A Design and Build a Website for Catering Sales and Orders Using Web Engineering. *Ultimatics: Jurnal Teknik Informatika*.

HCI and Computer Graphics

BS-Computer Science

Course Code: CS-322

Credit Hours: 02

Pre-requisite: Nil

Objectives

In this course, students will learn about some of the advanced and emerging topics in 3D graphics along with the classic graphics algorithms and the standard phases in the graphics pipeline. This course covers 3D graphics concepts like transformation, projections and rendering. Course topics include both the mathematical as well as technical aspects of developing graphics.

Learning Outcomes

- **Understand** and be familiar with current concepts in 3d graphics, along with the basic workflow of the graphics pipeline (**C2 Understand**).
- **Implement** basic graphics related Algorithms and techniques to create and manipulate 3d graphics (**C3 Apply**).
- **Create** a simple 3D game in Unity 3d and be familiar with the basics of game development (**C6 Create**).

Course Outline

Unit 1. Introduction To HCI And Color Models

Introduction to HCI. History and Usages CRT (Cathode Ray Tube) devices: DVST. Color Models: Pseudo Colors, True Colors, High colors and Deep colors. Human Cognition, Importance of Color models in visual perception. Color Modes: Additive and Subtractive. Metrics and Measures for Evaluation of the Interface.

Unit 2. Transformations and Projections

Transformations: 2D, 3D, HCS and Composite Transformations. Projection: Affine and Solid Body. Usability heuristics and principles of Usability testing. World window to Viewport Transformations. Principles of good interaction design

Unit 3. Line Drawing and Clipping Algorithms

Line Drawing Algorithms: DDA (Digital differential algorithm). Bresenham's Line Drawing Algorithm. Clipping Algorithms: Cohen Sutherland Clipping Algorithm. Sutherland Hodgeman Clipping Algorithm.

Unit 4. Filling Algorithms

Filling Algorithms: Scanline Filling Algorithm. 8-point filling Algorithm & 4-Point Filling Algorithm

Unit 5. Rendering, Lighting and Shading

Rendering: Forward and Backward Rendering and rendering in Nature, Vectors and 3d Geometry. Usability inspection methods, Usability testing methods. Lighting and Shading Interaction Technologies, Usability in practice.

Unit 6. Polynomial Curves and Surfaces

Polynomial curves and surfaces, approximation techniques such as polynomial curves, Bezier curves, spline curves and surfaces, animation as a sequence of still images. Visual Design and Typography, Icon Design. Ellipse and other Curves.

Recommended Books/Reference Material

1. Akenine-Moller, T., Haines, E., & Hoffman, N. (2019). Real-time rendering. AK Peters/crc Press.
2. Gordon, V. S., & Clevenger, J. L. (2020). Computer graphics programming in OpenGL with C++. Mercury Learning and Information.
3. Clevenger, J. L., & Gordon, V. S. (2021). Computer Graphics Programming in OpenGL with C+. Mercury Learning.

4. Kosarevsky, S., & Latypov, V. (2021). 3D Graphics Rendering Cookbook: A comprehensive guide to exploring rendering algorithms in modern OpenGL and Vulkan. Packt Publishing Ltd.

HCI and Computer Graphics Lab

BS-Computer Science

Course Code: CS-322L

Credit Hours: 01

Pre-requisite: Nil

Objectives

In this course, students will learn about some of the advanced and emerging topics in 3D graphics along with the classic graphics algorithms and the standard phases in the graphics pipeline. This course covers 3D graphics concepts like transformation, projections and rendering. Course topics include both the mathematical as well as technical aspects of developing graphics.

Learning Outcomes

- **Create** a 3D model in any modelling tool, light and shade it, add texture to it etc. and create a photorealistic scene **(P5 Naturalization)**.
- **Create** programs in OpenGL using any library **(P5 Naturalization)**.
- **Create** work based on the HCI guidelines **(P5 Naturalization)**.

Course Outline

Unit 1. Introduction To HCI And Color Models

Introduction to HCI. History and Usages CRT (Cathode Ray Tube) devices: DVST. Color Models: Pseudo Colors, True Colors, High colors and Deep colors. Human Cognition, Importance of Color models in visual perception. Color Modes: Additive and Subtractive. Metrics and Measures for Evaluation of the Interface.

Unit 2. Transformations and Projections

Transformations: 2D, 3D, HCS and Composite Transformations. Projection: Affine and Solid Body. Usability heuristics and principles of Usability testing. World window to Viewport Transformations. Principles of good interaction design

Unit 3. Line Drawing and Clipping Algorithms

Line Drawing Algorithms: DDA (Digital differential algorithm). Bresenham's Line Drawing Algorithm. Clipping Algorithms: Cohen Sutherland Clipping Algorithm. Sutherland Hodgeman Clipping Algorithm.

Unit 4. Filling Algorithms

Filling Algorithms: Scanline Filling Algorithm. 8-point filling Algorithm & 4-Point Filling Algorithm

Unit 5. Rendering, Lighting and Shading

Basic rendering: rendering in nature, i.e., the emission and scattering of light and its relation to numerical integration, affine and coordinate system transformations, ray tracing, visibility and occlusion, including solutions to this problem such as depth buffering, painter's algorithm, and ray tracing, the forward and backward rendering equation. Usability inspection methods, Usability testing methods. Lighting and Shading Interaction Technologies, Usability in practice.

Unit 6. Polynomial Curves and Surfaces

Polynomial curves and surfaces, approximation techniques such as polynomial curves, Bezier curves, spline curves and surfaces, animation as a sequence of still images. Visual Design and Typography, Icon Design. Ellipse and other Curves.

Recommended Books/Reference Material

1. Akenine-Moller, T., Haines, E., & Hoffman, N. (2019). Real-time rendering. AK Peters/crc Press.
2. Gordon, V. S., & Clevenger, J. L. (2020). Computer graphics programming in OpenGL with C++. Mercury Learning and Information.

3. Clevenger, J. L., & Gordon, V. S. (2021). Computer Graphics Programming in OpenGL with C+. Mercury Learning.
4. Kosarevsky, S., & Latypov, V. (2021). 3D Graphics Rendering Cookbook: A comprehensive guide to exploring rendering algorithms in modern OpenGL and Vulkan. Packt Publishing Ltd.

Cloud Computing

BS-IT

Course Code: CS-324

Credit Hours: 2

Pre-requisite: Nil

Objectives

This course introduces students to fundamentals of cloud computing and software development for cloud platforms. It covers topics such as cloud basic architecture, virtualization, architecture of cloud systems, programming for the cloud, resource management, as well as privacy and security issues.

Learning Outcomes

- **Apply** vSphere. OpenStack, Microsoft Azure Cloud (**C3 Apply**).
- **Practice** vSphere. OpenStack, o Microsoft Azure Cloud (**A5 Internalizing**).
- **Contribute** individually or as a team member to work effectively (**C2 Respond**).

Course Outline

Unit 1. Introduction vSphere Virtual Infrastructure

Introduction vSphere Virtual Infrastructure, Overview of vSphere virtual infrastructure Installation of ESXi ,Configuring ESXi services . vSphere Virtual

Infrastructure. Discuss the latest virtual machine hardware and its features, Explain the importance of VMware Tools™, Deploy and configure virtual machines and templates, Identify virtual machine disk format. Describe, create, and manage standard switches , Configure virtual switch security and load-balancing policies , Explain the importance of VMware Tools™, Describe the virtual switch connection types

Unit 2. Configuring and Managing Virtual Storage

Introduce storage protocols and storage device types. Create and manage VMFS and NFS datastores , Describe the new features of VMFS 6.7 . Deploy and configure vCenter Server Appliance ,use vSphere Web Client ,Backup and restore vCenter Server , vCenter Server permissions and roles . Compute, Storage and Network Management ,OpenStack Orchestration Management , Image Management . Use templates and cloning to deploy new virtual machines ,Modify and manage virtual machines ,Clone a virtual machine , Remove virtual machines from the vCenter Server inventory and datastore

Unit 3. Introduction to Microsoft Azure Cloud

Azure Foundations, Azure Portal ,Azure CLI,Cloud Shell, Creating a Free Azure Account, Footprint and Structure ,Azure Services ,Web and Mobile, Databases, Data and Analytics ,Security and Identity , Monitoring and Management . Creating Azure Resources. App Service , Azure Container Instances, Azure App Services

Unit 4. Networking – Azure

Creating a Virtual Network Connection , IP Addressing , Azure Active Directory, Create Azure AD Tenant , Create Users and Groups , Self-Service Password Reset, Creating a Storage Account, Add Disk ,Disk Caching.

Recommended Books/Reference Material

1. Gavanda, M., Mauro, A., Valsecchi, P., & Novak, K. (2019). Mastering VMware vSphere 6.7: Effectively deploy, manage, and monitor your virtual datacenter with VMware vSphere 6.7. Packt Publishing Ltd.
2. Ruparelia, N. B. (2023). *Cloud computing*. Mit Press.
3. Toroman, M. (2018). Hands-On Cloud Administration in Azure: Implement, monitor, and manage important Azure services and components including IaaS and PaaS. Packt Publishing Ltd.
4. Trofimczuk, D., Ahola, H., & Aunimo, L. (2022). Case study: Microsoft Azure Cloud experiences in teaching at Haaga-Helia University of Applied Sciences.

Cloud Computing Lab

BS-IT

Course Code: CS-324L

Credit Hours: 1

Pre-requisite: Nil

Objectives

This course introduces students to fundamentals of cloud computing and software development for cloud platforms. It covers topics such as cloud basic architecture, virtualization, architecture of cloud systems, programming for the cloud, resource management, as well as privacy and security issues.

Learning Outcomes

- **Apply** vSphere. OpenStack, Microsoft Azure Cloud (**C3 Apply**).
- **Practice** vSphere. OpenStack, o Microsoft Azure Cloud (**A5 Internalizing**).
- **Contribute** individually or as a team member to work effectively (**C2 Respond**).

Course Outline

Unit 1. Introduction vSphere Virtual Infrastructure

Introduction vSphere Virtual Infrastructure, Overview of vSphere virtual infrastructure Installation of ESXi ,Configuring ESXi services . vSphere Virtual Infrastructure. Discuss the latest virtual machine hardware and its features, Explain the importance of VMware Tools™, Deploy and configure virtual machines and templates, Identify virtual machine disk format. Describe, create, and manage standard switches , Configure virtual switch security and load-balancing policies , Explain the importance of VMware Tools™, Describe the virtual switch connection types

Unit 2. Configuring and Managing Virtual Storage

Introduce storage protocols and storage device types. Create and manage VMFS and NFS datastores , Describe the new features of VMFS 6.7 . Deploy and configure vCenter Server Appliance ,use vSphere Web Client ,Backup and restore vCenter Server , vCenter Server permissions and roles . Compute, Storage and Network Management ,OpenStack Orchestration Management , Image Management . Use templates and cloning to deploy new virtual machines ,Modify and manage virtual machines ,Clone a virtual machine , Remove virtual machines from the vCenter Server inventory and datastore

Unit 3. Introduction to Microsoft Azure Cloud

Azure Foundations, Azure Portal ,Azure CLI,Cloud Shell, Creating a Free Azure Account, Footprint and Structure ,Azure Services ,Web and Mobile , Databases, Data and Analytics ,Security and Identity , Monitoring and Management . Creating Azure Resources. App Service , Azure Container Instances, Azure App Services

Unit 4. Networking – Azure

Creating a Virtual Network Connection , IP Addressing , Azure Active Directory,
Create Azure AD Tenant , Create Users and Groups , Self-Service Password Reset,
Creating a Storage Account, Add Disk ,Disk Caching.

Recommended Books/Reference Material

1. Gavanda, M., Mauro, A., Valsecchi, P., & Novak, K. (2019). Mastering VMware vSphere 6.7: Effectively deploy, manage, and monitor your virtual datacenter with VMware vSphere 6.7. Packt Publishing Ltd.
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3. Toroman, M. (2018). Hands-On Cloud Administration in Azure: Implement, monitor, and manage important Azure services and components including IaaS and PaaS. Packt Publishing Ltd.
4. Trofimczuk, D., Ahola, H., & Aunimo, L. (2022). Case study: Microsoft Azure Cloud experiences in teaching at Haaga-Helia University of Applied Sciences.

Software Requirement Engineering

BS-IT

Course Code: IT-317

Credit Hours: 2

Pre-requisite: Software Engineering

Objectives

In this course, students will learn about some of the most basic topics on software engineering. This course would cover the basic and agile software process models. It further goes into the details of different phases of these models as Requirements Engineering, Analysis, Design and Testing.

Learning Outcomes

- **Describe** various software engineering processes and activities **(C2 Understand)**.
- **Explain** various software development processes/methodologies **(C2 Understand)**.
- **Analyze** software engineering key areas **(C4 Analyze)**.

Course Outline

Unit 1. Introduction

Software Crisis. What is a software? The Nature of Software, Defining Software, Software Application Domains, Legacy Software, The Changing Nature of Software (web apps, mobile apps, cloud computing, product line software), Software Engineering, The Software Process, The Process Framework, Umbrella Activities, Software Engineering Principles. software Development Life Cycle, A Generic Process Model, Defining a Framework Activity, Software Process Flow, Identifying Task sets, Process Patterns, Process Assessment and Improvement . What is process Model?, process flow, prescriptive vs descriptive process models, Prescriptive Process Model; The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models.

Unit 2. Specialized Process Models

Specialized Process Models; Component-Based Development, The Formal Methods Model, Aspect-Oriented Software Development, The Unified Process, A Brief History, Phases of the Unified Process, Personal and Team Process Models, Personal Software Process, Team Software Process. What Is Agility? Agile Software Development, Predictive vs descriptive, Agile manifesto, Agility and the Cost of Change, What Is an Agile Process?, Characteristics of Agile Software Development, Agility Principles, User Stories, template, good user stories, spike, user story writing workshop, story mapping . Agile Planning, concepts of effort, duration, accuracy, precision, relative, and absolute, estimation styles (planning

porker, card sorting), velocity in agile, release planning its types, Scrum process model, Extreme Programming

Unit 3. System Development Method

Dynamics system development method, Feature driven development, Kanban, pair programming . Human aspects of software engineering (Software teams, stakeholders): Characteristics of a Software Engineer, The Psychology of Software Engineering, The Software Team, Team Structures, Agile Team software requirement engineering, Functional vs non-functional requirement, RE process, Developing Use case . Software Design and Modelling-Introduction to UML, use case modelling, Context Models (Data Flow Diagrams) and behavioral models (activity Diagram) Architectural Design- Software Architecture, Architectural Styles Architectural Descriptions, Architectural Decisions, What is quality? Software quality, software quality dilemma, achieving software quality, Review techniques, informal reviews, formal reviews, post mortem evaluation, software quality assurance, formal approaches to SQA, software reliability, Software process improvement- CMM and CMMI.

Unit 4. Software Testing

Software Testing fundamentals, testing types, testing levels, Risk Management: Reactive versus Proactive Risk Strategies, Software Risks ,Risk Identification, Assessing Overall Project Risk, Risk Components and Drivers, Risk Projection, Developing a Risk Table, Assessing Risk Impact, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan .

Unit 5. Maintenance and Reengineering

Maintenance and Reengineering: Software Maintenance, Software Supportability, Reengineering, Business Process Reengineering, Business Processes , A BPR Model, Software Reengineering, A Software Reengineering Process Model, Software Reengineering Activities, Reverse Engineering ,Reverse Engineering to

Understand Data, Reverse Engineering to Understand Processing, Reverse Engineering User Interfaces

Recommended Textbook /Reference Material:

1. Laplante, P. A., & Kassab, M. (2022). Requirements engineering for software and systems. Auerbach Publications.
2. Laplante, P. A., & Kassab, M. (2022). What every engineer should know about software engineering. CRC Press.
3. Foster, E., & Towle Jr, B. (2021). Software engineering: a methodical approach. Auerbach Publications.

Software Requirement Engineering Lab

BS-IT

Course Code: IT-317L

Credit Hours: 1

Pre-requisite: Software Engineering

Objectives

In this course, students will learn about some of the most basic topics on software engineering. This course would cover the basic and agile software process models. It further goes into the details of different phases of these models as Requirements Engineering, Analysis, Design and Testing.

Learning Outcomes

- **Describe** various software engineering processes and activities **(C2 Understand)**.
- **Explain** various software development processes/methodologies **(C2 Understand)**.
- **Analyze** software engineering key areas **(C4 Analyze)**.

Course Outline

Unit 1. Introduction

Software Crisis. What is a software? The Nature of Software, Defining Software, Software Application Domains, Legacy Software, The Changing Nature of Software (web apps, mobile apps, cloud computing, product line software), Software Engineering, The Software Process, The Process Framework, Umbrella Activities, Software Engineering Principles. Software Development Life Cycle, A Generic Process Model, Defining a Framework Activity, Software Process Flow, Identifying Task sets, Process Patterns, Process Assessment and Improvement . What is process Model?, process flow, prescriptive vs descriptive process models, Prescriptive Process Model; The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models.

Unit 2. Specialized Process Models

Specialized Process Models; Component-Based Development, The Formal Methods Model, Aspect-Oriented Software Development, The Unified Process, A Brief History, Phases of the Unified Process, Personal and Team Process Models, Personal Software Process, Team Software Process. What Is Agility? Agile Software Development, Predictive vs descriptive, Agile manifesto, Agility and the Cost of Change, What Is an Agile Process?, Characteristics of Agile Software Development, Agility Principles, User Stories, template, good user stories, spike, user story writing workshop, story mapping . Agile Planning, concepts of effort, duration, accuracy, precision, relative, and absolute, estimation styles (planning poker, card sorting), velocity in agile, release planning its types, Scrum process model, Extreme Programming

Unit 3. System Development Method

Dynamics system development method, Feature driven development, Kanban, pair programming . Human aspects of software engineering (Software teams,

stakeholders): Characteristics of a Software Engineer, The Psychology of Software Engineering, The Software Team, Team Structures, Agile Teams. Software requirement engineering, Functional vs non-functional requirement, REprocess, Developing Use case . Software Design and Modelling-Introduction to UML, use case modelling, Context Models (Data Flow Diagrams) and behavioral models (activity Diagram) Architectural Design- Software Architecture, Architectural Styles Architectural Descriptions, Architectural Decisions, What is quality? Software quality, software quality dilemma, achieving software quality, Review techniques, informal reviews, formal reviews, post mortem evaluation, software quality assurance, formal approaches to SQA, software reliability, Software process improvement- CMM and CMMI.

Unit 4. Software Testing

Software Testing fundamentals, testing types, testing levels, Risk Management: Reactive versus Proactive Risk Strategies, Software Risks ,Risk Identification, Assessing Overall Project Risk, Risk Components and Drivers, Risk Projection, Developing a Risk Table, Assessing Risk Impact, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan .

Unit 5. Maintenance and Reengineering

Maintenance and Reengineering: Software Maintenance, Software Supportability, Reengineering, Business Process Reengineering, Business Processes , A BPR Model, Software Reengineering, A Software Reengineering Process Model, Software Reengineering Activities, Reverse Engineering ,Reverse Engineering to Understand Data, Reverse Engineering to Understand Processing, Reverse Engineering User Interfaces

Recommended Textbook /Reference Material:

1. Laplante, P. A., & Kassab, M. (2022). Requirements engineering for software and systems. Auerbach Publications.

2. Laplante, P. A., & Kassab, M. (2022). What every engineer should know about software engineering. CRC Press.
3. Foster, E., & Towle Jr, B. (2021). Software engineering: a methodical approach. Auerbach Publications.

Mobile Application Development

BS-IT

Course Code: CS-408

Credit Hours: 2

Pre-requisite: Nil

Objectives

Mobile development is creating applications and any other kind of software specific to mobile devices, including tablets. Mobile development seeks to optimize functionality and user experience on mobile devices, as there are important differences between mobile and desktop UX. This course aims to introduce students to the following concepts and cognitive skills.

Learning Outcomes

- **Understand** the life cycle of android applications **(C2 Understand)**.
- **Design** interactive interface for mobile applications using various layouts **(C6 Create)**.
- **Develop** mobile applications for comprehensive systems using latest trends and practices **(C6 Create)**.

Course Outline

Unit 1. Introduction

Mobile Application Development Platforms, System installation (Android Studio), Android Architecture and framework, what is Android, the various Android devices on the market, The Android Market application store, how to

develop your first Android application, Components of Android Project (Application Structure), Using code Completion Debugging Application.

Unit 2. Android Studio Layout editor

Android Studio Layout editor, component tree, Constraint view, layout properties, Activities, Layouts, layout attributes, Views. View Groups, layout Orientation, XML, files (string, colors, values, dimension) in the project, Resource folders, Intents in Android, Calling build in intents, communication between activities

Unit 3. Fragments

Display Notifications, Design interface with views, Displaying Pictures and menus with views. Data Persistence, Content providers, Messages (SMS, EMAIL), Location based services (Maps)

Unit 4. Networking

Establishing an HTTP Connection, Consuming Web Services using, HTTP, Consuming JSON Services, Android Services, Create Own Services, Establishing Communication between a Service and an Activity, Binding Activities to Services, Understanding Threading.

Unit 5. Architecture and Frameworks

Introduction to iOS Architecture and framework, Introduction to Xamarin/Flutter for cross platform development, Publishing, Android Applications, Mobile Programming Languages, Emerging Technologies.

Recommended Textbook /References Material:

1. Haq, M. S., Samani, M., & Hariyati, N. (2022). Android-Based Digital Library Application Development. International Journal of Interactive Mobile Technologies, 16(11).
2. Klingman, L. (2023). React Programming: The Big Nerd Ranch Guide. Pearson Technology Group.
3. Laurence, P. O., Hinchman-Dominguez, A., Meike, G. B., & Dunn, M. (2021). Programming Android with Kotlin. " O'Reilly Media, Inc."
4. Syaifudin, Y. W., Funabiki, N., Kuribayashi, M., & Kao, W. C. (2020). A proposal of Android programming learning assistant system with implementation of basic application learning. International Journal of Web Information Systems.
5. Syaifudin, Y. W., Funabiki, N., Kuribayashi, M., Mentari, M., Saputra, P. Y., Yunhasnawa, Y., & Ulfa, F. (2021, February). Web application implementation of Android programming learning assistance system and its evaluations. In IOP Conference Series: Materials Science and Engineering. IOP Publishing.

Mobile Application Development Lab

BS-IT

Course Code: CS-408L

Credit Hours: 1

Pre-requisite: Nil

Objectives

Mobile development is creating applications and any other kind of software specific to mobile devices, including tablets. Mobile development seeks to optimize functionality and user experience on mobile devices, as there are important differences between mobile and desktop UX. This course aims to introduce students to the following concepts and cognitive skills.

Learning Outcomes

- **Understand** the life cycle of android applications (**C2 Understand**).
- **Design** interactive interface for mobile applications using various layouts (**C6 Create**).
- **Develop** mobile applications for comprehensive systems using latest trends and practices (**C6 Create**).

Course Outline

Unit 1. Introduction

Mobile Application Development Platforms, System installation (Android Studio), Android Architecture and framework, what is Android, the various Android devices on the market, The Android Market application store, how to develop your first Android application, Components of Android Project (Application Structure), Using code Completion Debugging Application.

Unit 2. Android Studio Layout editor

Android Studio Layout editor, component tree, Constraint view, layout properties, Activities, Layouts, layout attributes, Views. View Groups, layout Orientation, XML, files (string, colors, values, dimension) in the project, Resource folders, Intents in Android, Calling build in intents, communication between activities

Unit 3. Fragments

Display Notifications, Design interface with views, Displaying Pictures and menus with views. Data Persistence, Content providers, Messages (SMS, EMAIL), Location based services (Maps)

Unit 4. Networking

Establishing an HTTP Connection, Consuming Web Services using, HTTP, Consuming JSON Services, Android Services, Create Own Services, Establishing

Communication between a Service and an Activity, Binding Activities to Services, Understanding Threading.

Unit 5. Architecture and Frameworks

Introduction to iOS Architecture and framework, Introduction to Xamarin/Flutter for cross platform development, Publishing, Android Applications, Mobile Programming Languages, Emerging Technologies.

Recommended Textbook /References Material:

1. Haq, M. S., Samani, M., & Hariyati, N. (2022). Android-Based Digital Library Application Development. International Journal of Interactive Mobile Technologies, 16(11).
2. Klingman, L. (2023). React Programming: The Big Nerd Ranch Guide. Pearson Technology Group.
3. Laurence, P. O., Hinchman-Dominguez, A., Meike, G. B., & Dunn, M. (2021). Programming Android with Kotlin. " O'Reilly Media, Inc."
4. Syaifudin, Y. W., Funabiki, N., Kuribayashi, M., & Kao, W. C. (2020). A proposal of Android programming learning assistant system with implementation of basic application learning. International Journal of Web Information Systems.
5. Syaifudin, Y. W., Funabiki, N., Kuribayashi, M., Mentari, M., Saputra, P. Y., Yunhasnawa, Y., & Ulfa, F. (2021, February). Web application implementation of Android programming learning assistance system and its evaluations. In IOP Conference Series: Materials Science and Engineering. IOP Publishing.

Software Project Management

BS-IT

Course Code: IT-316

Credit Hours: 2

Pre-requisite: Software Engineering

Objectives

Understand the fundamental principles of software project management & have a good knowledge of responsibilities of project manager. Be familiar with the different methods and techniques used for project management. Be able to apply the knowledge in an effective manner.

Learning outcomes

- **Develop** Software projects (C6 Create).
- **Implement** project scheduling, plan the resources, carry out the staffing, track the progress, apply software metrics, manage and motivate the team, and manage the crisis situation (C3 Apply).

Course Outline

Unit 1. Introduction

Introduction – Project Management (PM) Fundamentals – The PM field and job market – People, Process, Product, Technology, Overview of Project Management – Planning, Tracking, & measurement – Organizational structures, Project charter – Statement of Work Request for Proposal (RFP).

Unit 2. Planning Phase

Development lifecycle models, Matching lifecycles to projects, Project plans, Project selection, Project Financial Analysis, Net Present Value, Return on Investment, Payback Analysis Models, Weight Scoring Model, Feasibility study along with resource planning.

Unit 3. Estimation and Budgeting

Effort Estimation, Cost Estimation, Scheduling, Project network diagram fundamentals, PERT techniques, Gantt charts, Critical chain scheduling, Risk and Change Management, Risk management, Change control. Resource and budget

allocation. Streamlining resources along with budget scheduling and resource planning.

Unit 4. Development Management

Team models, Requirements process, Configuration management, Software metrics, Programming languages & tools, managing conflict and motivating, Project Control – Status reporting, Project metrics, earned value analysis, Communications Techniques, Process Improvement – MS Project: (a) Resource leveling (b) Other views.

Unit 5. System Test Process

Test specifications, Black box and white box testing, Test scripts, Unit and integration testing, Acceptance test specifications, Test tools, Final Phases & Other Issues, Project Recovery, Documentation, Cutover/Migration, Post Project Reviews, Closing, Project Success, Management support, Expectations, Success metrics.

Recommended Textbook /Reference Material

1. Nicholas, J. M., & Steyn, H. (2020). Project management for engineering, business and technology. Routledge.
2. Stoddard, M. M., Gillis, B., & Cohn, P. (2019). Agile project management in libraries: Creating collaborative, resilient, responsive organizations. Journal of Library Administration.
3. Ionică, A. C., Leba, M., & Saad, A. F. (2022). Exploring the Possibilities of Using Project Management Methodologies in the 21st Century Education. In MATEC Web of Conferences (Vol. 373). EDP Sciences.
4. Qinghua, F., & Jian, S. (2023, October). Development of Computer Information System Based on Scientific Research Project Management. In 2023 4th International Conference on Management Science and Engineering Management (ICMSEM 2023). Atlantis Press.

Software Project Management Lab

BS-IT

Course Code: IT-316L

Credit Hours: 1

Pre-requisite: Nil

Objectives

Understand the fundamental principles of software project management & have a good knowledge of responsibilities of project manager. Be familiar with the different methods and techniques used for project management. Be able to apply the knowledge in an effective manner.

Learning outcomes

- **Develop** Software projects (**C6 Create**).
- **Implement** project scheduling, plan the resources, carry out the staffing, track the progress, apply software metrics, manage and motivate the team, and manage the crisis situation (**C3 Apply**).

Course Outline

Unit 1. Introduction

Introduction – Project Management (PM) Fundamentals – The PM field and job market – People, Process, Product, Technology, Overview of Project Management – Planning, Tracking, & measurement – Organizational structures, Project charter – Statement of Work Request for Proposal (RFP).

Unit 2. Planning Phase

Development lifecycle models, Matching lifecycles to projects, Project plans, Project selection, Project Financial Analysis, Net Present Value, Return on

Investment, Payback Analysis Models, Weight Scoring Model, Feasibility study along with resource planning.

Unit 3. Estimation and Budgeting

Effort Estimation, Cost Estimation, Scheduling, Project network diagram fundamentals, PERT techniques, Gantt charts, Critical chain scheduling, Risk and Change Management, Risk management, Change control. Resource and budget allocation. Streamlining resources along with budget scheduling and resource planning.

Unit 4. Development Management

Team models, Requirements process, Configuration management, Software metrics, Programming languages & tools, managing conflict and motivating, Project Control – Status reporting, Project metrics, earned value analysis, Communications Techniques, Process Improvement – MS Project: (a) Resource leveling (b) Other views.

Unit 5. System Test Process

Test specifications, Black box and white box testing, Test scripts, Unit and integration testing, Acceptance test specifications, Test tools, Final Phases & Other Issues, Project Recovery, Documentation, Cutover/Migration, Post Project Reviews, Closing, Project Success, Management support, Expectations, Success metrics.

Recommended Textbook /Reference Material

1. Nicholas, J. M., & Steyn, H. (2020). Project management for engineering, business and technology. Routledge.
2. Stoddard, M. M., Gillis, B., & Cohn, P. (2019). Agile project management in libraries: Creating collaborative, resilient, responsive organizations. Journal of Library Administration.

3. Ionică, A. C., Leba, M., & Saad, A. F. (2022). Exploring the Possibilities of Using Project Management Methodologies in the 21st Century Education. In MATEC Web of Conferences (Vol. 373). EDP Sciences.
4. Qinghua, F., & Jian, S. (2023, October). Development of Computer Information System Based on Scientific Research Project Management. In 2023 4th International Conference on Management Science and Engineering Management (ICMSEM 2023). Atlantis Press.

Theory of Automata

BS-Computer Science

Course Code: CS-317

Credit Hours: 03

Pre-requisite: Nil

Objectives

Unlike most courses in Computer Science, this course is not directly about programming. Rather, it introduces some of the models, like automata and grammars that are useful in many applications. The theories of undecidability and intractability are there to remind us that there are certain things we would like to solve by computation, but which are either impossible (undecidable) or are possible but cannot be solved efficiently (intractable).

Learning Outcomes

- **Design** and derivation of regular languages using mathematical models (**C6 Create**).
- **Design** and derivation of non-regular languages using mathematical models (**C6 Create**).
- **Design** of Turing Machine (**C6 Create**).

Course Outline

Unit 1. Introduction to Finite Automata and Regular Expressions

Language definitions preliminaries, Descriptive Method, Regular expressions, Finite Automata, NFA, DFA, Transition graphs, TG to RE, Kleene's theorem,

Union, Intersection & Complement of FA, DFA Minimization, Transducers (Mealy Machine, Moore Machine), Conversions

Unit 2. Regular Languages

Regular languages vs Non regular languages, Properties of regular languages, Pumping Lemma, Decision properties: membership, equivalence, emptiness, finiteness, containment. Closure properties: union, concatenation, complementation, intersection, reversal, homomorphism and inverse homomorphism.

Unit 3. Context Free Grammars

Context free grammars, Derivations, derivation trees and ambiguity. Simplifying CFL, Normal form grammars and parsing, Decidability

Unit 4. Pushdown Automata

Push Down Automata, Context sensitive languages, grammars and linear bounded automata (LBA), Chomsky's hierarchy of grammars, Conversion of PDA and CFG

Unit 5. Turing Machines

Turing Machines Theory, Post machine, Variations on TM, TM encoding, Universal Turing Machine, Defining Computers by TMs.

Recommended Books/Reference Material

1. Automata theory and computability. (2021). (n.p.): Book Rivers.
2. Cohen, D. I. A. (1997). Introduction to computer theory. United Kingdom: Wiley.
3. Education.Homenda, W., Pedrycz, W. (2022). Automata Theory and Formal Languages. Germany: De Gruyter.
4. Hopcroft, J. E. (2008). Introduction to Automata Theory, Languages, and Computation. India: Pearson
5. Linz, P. (2021). An Introduction to Formal Languages and Automata. United Kingdom: Jones and Bartlett Publishers.

Department: Information Technology

Course Title: Web Security and Forensics

Course Code: IT-407

Pre-requisite: Information Security

Credit Hours: 02

Course Objectives

- Understand the architecture of web applications and their common vulnerabilities.
- Learn techniques for securing web applications against prevalent threats.
- Acquire fundamental knowledge of digital forensics, including forensic investigation methodologies and tools.
- Analyze, preserve, and investigate digital evidence for use in legal contexts.
- Understand legal, ethical, and policy issues related to cybersecurity and forensics.

Learning Outcomes

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

- Analyze common web application vulnerabilities and propose effective countermeasures. *(C4 Analyze)*
- Apply web security techniques including secure coding practices, encryption, and access control. *(C3 Apply)*
- Perform digital forensic investigations using industry-standard tools. *(P2 Manipulation)*
- Collect, preserve, and analyze digital evidence in accordance with legal standards. *(P4 Articulation)*
- Understand the ethical and legal implications of security breaches and forensic practices. *(C2 Understand)*

Course Outline**Unit 1: Web Application Security Overview**

- Web architecture and protocols (HTTP, HTTPS, Cookies, Sessions)

- Common web vulnerabilities: OWASP Top 10
- Web authentication and session management flaws
- Input validation and SQL Injection

Unit 2: Cross-Site Attacks and Countermeasures

- Cross-Site Scripting (XSS)
- Cross-Site Request Forgery (CSRF)
- Security misconfigurations
- Secure development lifecycle (SDL)

Unit 3: Web Security Practices

- Transport Layer Security (TLS)
- Secure cookies and Content Security Policy (CSP)
- Secure coding practices and frameworks (e.g., Django, Laravel)
- Vulnerability scanning and penetration testing tools (e.g., Burp Suite, OWASP ZAP)

Unit 4: Introduction to Digital Forensics

- Fundamentals of digital forensics
- Forensic tools and environments (FTK, Autopsy, EnCase, etc.)
- Forensic imaging and data acquisition
- Chain of custody and evidence handling

Unit 5: Web Forensics and Legal Framework

- Investigating web attacks and breaches
- Log file analysis and reconstruction of events
- Email, browser, and cloud forensics
- Legal and ethical considerations in cyber forensics
- Cybercrime laws and international standards (e.g., GDPR, ISO/IEC 27037)

Recommended Books / Reference Material

1. **Stuttard, D., & Pinto, M. (2020).** *The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws*. Wiley.
2. **Casey, E. (2011).** *Digital Evidence and Computer Crime: Forensic Science, Computers and the Internet*. Academic Press.
3. **Baggili, I. (2014).** *Digital Forensics and Cyber Crime: Proceedings of the 5th International Conference*. Springer.
4. **OWASP Foundation.** *OWASP Testing Guide v4* [Online Resource].
5. **Mitropoulos, F. (2021).** *Web Hacking 101: How to Make Money Hacking Ethically*.

Department: Information Technology

Course Title: Web Security and Forensics Lab

Course Code: IT-407L

Credit Hours: 01

Pre-requisite: Information Security

Lab Objectives

- To provide hands-on experience in identifying and exploiting common web application vulnerabilities.
- To equip students with practical skills for securing web applications using best practices.
- To introduce digital forensic tools and techniques for the collection, analysis, and presentation of digital evidence.
- To simulate real-world cybersecurity scenarios and forensic investigations.

Learning Outcomes

By the end of the lab, students will be able to:

- Use tools to detect and exploit web vulnerabilities such as XSS, SQLi, and CSRF. (*P2 Manipulation*)
- Apply secure coding practices and mitigation techniques for web attacks. (*P3 Precision*)

- Use digital forensics tools to acquire, analyze, and report on digital evidence. (*P4 Articulation*)
- Demonstrate an understanding of the legal and ethical principles surrounding digital investigations. (*C2 Understand*)

Lab Outline

Unit 1: Introduction to Web Security Tools

- Overview of web vulnerabilities
- Setup of vulnerable web applications (DVWA, OWASP Juice Shop, WebGoat)
- Introduction to Burp Suite, OWASP ZAP

Unit 2: Web Vulnerability Testing

- SQL Injection: detection and exploitation
- Cross-Site Scripting (XSS): reflected and stored
- Cross-Site Request Forgery (CSRF) and mitigation
- Session hijacking and secure session handling

Unit 3: Web Application Hardening

- Implementing input validation
- Using Content Security Policy (CSP)
- Securing cookies, HTTPS enforcement
- Secure authentication and password management

Unit 4: Introduction to Digital Forensics Tools

- Disk imaging and hash verification (using FTK Imager, Autopsy)
- File recovery and timeline analysis
- Email header analysis and metadata extraction
- Analyzing browser history and cache data

Unit 5: Forensics Case Simulation and Report Writing

- Capture the Flag (CTF) challenge simulation
- Incident response documentation
- Writing a digital forensics report
- Ethical and legal considerations during forensic handling

Recommended Software and Tools

- Burp Suite, OWASP ZAP
- DVWA, OWASP Juice Shop, WebGoat
- FTK Imager, Autopsy, Wireshark
- Kali Linux or Parrot OS
- Python (for writing simple security scripts)

Recommended Books / Reference Material

1. **Stuttard, D., & Pinto, M. (2020).** *The Web Application Hacker's Handbook*. Wiley.
2. **Casey, E. (2011).** *Digital Evidence and Computer Crime*. Academic Press.
3. **Baggili, I. (2014).** *Digital Forensics and Cyber Crime*. Springer.
4. OWASP Testing Guide, DVWA, and Juice Shop documentation (Online Resources).
5. **Altheide, C., & Carvey, H. (2011).** *Digital Forensics with Open Source Tools*. Syngress.

Department: Information Technology

Course Title: Object-Oriented Analysis and Design

Course Code: IT-408

Credit Hours: 03

Pre-requisite: Object-Oriented Programming

Course Objectives

- To introduce the principles and practices of object-oriented software analysis and design.
- To develop an understanding of modeling systems using the Unified Modeling Language (UML).

- To teach students how to move from problem statements to software architectures using object-oriented techniques.
- To enable students to apply best practices and patterns in software design.

Learning Outcomes

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

- Explain the key concepts of object-oriented analysis and design. *(C2 Understand)*
- Analyze software requirements and model software systems using UML. *(C4 Analyze)*
- Apply object-oriented design principles and design patterns in software development. *(C3 Apply)*
- Design and document modular, reusable, and maintainable object-oriented systems. *(P4 Articulation)*

Course Outline

Unit 1: Introduction to OOAD

- Importance of software modeling
- Software development life cycle (SDLC)
- Object-oriented paradigm vs. structured approaches
- Overview of UML and modeling tools

Unit 2: Object-Oriented Analysis

- Requirements elicitation techniques
- Use-case modeling: actors, use-cases, scenarios
- Identifying classes, attributes, and methods
- Class responsibilities and collaborations

Unit 3: Object-Oriented Design

- Class diagrams, object diagrams

- Sequence diagrams and communication diagrams
- Activity diagrams, state diagrams
- Package diagrams and component diagrams

Unit 4: Principles and Patterns

- Design principles: SOLID, DRY, GRASP
- Introduction to design patterns: Singleton, Factory, Observer, Strategy
- Applying patterns to solve design problems

Unit 5: System Architecture and Documentation

- Modeling system architecture using UML
- Mapping designs to code
- Documentation and case studies
- Overview of agile modeling and iterative design

Recommended Books / Reference Material

1. **Craig Larman (2012)**, *Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development*, Pearson.
2. **Grady Booch, James Rumbaugh, and Ivar Jacobson (2005)**, *The Unified Modeling Language User Guide*, Addison-Wesley.
3. **Gamma, Erich et al. (1994)**, *Design Patterns: Elements of Reusable Object-Oriented Software*, Addison-Wesley.
4. **Bennett, S., McRobb, S., & Farmer, R. (2010)**, *Object-Oriented Systems Analysis and Design Using UML*, McGraw-Hill.
5. Online UML Tools Documentation: Lucidchart, StarUML, Visual Paradigm, etc.

Department: Information Technology

Course Title: Natural Language Processing

Course Code: IT-409

Credit Hours: 02

Pre-requisite: Programming Fundamentals

Course Objectives

- Introduce fundamental concepts and algorithms in Natural Language Processing (NLP).
- Explore syntactic, semantic, and pragmatic processing of natural language.
- Equip students with the ability to build NLP applications using modern tools and models.
- Understand the role of machine learning and deep learning in modern NLP.

Learning Outcomes

By the end of this course, students will be able to:

- Understand the linguistic and algorithmic foundations of NLP. *(C2 Understand)*
- Apply NLP tools and techniques for tasks such as text classification, POS tagging, and parsing. *(C3 Apply)*
- Analyze and evaluate NLP models and systems. *(C4 Analyze)*
- Build basic applications for sentiment analysis, translation, and chatbots. *(P4 Articulation)*

Course Outline

Unit 1: Introduction to NLP

- What is NLP? Applications and Challenges
- Levels of NLP: Morphological, Syntactic, Semantic, Pragmatic
- NLP vs Computational Linguistics
- Text Preprocessing: Tokenization, Stemming, Lemmatization, Stop-word Removal

Unit 2: Syntax and Parsing

- Part-of-Speech (POS) Tagging
- Context-Free Grammar and Syntax Trees

- Parsing Techniques: Top-down and Bottom-up
- Dependency Parsing

Unit 3: Semantics and Word Representation

- Word Sense Disambiguation
- Distributional Semantics: Word2Vec, GloVe
- TF-IDF and Bag-of-Words
- Embeddings: Contextual vs Non-contextual

Unit 4: NLP Tasks and Applications

- Text Classification and Sentiment Analysis
- Named Entity Recognition (NER)
- Question Answering
- Information Extraction
- Text Summarization

Unit 5: Neural NLP and Transformers

- RNNs, LSTMs in NLP
- Attention Mechanism
- Introduction to Transformers and BERT
- Transfer Learning in NLP (Fine-tuning pre-trained models)

Recommended Books / References

1. **Jurafsky & Martin**, *Speech and Language Processing*, Pearson.
2. **Bird, Klein & Loper**, *Natural Language Processing with Python*, O'Reilly.
3. **Yoav Goldberg**, *Neural Network Methods for NLP*, Morgan & Claypool.
4. Hugging Face Transformers Documentation & Tutorials
5. Selected research papers and datasets (e.g., from ACL, arXiv)

Course Title: Natural Language Processing Lab

Course Code: IT-409L

Credit Hours: 01

Pre-requisite: Object-Oriented Programming

Objectives

- Provide hands-on experience in processing and analyzing text using Python and NLP libraries.
- Enable students to design and implement real-world NLP applications.
- Reinforce theoretical concepts through practical assignments.

Learning Outcomes

- Implement standard NLP tasks such as tokenization, tagging, and classification. (*P2 Manipulation*)
- Use NLP libraries (e.g., NLTK, spaCy, Transformers) to solve real problems. (*P3 Precision*)
- Evaluate model performance on various datasets. (*C4 Analyze*)
- Design mini-projects integrating modern NLP APIs. (*P4 Articulation*)

Outline**Unit 1: NLP Tools and Preprocessing**

- Installation of NLTK, spaCy, Transformers
- Tokenization, Stemming, Lemmatization
- Stop-word Removal, POS Tagging
- Frequency Distributions and Word Clouds

Unit 2: Text Representation

- Bag-of-Words and TF-IDF with scikit-learn
- Word Embeddings: Word2Vec, GloVe using Gensim

- Dimensionality reduction (t-SNE, PCA)

Unit 3: Classification and Sequence Labeling

- Text classification (e.g., spam detection, sentiment analysis)
- Named Entity Recognition (NER) using spaCy
- Chunking and parsing syntactic structures

Unit 4: Deep Learning for NLP

- Sentiment analysis using RNNs and LSTMs
- Fine-tuning BERT for classification tasks
- Text generation using Transformers
- Translation using pre-trained models

Unit 5: Mini Project

- Design and implement a chatbot / Q&A system / sentiment analyzer
- Prepare a report, model evaluation, and present outcomes

Department: Information Technology

Course Title: Machine Learning

Course Code: IT-410

Credit Hours: 02

Pre-requisite: Programming Fundamentals

Course Objectives

- Introduce foundational concepts and algorithms of machine learning.
- Teach supervised, unsupervised, and reinforcement learning techniques.
- Provide hands-on experience with machine learning tools and frameworks.
- Enable students to develop and evaluate ML models for real-world problems.

Learning Outcomes

By the end of this course, students will be able to:

- Understand and explain key ML concepts and algorithms. *(C2 Understand)*
- Apply supervised and unsupervised learning algorithms to datasets. *(C3 Apply)*
- Analyze model performance and optimize learning processes. *(C4 Analyze)*
- Develop ML models using popular libraries and tools. *(P4 Articulation)*

Course Outline

Unit 1: Introduction to Machine Learning

- What is Machine Learning? Types: Supervised, Unsupervised, Reinforcement
- Learning paradigms and model evaluation
- Overfitting, underfitting, bias-variance tradeoff
- Train/test split, cross-validation

Unit 2: Supervised Learning Algorithms

- Linear Regression and Logistic Regression
- Decision Trees and Random Forests
- Support Vector Machines (SVM)
- k-Nearest Neighbors (k-NN)
- Evaluation metrics: accuracy, precision, recall, F1-score, ROC-AUC

Unit 3: Unsupervised Learning Algorithms

- Clustering: k-Means, Hierarchical Clustering, DBSCAN
- Dimensionality Reduction: PCA, t-SNE
- Anomaly Detection
- Association Rule Mining

Unit 4: Advanced Topics

- Neural Networks basics
- Introduction to Deep Learning
- Ensemble Methods: Bagging, Boosting, AdaBoost, Gradient Boosting
- Introduction to Reinforcement Learning

Unit 5: Model Optimization and Deployment

- Hyperparameter tuning: Grid search, Random search
- Regularization techniques: L1, L2
- Model deployment basics and tools
- Ethical considerations in Machine Learning

Recommended Books / Reference Material

1. **Tom M. Mitchell**, *Machine Learning*, McGraw-Hill.
2. **Ian Goodfellow, Yoshua Bengio, Aaron Courville**, *Deep Learning*, MIT Press.
3. **Peter Flach**, *Machine Learning: The Art and Science of Algorithms that Make Sense of Data*.
4. **Aurélien Géron**, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*.
5. Documentation of scikit-learn, TensorFlow, and PyTorch.

Course Title: Machine Learning Lab

Course Code: IT-410L

Credit Hours: 01

Pre-requisite: Object-Oriented Programming

Objectives

- Provide practical experience with ML algorithms and data preprocessing.
- Teach model building, evaluation, and improvement techniques.

- Use Python-based ML libraries (scikit-learn, TensorFlow, Keras, PyTorch).

Learning Outcomes

- Perform data preprocessing and feature engineering. *(P2 Manipulation)*
- Implement and compare supervised and unsupervised learning models. *(P3 Precision)*
- Evaluate model performance using appropriate metrics. *(C4 Analyze)*
- Build a complete ML pipeline and deploy simple models. *(P4 Articulation)*

Outline

Unit 1: Data Preprocessing and Exploration

- Loading datasets (CSV, databases)
- Data cleaning, handling missing values
- Feature scaling and normalization
- Exploratory data analysis (EDA) with visualizations

Unit 2: Supervised Learning Implementation

- Linear and Logistic Regression
- Decision Trees and Random Forests
- SVM and k-NN
- Model evaluation: confusion matrix, ROC curve

Unit 3: Unsupervised Learning Implementation

- K-means Clustering
- Hierarchical Clustering
- PCA for dimensionality reduction
- Anomaly detection basics

Unit 4: Neural Networks and Deep Learning Introduction

- Build simple neural networks with Keras or PyTorch

- Activation functions, loss functions
- Training and validation procedures

Unit 5: Mini Project

- Choose a real-world dataset (e.g., classification or regression)
- Apply preprocessing, train models, evaluate results
- Prepare a report and presentation

Department: Information Technology

Course Title: Internet of Things

Course Code: IT-411

Credit Hours: 02

Pre-requisite: Computer Networks

Course Objectives

- Introduce IoT concepts, architecture, and enabling technologies.
- Explore sensor networks, communication protocols, and data analytics in IoT.
- Teach design, implementation, and security of IoT systems.
- Provide hands-on experience with IoT hardware and software platforms.

Learning Outcomes

Students will be able to:

- Understand the components, architecture, and challenges of IoT systems. *(C2 Understand)*
- Analyze IoT communication protocols and data management techniques. *(C4 Analyze)*
- Develop IoT applications using sensors, microcontrollers, and cloud platforms. *(P4 Articulation)*
- Address security and privacy issues in IoT environments. *(C3 Apply)*

Course Outline

Unit 1: Introduction to IoT

- What is IoT? Definitions and applications
- IoT Architecture: Perception, Network, and Application layers
- IoT Enabling Technologies: Sensors, Actuators, RFID, Embedded Systems
- IoT vs M2M (Machine to Machine)

Unit 2: IoT Communication and Networking

- IoT Network Protocols: MQTT, CoAP, HTTP, DDS
- Wireless Communication Technologies: WiFi, Bluetooth, ZigBee, LoRa, NB-IoT
- IPv6 and 6LoWPAN for IoT
- Gateway and Edge Computing

Unit 3: IoT Data Processing and Cloud

- Data Acquisition and Preprocessing
- Cloud Platforms for IoT: AWS IoT, Azure IoT, Google Cloud IoT
- Big Data and Analytics in IoT
- Introduction to Fog and Edge Computing

Unit 4: IoT Security and Privacy

- Security Challenges in IoT
- Authentication and Authorization
- Data Privacy, Encryption, and Secure Communication
- IoT Security Standards and Protocols

Unit 5: IoT Applications and Case Studies

- Smart Homes, Smart Cities, Healthcare, Agriculture, Industry 4.0
- Real-time Monitoring and Control

- IoT System Design Considerations
- Future Trends and Challenges in IoT

Recommended Books / Reference Material

1. **Arshdeep Bahga & Vijay Madisetti**, *Internet of Things: A Hands-On Approach*.
2. **Adrian McEwen & Hakim Cassimally**, *Designing the Internet of Things*.
3. **Rajkumar Buyya, Amir Vahid Dastjerdi**, *Internet of Things: Principles and Paradigms*.
4. **Pethuru Raj & Anupama C. Raman**, *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*.

Course Title: Internet of Things Lab

Course Code: IT-411L

Credit Hours: 01

Pre-requisite: Computer Networks

Objectives

- Develop practical skills in IoT device programming and system integration.
- Use microcontrollers, sensors, and communication modules to build IoT solutions.
- Practice IoT data collection, transmission, and cloud-based analytics.

Learning Outcomes

- Interface sensors and actuators with microcontrollers (Arduino/Raspberry Pi). (*P2 Manipulation*)
- Implement communication protocols like MQTT and HTTP. (*P3 Precision*)
- Collect, process, and visualize IoT data using cloud platforms. (*C3 Apply*)
- Design and implement small-scale IoT projects. (*P4 Articulation*)

Outline

Unit 1: Getting Started with IoT Hardware

- Introduction to Arduino / Raspberry Pi / ESP32 boards
- Basic sensor interfacing (temperature, humidity, motion)
- Reading sensor data and controlling actuators

Unit 2: Communication Protocols

- Implementing MQTT and HTTP communication
- Using WiFi and Bluetooth modules for IoT connectivity

Unit 3: Data Management

- Sending data to cloud services (AWS IoT, Thingspeak)
- Data visualization using dashboards

Unit 4: IoT Security Basics

- Implementing simple security measures (passwords, encryption basics)
- Secure device communication

Unit 5: Mini Project

- Design and develop a simple IoT application (e.g., smart weather station, home automation)
- Prepare a demo and report

Department: Information Technology

Course Title: Game Development

Course Code:CS-308

Credit Hours: 03

Pre-requisite: Nil

Objectives

Define the principles of game design and development. Gain programming capability to develop games. Learn to structure and define the duties of the game development team. Practice art creation, music and animations and various tools needed to create assets. Apply the mathematics and physics to game design. Apply basic artificial intelligence to developing computer games. Manage porting issues on various platforms.

Learning Outcomes

- **Understand** the concept of a Game Engine (**C2 Understand**).
- **Demonstrate** knowledge of the Unity Game Engine interface (**C3 Apply**).
- **Demonstrate** knowledge of the Integrated Development Environment (IDE) of computer programming (**C3 Apply**).
- **Demonstrate** knowledge of the various interface components that compromise the Integrated Development Environment (IDE) of Unity (**C3 Apply**).
- **Apply** the programming structure learned in Visual Basic language as a basis for learning JavaScript and C# scripting language to manage, manipulate, and animate the game objects in Unity (**C3 Apply**).

Course Outline

Unit 1. Introduction

Explore the world of Game Engines/Unity the game engine of choice/Unity Interface/Install Unity software. Layout and Creating Scenes/Transitions and Manipulation of Objects.

Unit 2. C# Programming: The Language of Choice

Introduction to C# programming language; creating your first script. Features to add to knowledge base: Sprite Renderer, Prefab creation, Collision Detection, Score management; Create a game environment – navigate camera, design play area, create & collect objects, display score, build the game.

Unit 3. Simple Movement and Input

Simple Movement, Simple Rotation and Scaling, Easy Input Handling in Unity, Parent-Child Objects, Sorting Layers, Tagging Game Objects, Collision Layers, Prefabs, Creating and Destroying Objects, Controlling Object Lifespans with Invoke.

Unit 4. Organizing Game Objects

Simple Movement, Simple Rotation and Scaling, Easy Input Handling in Unity, Parent-Child Objects, Sorting Layers, Tagging Game Objects, Collision Layers, Prefabs, Creating and Destroying Objects, Controlling Object Lifespans with Invoke.

Unit 5. Animation

Simple Unity Animation, Animator States, Scripting Animations, Animations and Colliders.

Recommended Books/Reference Material

1. Cossu, S. M. (2019). Game development with GameMaker Studio 2: Make your own games with gamemaker language. Apress.
2. Hautala, N. (2021). Creating Emotional VR Game Narrative: Experimental Game Design Research (Master's thesis).
3. Tarhan, A. K. (2022). Game Design as a Pedagogic Tool: The Future of STEM Education.

Department: Information Technology

Course Title: Visual Programming

Course Code:CS-309

Credit Hours: 03

Pre-requisite: Object Oriented Programming

Objectives

This course will provide the different elements of a visual programming language as building blocks to develop correct, coherent programs. To develop a Program using the fundamental software development process, including design, coding, documentation, testing, and debugging. This course will also develop the ability to analyze problems, develop conceptual designs that solve those problems, and transform those designs to Visual Programs.

Learning Outcomes

- **Implement** different elements of a visual programming language as building blocks to develop correct, coherent programs (**C3 Apply**).
- **Develop** using the fundamental software development process, including design, coding, documentation, testing, and debugging (**C6 Create**).
- **Analyze** problems, develop conceptual designs that solve those problems, and transform those designs to Visual Programs (**C4 Analyze**).

Course Outline

Unit 1. Visual Programming Basics

Visual Programming Basics; Introduction to Events; Fundamentals of Event-driven Programming, message handling, user interfaces, graphics device interface, painting and drawing, windows management, input devices, resources, string and menu resource, dialogs and windows controls, common controls, dynamic link libraries.

Unit 2. Network Programming and Building Class Libraries

Threads and synchronization, network programming, Building Class Libraries at the Command Line, Class Libraries, Using References, Assemblies, Private Assembly Deployment, Shared Assembly Deployment, Configuration Overview, Configuration Files, Programmatic Access to Configuration.

Unit 3. SDK Tools

Using SDK Tools for Signing and Deployment, Metadata, Reflection, Late Binding, Directories, Files, Serialization, Attributes, Memory Management and Garbage Collection, Threading and Synchronization, Asynchronous Delegates, Application Domains, Marshal by Value, Marshal by Reference.

Unit 4. Configuring Security

Authentication and Authorization, Configuring Security, Code Access Security, Code Groups, Evidence, Permissions, Role-Based Security, Principals and Identities.

Unit 5. Using Data Sets and Interacting with XML Data

Using Data Readers, Using Data Sets, Interacting with XML Data, Tracing Event Logs, Using the Boolean Switch and Trace Switch Classes, Print Debugging Information with the Debug Class, Instrumenting Release Builds with the Trace Class, Using Listeners, and Implementing Custom Listeners.

Recommended Books/Reference Material

1. Asadi, F. (2023). Installation of Microsoft® Visual Studio®. In Essentials of C Programming with Microsoft® Visual Studio® (pp. 1-17). Cham: Springer Nature Switzerland.
2. Deitel, H., & Deitel, P. C. (2021). How to program. Pearson.
3. Deitel, P., & Deitel, H. (2022). C++ 20 for Programmers: An Objects-Natural Approach. Pearson.
4. Soon, W., & Cox, G. (2020). Aesthetic programming: A handbook of software studies (p. 298). Open Humanities Press.

Department: Information Technology

Course Title: Digital Image Processing

Course Code:CS-315

Credit Hours: 03

Pre-requisite: Nil

Objectives

To learn the fundamental concepts of Digital Image Processing. To study basic image processing operations. To understand image analysis algorithms. To expose students to current applications in the field of digital image processing.

Learning Outcomes

- **Develop and implement** algorithms for digital image processing (**C6 Create**).
- **Apply** image processing algorithms for practical object recognition applications (**C3 Apply**).

Course Outline**Unit 1. Introduction**

The human visual system, electromagnetic system, working and components inside digital camera, pixels.

Unit 2. Image representation

Image representation, sampling, quantization, mathematics of image formation, convolution, camera projection.

Unit 3. Image Processing

Point-based image processing, Fourier theory, image filtering in spatial and frequency domain, wavelets, image registration documentation,

Unit 4. Morphological operations and Feature Detection

Morphological operations, color models, multispectral images, feature detection.

Unit 5. Image Segmentation

Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, implementation in Matlab, Segmentation Using Morphological Watersheds Object recognition, Descriptors: boundaries, regions, global Pattern recognition as applied to images, Object/scene/activity categorization, Object detection, Supervised classification algorithms, Probabilistic models for sequence data, Deep learning, convolutional neural networks Visual attributes, Active learning ,Dimensionality reduction ,Non-parametric methods and big data.

Recommended Books/Reference Material

2. Thanki, R. M., & Kothari, A. M. (2019). Digital image processing using SCILAB. Springer International Publishing.
3. Umbaugh, S. E. (2022). Digital Image Processing and Analysis: Digital Image Enhancement, Restoration and Compression. Crc Press.
4. Umbaugh, S. E. (2023). Digital image processing and analysis: computer vision and image analysis. CRC Press.

Department: Information Technology

Course Title: Data Mining

Course Code:CS-311

Credit Hours: 03

Pre-requisite: Nil

Objectives

Introduce students to the basic concepts and techniques of Data Mining. Develop skills of using recent data mining software for solving practical problems.

Learning Outcomes

- **Explain** the importance of Data Mining as a new discipline in the IT field (**C2 Understand**).
- **Use** the various kinds of Data Mining Tasks (**C3 Apply**).
- **Apply** data mining to solve real life problems (**C3 Apply**).

Course Outline

Unit 1. Data Preprocessing

Data representation, Data summarization, Data cleaning, Data integration and transformation.

Unit 2. Association Rule Mining

The Apriori algorithm, FP-Growth Algorithm. Class based Association Rules.

Unit 3. Classification

Decision tree induction, Attribute Selection Measures, Decision tree measures, K- Nearest Neighbor, Naïve Bayes, VIVA of Assignments. Belief Network, Neural Networks.

Unit 4. Clustering

Introduction, K-Means, Hierarchical, DB-Scan. Features Selection.

Unit 5. Web Mining

Introduction, Fingerprinting, HITS algorithm.

Recommended Books/Reference Material

1. Chakraborty, S., Islam, S. H., & Samanta, D. (2022). Introduction to Data Mining and Knowledge Discovery. In *Data Classification and Incremental Clustering in Data Mining and Machine Learning* (pp. 1-22). Cham: Springer International Publishing.
2. Data, V. (2019). T 4.50 Course: Data Mining and Applications [T-WIWI-103066]. *Module Handbook*.
3. Han, J., Pei, J., & Tong, H. (2022). *Data mining: concepts and techniques*. Morgan kaufmann.
4. Hanjo, L. (2023). *Data Mining: Concepts, Models, Methods, and Algorithms*.

Department: Information Technology

Course Title: Data Science

Course Code:CS-404

Credit Hours: 03

Pre-requisite: Nil

Objectives

The Data Science course offers: In-depth knowledge of Data Science Life Cycle and Machine Learning Algorithms. Comprehensive knowledge of various tools and techniques for Data Transformation. The capability to perform Text Mining and Sentimental analyses on text data and gain an insight into Data Visualization and Optimization techniques. The exposure too many real- life industry-based projects which will be executed in R Studio and python. Projects which are diverse in nature covering media, healthcare, social media, aviation and HR. Rigorous involvement of an SME throughout the Data Science Training to learn industry standards and best practices.

Learning Outcomes

- **Implement** Text Mining and Sentimental analyses on text data and gain an insight into Data Visualization and Optimization techniques **(C3 Apply)**.

- **Implement** many real-life industry-based projects which will be executed in R Studio and python (**C3 Apply**).

Course Outline

Unit 1. Introduction to Data Science

Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Exploratory Data Analysis and the Data Science Process, Exploratory Data Analysis: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA. Exploratory Data Analysis: The Data Science Process, Case Study: Real Direct (online real estate firm), Statistical Inference: Populations and samples, Statistical Inference: Statistical modeling, probability distributions, fitting a model.

Unit 2. Data Visualization

Statistical Inference: Intro to R and Python , Data Visualization: Basic principles, ideas and tools for data visualization , Data Visualization: Examples of inspiring (industry) projects- Exercise: create your own visualization of a complex dataset , Introduction to machine learning: Linear regression and regularization , Introduction to machine learning Model selection and evaluation , Classification: decision trees, SVM, kNN, Ensemble methods: random forests, Intro to probability: Naïve Bayes and logistic regression.

Unit 3. Clustering, Machine Learning Algorithms

Clustering: k-means, hierarchical clustering, Dimensionality reduction: PCA and SVD. One More Machine Learning Algorithm and Usage in Applications Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web, Feature Generation and Feature Selection (Extracting Meaning from Data).

Unit 4. Features Generations, Text Mining and Recommendation Systems

Feature Generation (brainstorming, role of domain expertise, and place for imagination).
Feature Selection algorithms, Filters; Wrappers; Decision Trees; Random Forests, Text mining and information retrieval, Recommendation Systems: Building a User-Facing Data Product, Recommendation Systems: Algorithmic ingredients of a Recommendation Engine, Recommendation Systems: build your own recommendation system.

Unit 5. Mining Social-Network Graphs, Big Data, & Data Science and Ethical Issues

Mining Social-Network Graphs Mining Social-Network Graphs: Clustering of graphs, Direct discovery of communities in graphs, Big Data: Big data storage and retrieval, Big data distributed computing, Data Science and Ethical Issues Discussions on privacy, security, ethics, A look back at Data Science, Next- generation data scientists Recommended Books/Reference Material.

Recommended Books/Reference Material

1. Bruce, P., Bruce, A., & Gedeck, P. (2020). Practical statistics for data scientists: 50+ essential concepts using R and Python. O'Reilly Media.
2. Efron, B., & Hastie, T. (2021). Computer age statistical inference, student edition: algorithms, evidence, and data science (Vol. 6). Cambridge University Press.
3. Kabacoff, R. (2022). R in action: data analysis and graphics with R and Tidyverse. Simon and Schuster.
4. Wickham, H., Çetinkaya-Rundel, M., & Grolemund, G. (2023). R for data science. "O'Reilly Media, Inc."

**21.List of Mathematics and Supporting Courses of IT (Interdisciplinary/
Allied)**

Sr#	Course Code	Course Title	Pre-Requisite	Credit Hours
1	MTH-107	Multivariable Calculus	Calculus and Analytical Geometry	3 (3-0)
2	MTH-111	Elementary Linear Algebra	Nil	3 (3-0)
3	STA 106	Introduction to Probability and Statistics	Nil	3 (3-0)
4	ENG 104	Business and Technical Writing	Nil	3 (3-0)

22.Course Outlines for Mathematics and Supporting of IT (Interdisciplinary/ Allied)

Multivariable Calculus

Course Code: MTH-107

Credit Hours: 03

Pre-requisite: Calculus and Analytical Geometry

Objectives

To provide foundation and basic ground for multivariable calculus and analytical background with multi variables.

Learning Outcomes

After completion of this course; the students will be able to

- Understand the basic concepts and know the basic techniques of differential and integral calculus of functions of several variables. PLO-1
- Apply the theory to calculate the gradients, directional derivatives, arc length of curves, area of surfaces, and volume of solids. PLO-3
- Solve problems involving maxima and minima, line integral and surface integral, and vector calculus. PLO-2

Course Outline

Unit 1. Function of Several variables

Function of two or more variables. Limits, calculating limits using limits Laws.
Continuity, examples.

Unit 2. Partial Derivatives

Partial derivatives. Differentiability and differentials and chain rule.

Unit 3. Multiple Integrals

Double Integrals, Double Integrals over nonrectangular regions and in polar coordinates. Triple Integrals.

Unit 4. Vector Calculus

Line and surface integrals, Green's theorem, Green's theorem. Stoke's theorem.

Unit 5. Fourier series, Laplace and Z-Transform

Fourier series, Functions of any period $P=2L$. Even and odd functions. Half Range expansions. Fourier transform. Laplace transform. Z-transform.

Recommended Books/Reference Material

1. Anton, H., Bivens, I. C., Davis, S. (2022). *Calculus: Single Variable*. United States: Wiley.
2. Helfgott, M. (2023). *Calculus for the Natural Sciences*. United States: Society for Industrial and Applied Mathematics, Wiley.
3. HughesHallett, D., Gleason, A. M., McCallum, W. G. (2020). *Calculus, Single and Multivariable*. United Kingdom: Wiley.
4. Stewart, J., Clegg, D.K., and Watson, S. (2020). *Calculus: Early Transcendentals*. Cengage Learning.
5. Thomas, G. B., Finney, R. L., Weir, M. D., & Giordano, F. R. (2003). *Thomas' calculus*. Reading: Addison-Wesley.

Elementary Linear Algebra

Course Code: MTH-111

Credit Hour: 03

Prerequisite: Nil

Objectives

Students should be familiar with the basics of Linear algebra which is a branch of mathematics that deals mainly with properties of matrices, vector spaces and linear transformations.

Learning Outcomes

- The students must be familiar with the properties of matrices in solving the linear equations and how these are useful in linear transformations between the vector spaces. PLO-1
- The students can use this skill set in different fields of computer sciences and information technology. PLO-2

Course Outline

Unit 1. Algebra of Matrices

Matrices, squares of Matrices, trace, powers of matrices, polynomials in matrices, invertible matrices. Orthogonal matrix, normal matrix. Hermitian matrix, unitary matrix, (Complex). Normal Matrix. Block matrices.

Unit 2. System of Linear Equations

System of linear equations and its solutions. Equivalent systems. Elementary operations echelon and reduced echelon form, inverse of matrix using elementary row operations, Solution of linear systems. Gauss-Jordan method and Gaussian elimination method.

Unit 3. Determinants

Determinants of matrix of order two and three, Definition of determinants of the same order, computing of determinants. Definition of higher order determinants, properties, expansion and applications of determinants.

Unit 4. Vector Spaces, Eigen values and Eigenvectors

Vector's basic definitions, Vector addition and scalar multiplication. Dot and cross product. Orthogonality. Definition and examples of vector spaces, subspaces. Linear combination spanning. Linear independence and dependence. Eigen values and eigenvectors. Diagonalization.

Unit 5. Inner Product Spaces

Definition and examples. Properties and Projection. Angle and orthogonality.
Cauchy inequality.

Recommended Books/Reference Material

1. Anton, H., & Rorres, C. (2013). *Elementary linear algebra: applications version*. John Wiley & Sons.
2. Lyche, T. (2020). *Numerical Linear Algebra and Matrix Factorizations*. Springer Nature
3. Rorres, C. (2006). *Elementary linear algebra*. Mississauga, Ont.: Wiley.
4. Strang, G. (2022). *Introduction to linear algebra*. Wellesley-Cambridge Press.
5. Shapiro, H. (2015). *Linear algebra and matrices*. AMS, Providence, Rhode Island.

Business and Technical Writing

Allied/Interdisciplinary Course

Course Code: ENG-104

Credit Hours: 03

Pre-requisite: Nil

Objectives

The objective of the Business and Technical Writing course is to equip participants with the essential skills needed to communicate effectively in professional settings. Through this course, individuals learn to convey complex technical information in a clear, concise, and reader-friendly manner. Emphasis is placed on developing proficiency in various business writing formats, such as reports, proposals, and emails, as well as mastering the art of creating user-friendly technical documentation. The goal is to empower participants with the ability to produce high-quality written communication that enhances clarity, professionalism, and overall effectiveness in both business and technical contexts.

Learning Outcomes

- Mastering the art of crafting clear and concise business documents. PLO- 1

- Developing proficiency in various business writing formats, including reports, proposals, and emails. PLO-2
- Acquiring skills to communicate complex technical information in a reader-friendly manner. PLO-3
- Creating effective and user-friendly technical documentation.
- Enhancing professionalism in written communication for business and technical contexts. PLO-9
- Gaining the ability to tailor messages to diverse audiences and purposes.
- Practicing critical editing and revision techniques for polished and error-free documents. PLO-7

Course Outline

Unit 1. Introduction to Business and Technical Writing

Overview of the importance of effective communication in professional settings. Understanding the audience and purpose in business and technical contexts. Key principles of clarity, conciseness, and professionalism in writing. Employment interviews (types of interviews, preparation for interviews, follow up communication in interviews) Communication in team (group work business project)

Unit 2. Business Writing Fundamentals

Exploring various business writing formats: memos, emails, and reports. Crafting professional and persuasive messages for different purposes. Techniques for organizing and structuring business documents effectively. Memoranda and Proposal Writing.

Unit 3. Technical Writing Essentials

Introduction to technical writing principles and conventions. Conveying complex technical information in a clear and accessible manner. Creating user-friendly technical documentation, including manuals and guides. Business Correspondence,

Formal Letters (Letters of inquiry, order, complaint, invitation, business request, Replies to queries and requests)

Unit 4. Document Design and Visual Elements

Importance of document design in enhancing readability and user experience. Incorporating visual elements such as graphs, charts, and images. Balancing text and visuals for optimal communication impact.

Unit 5. Editing and Revision Techniques

Strategies for proofreading and editing written content. Addressing common errors and improving overall writing quality. Peer review and collaborative editing for constructive feedback.

Unit 6. Tailoring Messages to Diverse Audiences

Adapting communication style for different audiences and purposes. Consideration of cultural and contextual factors in business and technical writing. Final project: Applying learned skills to create a comprehensive business or technical document tailored for a specific audience. Presentations, how to present a business proposal. Presentations, Do's and don'ts of a good presentation.

Recommended Books/Reference Material

1. Bailey Jr, E. P. (1997). *The plain English approach to business writing*. Oxford University Press.
2. Bargiela-Chiappini, F., & Nickerson, C. (2014). Business writing as social action. In *Writing Business* (pp. 1-32). Routledge.
3. Canavor, N. (2021). *Business writing for dummies*. John Wiley & Sons.
4. Dwyer, J., & Hopwood, N. (2019). *The business communication handbook*. Cengage AU.
5. Hollis-Turner, S., & Scholtz, D. (2010). Business writing in academic and workplace contexts. *Southern African Linguistics and Applied Language Studies*.

6. Jenkins, S., & Hinds, J. (1987). Business letter writing: English, French, and Japanese. *TESOL quarterly*, 21(2), 327-349.
7. Van Laan, K. (2022). *The insider's guide to technical writing*. XML Press.

Introduction to Probability and Statistics

Course Code: STA-106

Credit Hours: 03

Pre-requisite: Nil

Objectives

The main purpose of the course is to enable students to understand the significance of statistics in the real world, particularly in the field of other sciences. The course focuses on the methods of collection presentation and analysis of data using measures of central tendency and measures of dispersion. Furthermore, the course focuses on basic principles of probability and probability distributions for discrete and continuous random variables.

Learning Outcomes

- Students will be capable to explain the random variables, discrete and continuous random variables, and their probability distributions. PLO-1
- Students will gain understanding to apply the probability distribution on scientific studies and interpret the results of statistical analyses accurately and effectively. PLO-2
- Student will understand the basic statistical concepts and able to calculate and explain measures of central tendency and dispersion. PLO-3
- Students will be able to present the data using suitable graph, chart, and diagram. PLO-4

Course Outline

Unit 1. Introduction to Statistics & Presentation of Data

Introduction Statistics, important statistical terms, variable, data & data collection. Classification and tabulation of data. Frequency distribution, its construction and

other related concepts. Graphical Presentation: Simple bar chart, Component & Multiple bar chart, Pie chart, Histogram, Frequency polygon and Ogive.

Unit 2. Measures of Central Tendency

Mean, Median & Mode for ungrouped and grouped data, quartiles, deciles and percentiles for ungrouped & grouped data.

Unit 3. Measures of Dispersion

Absolute and relative measures of dispersion for ungrouped and grouped data. Moments about mean. Measures of skewness and kurtosis. Moment-ratios.

Unit 4. Probability & Probability Distributions

Introduction to probability theory, types of events. Functions of classical probability with real world problems. Numerical examples of probability. Concept of random variable, discrete and continuous random variables. Binomial probability distribution & its numerical examples

Unit 5. Discrete and Continuous Probability Distributions

Binomial probability distribution & its numerical examples. Hyper geometric probability distribution & its numerical examples. Poisson probability distribution & numerical examples related to it. Normal distribution, numerical examples with direct & inverse use of area table for standard normal distribution.

Recommended Books/Reference Material

1. [Carlton](#), M.A., & Devore, [J.L.](#) (2020). *Probability with STEM applications*, (3rd ed.). Wiley.
2. Chaudhry S.M., & Kamal. S. (2018). *Introduction to statistical theory part 1*. Lahore, Pakistan: Ilmi Kitab Khana.
3. Hogg, R., Mckean, J., & Craig, A. (2021). *Introduction to mathematical statistics*, (8th ed.). Boston: Pearson Education.
4. Mendenhall, W., Beaver, R. J., & Beaver, B. M. (2012). *Introduction to probability and statistics*. Cengage Learning.

5. Mood, A.M., Graybill, F.A., & Boes, D.C. (1974). *Introduction to the theory of statistics*, (3rd ed.). New York: McGraw Hill.
6. Scheaffer, R. L., Mulekar, M., & McClave, J. T. (2010). *Probability and statistics for engineers*. Cengage Learning.
7. Walpole, R. E. (2002). *Introduction to statistics*, (7th ed.). New York: Macmillan publishing company.
8. Walpole, R.E., Myers, R.H., & Myers, S.L. (1998). *Probability and statistics for engineers and scientist*, (6th ed.). New York: Prentice Hall.
9. Weiss, N. A., & Hassett, M. J. (1999). *Introductory statistics*. Boston: Addison-Wesley.

23.List of Elective Supporting Courses of IT

Sr#	Course Code	Course Title	Pre-Requisite	Credit Hours
1	ECO-101	Introduction to Economics	Nil	3
2	MGT-105	Introduction to Digital Marketing	Nil	3
3	MGT-101	Fundamentals of Accounting	Nil	3

24.Course Outlines for Elective Supporting Courses of IT

Introduction to Economics

BBA-Business Administration

Course Code: ECO-101

Credit Hours: 03

Pre-requisite: Nil

Objectives

This course is designed to give an understanding of economic laws and their application. The course addresses behavior of individuals, firms in the economy and major macroeconomic issues in different markets environment, and making students aware of the day to day changing market conditions. They will learn how to use different economic instruments to apply in their practical field works.

Learning outcomes:

After studying this course, the student will be able to understand, comprehend and analyze:

- The Economic problem of allocation and distribution of resources.
- The factors that determine demand and supply
- The concept of elasticity of demand and supply

Course Outline

Unit 1. Basic Economic Concepts

Economics: Basic Themes and Nature. Micro versus Macro Economics. Positive versus Normative economics. Economic problem of resource allocation. Economics relevance to business organizations. Nature, scope and importance of Economics, Scarcity and choice. Opportunity cost, Factors of production, Production possibility frontier.

Unit 2. Demand and Supply Analysis

The demand functions. Changes in demand. The supply functions. Changes in supply. Equilibrium of Supply & Demand. Elasticity of demand/supply and its measurement.

Unit 3. Elasticity

Concept of elasticity, Price elasticity of demand, Income elasticity of demand, Cross Elasticity of Demand, Price elasticity of supply, Applications of elasticity. Shifts in demand and supply curves.

Unit 4. Theories- Utility Theory, Theory of Firm

Consumer behavior, Preferences, Utility function, Law of increasing and decreasing marginal utility, Law of equi-marginal utility.

Unit 5. Production Analysis

Basic production concepts. Total, Average and Marginal Product. Returns to scale. Short-run and long-run production. Least-cost factor combination. Producer equilibrium.

Unit 6. Cost and Revenue Analysis

Various cost concepts. The cost of production: Short-run cost, long-run cost. Revenue and revenue curves: Total, average and marginal revenues. Profit-Maximization.

Unit 7. Market Structures and Pricing

Market and its forms. Price and out-put under perfect competition. Price and out-put under monopoly, duopoly, oligopoly and monopolistic competition.

Unit 8. Resource Allocation

Role of the government in market efficiency. The theory of Marginal Productivity. Market demand for resources.

Recommended Books/ Reference Material

1. Besanko, D., & Braeutigam, R. (2020). *Microeconomics*. John Wiley & Sons.
2. Browning, E. K., & Zupan, M. A. (2022). *Microeconomics: Theory and applications*. John Wiley & Sons.
3. Gans, J., King, S., Byford, M., & Mankiw, G. (2023). *Principles of Microeconomics 9e*. Cengage AU.
4. Mankiw, N. G., Kneebone, R. D., & McKenzie, K. J. (2020). *Principles of microeconomics*. Nelson Education Ltd.
5. Nicholson, W., & Snyder, C. M. (2021). *Intermediate microeconomics and its application*. Cengage Learning.

Introduction to Digital Marketing

BBA- Business Administration

Course Code: MGT-105

Credit Hours: 03

Pre-requisite: Nil

Objectives

The aim of the this course is to provide students with the knowledge about business advantages of the digital marketing and its importance for marketing success; to develop a digital marketing plan; to make SWOT analysis; to define a target group; to get introduced to various digital channels, their advantages and ways of integration; how to integrate different digital media and create marketing content; how to optimize a Web site and SEO optimization; how to create Google AdWords campaigns; social media planning; to get basic knowledge of Google Analytics for measuring effects of digital marketing and getting insight of future trends that will affect the future development of the digital marketing. The application of the gained knowledge, skills and competences will help future managers in forming digital marketing plan in order to manage a digital marketing performance efficiently.

Learning outcomes

- Develop and implement Internet marketing strategies.
- Critically appraise the application of the Internet in marketing.

- Apply the marketing concepts in an online environment

Course Outline

Unit 1. Introduction of the Digital Marketing, Creating Initial Digital Marketing Plan

Digital vs. real marketing, Digital marketing channels, The Opportunity-Mega trends, Content management, SWOT analysis, Target group analysis.

Unit 2. Strategic E-marketing and SEO Optimization

Writing the SEO content, E-business models, Consumers online characteristics.

Unit 3. Site Design Basics

Four cornerstone approach, Personas and scenarios, how to write project briefs, Site design usability, Usability Best Practices, Domain name management.

Unit 4. Introduction to CRM

CRM platform, CRM models, CRM strategy.

Unit 5. Introduction to Web Analytics and Marketing Communications

Factors for Segmentation. Selecting the target market. Developing the positioning and target market strategies. Different trends. Rules of doing e-business. E-business application in the market.

Unit 6. Business Opportunities and Social Media

Instagram options, Optimization of Instagram profiles, Integrating Instagram with a Web Site and other social networks, keeping up with posts, Linked-in options, creating campaigns on LinkedIn, analyzing visitation on LinkedIn, YouTube Advertising, YouTube Analytics, Facebook Ads, Creating Facebook Ads, Ads Visibility, E-mail marketing.

Unit 7. Digital Marketing Impact on Society

Its impact and way forward in the society.

Recommended Books/ Reference Material

1. Chaffey, D., & Smith, P. R. (2022). *Digital marketing excellence: planning, optimizing and integrating online marketing*. Taylor & Francis.
2. Deiss, R., & Henneberry, R. (2020). *Digital marketing for dummies*. John Wiley & Sons.
3. Hall, S. (2023). *B2B digital marketing strategy: how to use new frameworks and models to achieve growth*. Kogan Page Publishers.
4. Kingsnorth, S. (2022). *Digital marketing strategy: an integrated approach to online marketing*. Kogan Page Publishers.
5. Zahay, D. (2020). *Digital marketing management: A handbook for the current (or future) CEO*. business expert press.

Fundamentals of Accounting

BBA-Business Administration

Course Code: MGT-101

Credit Hours: 03

Pre-requisite: Nil

Objectives

The primary aim of Financial Accounting is to provide students with an introduction to the process and function of financial reporting. Whilst a large proportion of the course is aimed at understanding accounting as a process, taking a preparer's perspective, we will also seek to develop an understanding of the importance of the role of accounting in today's society.

Learning Outcomes

By the end of this course, students will:

- Be able to understand accounting and financial reporting;
- Be able to comprehend complete accounting cycle

- Be able to Prepare financial issues and the role of Journal, Ledger and subsidiary books, Preparation of balance sheet, profit and loss account and cash flow statement.

Course Outline

Unit 1. Accounting: Information For Decision Making

Accounting Information: A Means to an End, Accounting Systems. Financial Accounting Information. Management Accounting Information. Integrity of Accounting Information. Careers in Accounting.

Unit 2. Basic Financial Statements

Introduction to Financial Statements. A Starting Point: Statement of Financial Position. Income Statement. Statement of Cash Flows, Relationships among Financial Statements. Financial Analysis and Decision Making. Forms of Business Organization. The Use of Financial Statements by External Parties.

Unit 3. The Accounting Cycle: Capturing Economic Events

The Accounting Cycle. The Ledger. The Use of Accounts, Debit and Credit Entries. The Journal, Recording Balance Sheet Transactions: An Illustration. Ledger Accounts after Posting. What Is Net Income? Dividends. Recording Income Statement Transactions: An Illustration. February's Ledger Balances. The Trial Balance

Unit 4. The Accounting Cycle: Accruals and Deferrals

The Need for Adjusting Entries. Types of Adjusting Entries. Adjusting Entries and Timing Differences. Characteristics of Adjusting Entries. Year-End at Overnight Auto Service. Converting Assets to Expenses. The Concept of Depreciation. Converting Liabilities to Revenue. Accruing Unpaid Expenses. Accruing Uncollected Revenue. Accruing Income Taxes Expense: The Final Adjusting Entry

Unit 5. The Accounting Cycle: Reporting Financial Results

Preparing financial statements. Relationships among the financial statements

Drafting the notes that accompany financial statements.

Unit 6. Merchandising Activities

Merchandising Companies. The Operating Cycle of a Merchandising Company. Income Statement of a Merchandising Company. Accounting System Requirements for Merchandising Companies. Two Approaches Used in Accounting for Merchandise Inventories. Perpetual Inventory Systems. Periodic Inventory Systems. Comparison of Perpetual and Period Inventory Systems.

Recommended Books/ Reference Material

1. Bettner, M., Williams, J., Haka, S., & Carcello, J. (2023). Financial & Managerial Accounting. (Latest Edition)
2. Khan, (2021): Financial Accounting. Pakistan
3. Kimmel, P. D., Weygandt, J. J., & Kieso, D. E. (2020). *Financial accounting: tools for business decision-making*. John Wiley & Sons.
4. Narayanaswamy, R. (2022). *Financial accounting: a managerial perspective*. PHI Learning Pvt. Ltd.
5. Schroeder, R. G., Clark, M. W., & Cathey, J. M. (2022). *Financial accounting theory and analysis: text and cases*. John Wiley & Sons.

25.List of General Education Requirement Courses of IT

Sr#	Course Code	Course Title	Pre-Requisite	Credit Hours
1	CS-107	Application of Information and Communication Technologies	Nil	2
2	CS-107L	Application of Information and Communication Technologies (Lab)	Nil	1
3	ENG-110	Functional English	Nil	3
4	ENG-111	Expository Writing	Nil	3
5	CS-123	Discrete Structures (Quantitative Reasoning – II)	Nil	3
6	MTH-104	Calculus and Analytical Geometry (Quantitative Reasoning – I)	Nil	3
7	ISL-101/ ETH-101	Islamic Studies/ Ethics	Nil	2
8	PAK-103	Ideology and Constitution of Pakistan	Nil	2
9	MGT-104	Social Sciences (Example: Introduction to Management)	Nil	3
10	PHY-103	Natural Sciences (Applied Physics)	Nil	2
11	PHY-103L	Natural Sciences (Applied Physics (Lab))	Nil	1
12	CS-209	Professional Practices (Arts and Humanities)	Nil	2
13	CCE-497	Civic and Community Engagement	Nil	2
14	MGT-108	Entrepreneurship	Nil	2
15	PAK-104	Pakistan Studies	Nil	2

26.Course Outlines for General Education Requirement Courses of IT

Application of Information and Communication Technologies

BS-Computer Science

Course Code: CS-107

Credit Hours: 02

Pre-requisite: Nil

Objectives

This course provides a very broad range of topics and prepares the students for various domains in computing that they will face in upcoming semesters. This course is very comprehensive as it provides every student a set of productivity tools that they will be able to use for the rest of their lives. It provides knowledge and skills for use of computing and communication technologies to solve real life problems. This is an introductory course about Information and Communication Technologies that includes ICT terminologies, hardware and software components, the internet and World Wide Web, and ICT based applications.

Learning Outcomes

- **Define** various types and components of computer including input/output devices, memory, storage media (**C1 Remember PLO-1**).
- **Describe** different types of software from operating systems to system utilities and productivity apps (**C2 Understand PLO-1**).
- **Apply** the basic concepts of computer networks, database management and computer security from a user point of view, components of a computer including input/output devices, memory, storage media (**C3 Apply PLO-4**).

Course Outline

Unit 1. Technology

Types of Computers, Mobile & Game Devices, Data and Information, The Web, Web Searching, Online Social Networks, Internet Communications. Digital Security and Privacy, Viruses and Other Malware, Privacy, Health Concerns, Environmental Issues,

Programs and Apps, Operating Systems, Applications, Installing and Running Programs, Developing Programs and Apps, Communications and Networks, Wired and Wireless Communications, Networks, Technology Uses, Government, Finance, Retail, Entertainment, Health Care, Science, Travel, Publishing, Manufacturing, Technology Users.

Unit 2. Online Web

The Internet, Websites and Media, The Internet, Evolution of the Internet, connecting to the Internet, Internet Service Providers, How Data Travels the Internet, IP & MAC Addresses and Domain Names, The World Wide Web, Navigating the Web, Web Addresses, Web Apps and Mobile Apps. Types of Websites, Digital Media on the Web, Graphics, Audio, Video, Plug-Ins, Other Internet Services, Email, Email Lists, Internet Messaging, Chat Rooms, Online Discussions, VoIP, FTP, Netiquette.

Unit 3. Evaluating Computers and Mobile Devices

Mobile Computers and Desktops, Laptops, Tab and Other Mobile Computers, Handheld Computers, Desktops and All-in-Ones, Servers, Terminals, Point-of-Sale Terminals, Wearable Devices, Game Devices, Embedded Computers, Inside the Case, The Motherboard, Processors, The Control Unit, The Arithmetic Logic Unit, Machine Cycle, Registers, The System Clock, Personal Computer and Mobile Device Processors, Processor Cooling, The Internet of Things, Cloud Computing, Cloud Computing Services. Memory, Bytes and Addressable Memory, Types of Memory, RAM, Cache, ROM, Flash Memory, CMOS, Memory Access Times, Adapters, Adapter Cards, USB Adapters, Buses, Bus Width, Types of Buses, Power Supply and Batteries, Data Representation & Number System.

Unit 4. Programs and Apps

Role of the Operating System, Obtaining Software, Installing Software, Categories of Programs and Apps, Multimedia and Interest Applications, Communications Applications, File, Disk, and System Management Tools.

Unit 5. Digital Security Ethics, and Privacy: Threats, Issues, and Defenses

Digital Security Risks, Cybercrime, Internet and Network Attacks Malware, Botnets, Encryption, Digital Signatures and Certificates, Hardware Theft, Vandalism, and Failure, Backing Up — The Ultimate Safeguard, Wireless Security, Ethics and Society, information Accuracy, Intellectual Property Rights, Codes of Conduct, Cookies, Phishing, Spyware and Adware, Social Engineering, Privacy Laws, Employee Monitoring, Content Filtering, What is data base and data base management system, Evolution of database management, Data Concepts and Characteristics, Data Organization, Operating Systems, Operating System Functions, Starting Computers and Mobile Devices, Shutting Down Computers and Mobile Devices, providing a User Interface, Managing Programs, Managing Memory.

Recommended books/reference material:

1. Campbell, J. T., Freund, S. M., Frydenberg, M., Last, M. Z., & Pratt, P. J. (2016). Shelly
2. Hafez, K., Skinner, A., & Grüne, A. (2022). Foundations of Global Communication: A Conceptual Handbook. Routledge.
3. Hawkrige, D. (2022). New information technology in education. Taylor & Francis.
4. Pearlson, K. E., Saunders, C. S., & Galletta, D. F. (2024). Managing and using information systems: A strategic approach. John Wiley & Sons.

Application of Information and Communication Technologies LAB

BS-Computer Science

Course Code: CS-107L

Credit Hours: 01

Pre-requisite: Nil

Objectives

This course provides a very broad range of topics and prepares the students for various DOMAINS in computing that they will face in upcoming semesters. This course is very comprehensive as it provides every student a set of productivity tools that they will be able to use for the rest of their lives. It provides knowledge and skills for use of computing and communication technologies to solve real life problems. This is an introductory course about Information and Communication Technologies that includes ICT terminologies, hardware and software components, the internet and World Wide Web, and ICT based applications.

Learning Outcomes

- **Analyze** various types and components of computer including input/output devices, memory, storage media (**C4 Analyze PLO-3**).
- **Apply** different types of software from operating systems to system utilities and productivity apps (**C3 Apply PLO-5**).
- **Apply in Team** the basic concepts of computer networks, database management and computer security from a user point of view, components of a computer including input/output devices, memory, storage media (**C3 Apply PLO-6**).

Course Outline

Unit 1. Technology

Introduction to the lab equipment and SOPs of the labs. Introduction to computer hardware and system information. Introduction to the Web, Web Searching, Online Social Networks, Internet Communications. Digital Security and Privacy, Viruses and Other Malware, Privacy.

Unit 2. Online Web

IP & MAC Addresses and Domain Names, the World Wide Web, Navigating the Web, Web Addresses, Web Apps and Mobile Apps. Types of Websites, Digital Media on the Web, Graphics, Audio, Video, Plug-Ins, Other Internet Services, Email, Email Lists, Internet Messaging, Chat Rooms, Online Discussions, VoIP, FTP, Netiquette.

Unit 3. Evaluating Computers and Mobile Devices

Inside world: The Motherboard, Processors, The Control Unit, The Arithmetic Logic Unit, Machine Cycle, Registers, The System Clock, Personal Computer and Mobile Device Processors, Processor Cooling, The Internet of Things, Cloud Computing, Cloud Computing Services. Memory, Bytes and Addressable Memory, Types of Memory, RAM, Cache, ROM, Flash Memory, CMOS, Memory Access Times, Adapters, Adapter Cards, USB Adapters, Buses, Bus Width, Types of Buses, Power Supply and Batteries, Data Representation & Number System.

Unit 4. Programs and Apps

File, Disk, and System Management Tools. MS office

Unit 5. Digital Security Ethics, and Privacy: Threats, Issues, and Defenses

Digital Security Risks, Cybercrime, Internet and Network Attacks Malware, Botnets, Encryption, Digital Signatures and Certificates, Hardware Theft, Vandalism, and Failure, Backing Up — The Ultimate Safeguard, Wireless Security, Ethics and Society, information Accuracy, Intellectual Property Rights, Codes of Conduct, Cookies, Phishing, Spyware and Adware, Social Engineering, Privacy Laws, Employee Monitoring, Content Filtering, What is data base and data base management system, Evolution of database management, Data Concepts and Characteristics, Data Organization, Operating Systems, Operating System Functions, Starting Computers and Mobile Devices, Shutting Down Computers and Mobile Devices, providing a User Interface, Managing Programs, Managing Memory.

Recommended books/reference material:

1. Campbell, J. T., Freund, S. M., Frydenberg, M., Last, M. Z., & Pratt, P. J. (2016).
2. Hafez, K., Skinner, A., & Grüne, A. (2022). Foundations of Global Communication: A Conceptual Handbook. Routledge.
3. Hawkrige, D. (2022). New information technology in education. Taylor & Francis.
4. Pearlson, K. E., Saunders, C. S., & Galletta, D. F. (2024). Managing and using information systems: A strategic approach. John Wiley & Sons.

Functional English

General Education Courses

Course Code: ENG-110

Credit Hours: 03

Pre-requisite: Nil

Objectives

This course is designed to equip students with essential language skills for effective communication in diverse real-world scenarios. It focuses on developing proficiency in English language usage: word choices, grammar and sentence structure. In addition, the course will enable students to grasp nuanced messages and tailor their communication effectively through application of comprehension and communication aspects including professional writing, public speaking, and everyday conversation. Ensuring that students are equipped in both academic and professional spheres. An integral part of the course is fostering a deeper understanding of the impact of language on diverse audiences. Students will learn to communicate inclusively and display a strong commitment to cultural awareness in their language use. Additionally, the course will enable them to navigate the globalized world with ease and efficacy, making a positive impact on their functional interactions.

Learning Outcomes

- Apply enhanced English communication skills through effective use of word choices, grammar and sentence structure **PLO-7**
- Comprehend a variety of literary non-literary written and spoken texts in English. **PLO-1**
- Effectively express information, ideas and opinions in written and spoken English. **PLO-10**
- Recognize inter-cultural variations in the use of English language and to effectively adapt their communication style and content based on diverse cultural and social contexts. **PLO-9**

Course Outline

Unit 1. Introduction

Ice breaking Activities. Types and modes of Communication. Intrapersonal, Intrapersonal and group Communication.

Unit 2. Rules for Structure of Sentences

Types of sentences. Punctuation and Spelling, Vocabulary. Lexical and functional categories. Structural kind of sentences: simple, compound, complex. Synthesis of sentences.

Unit 3. Concept of Time and Tense (present, past, future).

Discussion: General topics and everyday conversation. Concept of Voice: active and passive voice. Functional use of Voice in different situations. Discussion: General topics and everyday conversation.

Unit 4. Direct and Indirect Reporting.

Discussion: General topics and everyday conversation, describing things persons, places, pictures, events etc. Salutation & Greeting, Introduction, Asking and answering questions. Discussion: General topics and everyday conversation.

Unit 5. Practicing Everyday Conversation

Request and Permission, Agreement and Disagreement. Apologizing, Expressing likes and Dislikes, expressing opinion. Expressing approval, Disapproval, Discussion: General topics and everyday conversation.

Unit 6. Articulating Expression

Expressing appreciation, regret, and indifference. Expressing certainty, uncertainty, and obligation. Expressing suggestion, warning, Expressing possibility, impossibility & logical conclusion. Discussion: General topics and everyday conversation.

Unit 7. Art of Inviting

Accepting, declining invitation. Expressing & inquiring about preferences. Stating intentions and Making Plans. Giving directions. Instructing people how to do things.

Unit 8. Discussing Past and Present

Future prospects. Talking about the past.

Recommended books/ Reference material

1. Azar, B. S. (2003). *Fundamentals of English grammar*. Longman.
2. Beebe, S. A., Beebe, S. J., & Ivy, D. K. (2010). *Communication: Principles for a lifetime* (p. 483). Boston, MA: Allyn & Bacon.
3. Eastwood, J. (1994). *Oxford guide to English grammar*. Oxford University Press.
4. Floyd, K., & Cardon, P. (2023). *Business and Professional Communication*. McGraw-Hill US Higher Ed USE.)
5. Kortmann, B. (2020). *English linguistics: essentials*. Springer Nature.
6. Langan, J. (2001). *College writing skills with readings*. New York.
7. Murphy, R. (2003). *English grammar in use*. Cambridge: Cambridge University Press.
8. Sharma, Gajendra Dutt (2023) *A Comprehensive Resource Book of Functional English*, OEP, New Delhi.
9. Thomson, A. J., & Martinet, A. V. (2015). *A practical English grammar*. New York: Oxford University Press.
10. Wren, P. C., & Martin, H. (2000). *English grammar and Composition*. New Delhi: S Chand & Company Ltd.

Expository Writing

General Education Course

Course Code: ENG-111

Credit Hours: 03

Pre-requisite: Nil

Objectives

Expository Writing is a sequential undergraduate course aimed at refining writing skills in various contexts. Building upon the foundation building pre-requisite course, Functional English, this course will enhance students' basic skills of producing clear, concise and coherent written texts in English. The course will also enable students to dissect intricate ideas, to amalgamate information and to express their views and opinions through well-organized essays. The students will further be able to refine their analytical skills to substantiate their viewpoints using credible sources while adhering to established ethical writing norms. Additionally, the course will highlight the significance of critical thinking enabling students to produce original and engaging written texts.

Learning Outcomes

- Understand the essentials of the writing process integrating pre-working, drafting, editing and proofreading to produce well-structured essays. **PLO-1**
- Uphold ethical practices to maintain originality in expository writing. **PLO-9**

Course Outline

Unit 1. Introduction to Expository Writing

Understanding expository writing (definition, types, purpose and applications).

Characteristics of effective expository writing (clarity, coherence and organization). Introduction to paragraph writing.

Unit 2. The Writing Process

Pre-writing techniques (brainstorming, free-writing, mind-mapping, listing, questioning and outlining etc.). Drafting (three stage process of drafting techniques). Revising and editing (ensuring correct grammar, Clarity, coherence, conciseness etc.). Proofreading (fine-tuning of the draft). Peer review and feedback (providing and receiving critique).

Unit 3. Essay Organization and Structure

Introduction and hook (engaging readers and introducing the topic). Thesis statement (crafting a clear and focused central idea). Body Paragraphs (topic sentences, supporting evidence and transitional devices). Conclusion (types of concluding paragraphs and leaving an impact). Ensuring cohesion and coherence (creating seamless connections between paragraphs

Unit 4. Types of Expository Writing

Description, Illustration, Classification. Cause and effect (exploring causal relationships and outcomes). Process analysis (explaining step-by-step procedures). Comparative analysis (analyzing similarities and differences

Unit 5. Writing for Specific Purposes and Audiences

Different types of purposes (to inform, to analyze, to persuade, to entertain etc.). Writing for academic audiences (formality, objectivity, and academic conventions). Writing for public audiences (engaging, informative and persuasive language). Different tones and styles for specific purposes and audiences.

Unit 6. Ethical Considerations

Ensuring original writing (finding credible sources, evaluating information etc.).
Proper citation and referencing (APA, MLA, or other citation styles). Integrating
quotes and evidences (quoting, paraphrasing, and summarizing). Avoiding
plagiarism (ethical considerations and best practices)

Recommended books/ Reference material

1. Axelrod, R. B., & Cooper, C. R. (2010). *The St. Martin's guide to writing*. Macmillan.
2. Faigley, L., Selzer, J., Enoch, J., & Wible, S. (2009). *Good reasons with contemporary arguments*. Pearson Longman.
3. Floyd, K., & Cardon, P. (2023). *Business and Professional Communication*. McGraw-Hill US Higher Ed USE.
4. Graff, G., Birkenstein, C., & Maxwell, C. (2014). *They say, I say: The moves that matter in academic writing* (p. 245). Gildan Media Corp Book Publisher.
5. Johnson-Sheehan, R., Paine, C., & Paine, C. (2010). *Writing today*. Pearson Education India.
6. Keizer, E. (2015). *A functional discourse grammar for English*. Oxford University Press.
7. Rosenwasser, D., & Stephen, J. (2011). *Writing analytically*. Cengage Learning Press.
8. Straaijer, R. (2018). Modern English usage from Britain to America: Bryan Garner follows Henry Fowler from A Dictionary of Modern American English Usage to Garner's Modern English Usage. *English Today*, 34(4), 39-47.
9. Wachal, R. S. (2000). The Elements of Style, by William Strunk, Jr., and EB White; and A Dictionary of Modern American Usage, by Bryan A. Garner. *American speech*, 75(2), 199-207.
10. Williams, J. M., & Bizup, J. (2022). *Lessons in clarity and grace*. Pearson.

Calculus and Analytical Geometry

Course Code: MTH-104

Credit Hours: 03

Pre-requisite: Nil

Objectives

Calculus serves as the foundation of advanced subjects in all areas of mathematics. This is the first course of Calculus. The objective of this course is to introduce students to the fundamental concepts of limit, continuity, differential and integral calculus of functions of one variable.

Learning Outcomes

Upon successful completion of this course,

- The students will be able to understand the concepts of limit and continuity. **PLO-1**
- The students will be able to calculate derivatives. They can understand the concept of integration. **PLO-2**

Course Outline

Unit1. Limits and Continuity

Limit of a function, graphical approach, Properties & theorems of limits, limits of polynomials and rational and transcendental functions, limits at infinity, infinite Limits, one-sided limits, continuity.

Unit 2. Derivatives

The derivative as a function, the derivative as a rate of change, derivatives of products, quotients and negative powers, derivatives of trigonometric, polynomials, implicit differentiation, higher derivatives.

Unit 3. Applications of Derivatives

Applications of derivatives, Relative extreme and optimization. Mean value theorem. Intermediate forms and L' Hospital rule.

Unit 4. Techniques of Integration

The fundamental theorem of Integral calculus. The substitution rules. Integrals of elementary, hyperbolic, trigonometric, logarithmic and exponential functions. Integration by parts. Integration by partial fractions. Improper integrals.

Unit 5. Applications of Integration

Definite Integrals. Volume. Surface of revolution. Arc length. Applications to Economics, Physics, Engineering and Biology.

Recommended Books/Reference Material

1. Anton, H. Bivens, I.C., and Davis, S. (2021). *Calculus*. John Wiley and Sons.
2. Ayres, F., and Mendelson, E. (2009). *Calculus*. Schaum's Outlines.
3. Hughes-Hallett, D., Gleason, A.M., and McCallum, W.G. (2020). *Calculus: Single and Multivariable*. John Wiley and Sons.
4. Stewart, J., Clegg, D.K., and Watson, S. (2020). *Calculus: Early Transcendentals*. Cengage Learning.
5. Thomas, G. B., Finney, R. L., Weir, M. D., & Giordano, F. R. (2003). *Thomas' calculus*. Reading: Addison-Wesley.

Ideology and Constitution of Pakistan

Course Code: PAK-103

Credit Hours: 02

Pre-requisite: Nil

Objectives

This course is designed to provide students with a fundamental exploration of the ideology and the constitution of Pakistan. The course focuses on the underlying principles, beliefs, and aspirations that have been instrumental in shaping the creation and development of Pakistan as a sovereign state. Moreover, the course will enable students to understand the core provisions of the Constitution of the Islamic Republic of Pakistan concerning the fundamental rights and responsibilities of Pakistan citizens to enable them function in a socially responsible manner.

Learning Outcomes

- Demonstrate enhanced knowledge of the basis of the ideology of Pakistan with special reference to the contributions of the founding fathers of Pakistan. **PLO-1**
- Demonstrate fundamental knowledge about the Constitution of Pakistan 1973 and its evolution with special reference to state structure. **PLO-8**
- Explain about the guiding principles on rights and responsibilities of Pakistani citizens are enshrined in the Constitution of Pakistan 1973. **PLO-10**

Course Outline

Unit 1. Introduction to the Ideology of Pakistan

Definition and significance of ideology. Historical context of the creation of Pakistan (with emphasis on socio-political. Religious and cultural dynamics of British India between 1857 till 1947). Contributions of founding fathers of Pakistan in the freedom movement including but not limited to Allama Muhammad Iqbal, Muhammad Ali Jinnah., etc. Contributions of women and students in the freedom movement or separate homeland.

Unit 2. Two-Nation Theory:

Evolution of the Two-Nation Theory (Urdu-Hindi controversy. Partition of Bengal. Simla Deputation 1906, Allama Iqbal Presidential Address 1930, Congress Ministries 1937 Lahore Resolution 1940). Role of communalism and religious differences.

Unit 3. Introduction to the Constitution of Pakistan:

Definition and importance of a constitution. Ideological factors that shaped the Constitution(s) of Pakistan. Overview of constitutional developments in Pakistan.

Unit 4. Constitution and State Structure

Structure of government (executive, legislature, and judiciary). Distribution of powers between federal and provincial governments. 18th Amendment and its impact of federalism.

Unit 5. Fundamental Rights, Principles of Policy and Responsibilities

Overview of fundamental rights guaranteed to citizens by the Constitution of Pakistan 1973 (Articles 19-28). Overview of Principles of Policy (Articles 29-40). Responsibilities of the Pakistani citizen.

Unit 6 Constitutional Amendments:

Procedures for amending the Constitution. Notable constitutional amendments and their implications.

Recommended Books/Reference Material

1. Ahmed, A. S. (1997). *Jinnah, Pakistan and Islamic Identity: The Search for Saladin*. Routledge.
2. Aziz, K. K. (2002). *The Making of Pakistan: A Study of Nationalism*. Sang-e-Meel Publishers.
3. Choudhury, G. W. (1969). *Constitution-Making in Pakistan: The Dynamics of Political*. Columbia: University of British.
4. Cohen, S. P. (2004). *The Idea of Pakistan*. Washington: Brookings Institution Press.
5. Hussain, M. (2020). *The Parliament of Pakistan*. London:Oxford University press.
6. Iqbal, J. (2005). *Ideology of Pakistan*. Sang-e-Meel.
7. Jalal, A. (2014). *The Struggle for Pakistan: A Muslim Homeland and Global Politics*. Belknap Press: An Imprint of Harvard University Press.
8. Khan, H. (2020). *Constitutional and Political Development of Pakistan*. London: Oxford University Press.

9. Mahmood, S. (2003). *Pakistan: Political Roots and Development*. Sterling: University of Michigan.
10. Mujahid, S. u. (2001). *Ideology of Pakistan*. Progressive Publishers.
11. Qureshi, I. H. (1965). *The Struggle for Pakistan*. Karachi: University of Karachi Press.
12. Sayeed, K. B. (1960). *Pakistan: The Formative Phase*. London: Oxford University Press
13. Talbot, I. (2015). *Pakistan: A New History*. London: Oxford University Press.
14. *The Constitution of Pakistan 1973*. Original text. Retrieved from website: National Assembly: https://na.gov.pk/uploads/documents/1333523681_951.pdf
15. Ziring, L. (2000). *Pakistan in the Twentieth Century: A Political History*. London: Oxford University Press.

Introduction to Management

BBA- Business Administration

Course Code: MGT-104

Credit Hours: 03

Pre-requisite: Nil

Objectives

This is an introductory course about the management of organizations. It provides instructions on principles of management that have general applicability to all types of enterprises; basic management philosophy and decision making; principles involved in planning, organizing, leading, and controlling; and recent concepts in management. The principles learned in this course will allow the student to effectively work with and through others in an organization.

Learning outcomes:

By the end of this course, students will:

- Be able to enhance their expertise in managing organizations. **PLO-1**
- Be able to understand the relevance of the management principles and theories, for local settings. **PLO-2**

- Be able to comprehend knowledge on the reality regarding management. **PLO-9**

Course Outline

Unit 1. Introduction to Management

Organization, The management Process.

Unit 2. The History and Evaluation of Management

Organizational theories and different approaches to management.

Unit 3. The Organizational Culture and The Manager, Motivation Its Theories

The internal/external environment and the Manager. Current issues in Motivation.

Unit 4. Foundations and Basic Elements of Planning

Process of planning and MBO. SWOT Analysis Effective strategic planning. Strategic management process.

Unit 5. Organizational Structure, Team work and Group Behavior

Types of organizational structures. Case Decision-making. The process of Control the Control Standards. Case of Controlling, Case of team and team work.

Unit 6. Decision Making Process, Leadership and Its Characteristics

The manager's role as decision maker. Leadership styles and behaviors.

Unit 7. Managing Change & Basics of Strategic Management

Define the importance of change management and explain where it fits in the four management functions. Explain the steps managers can take to implement planned change. Explain why people resist change. Apply attitude change strategies. HRM and staffing.

Unit 8: Nature & Importance of Communication

- Recognize the part communication plays in the 4 management functions •
- Assess basic communication skills.

Recommended Books/ Reference Material

1. Gupta, M. J., Chaturvedi, S., Prasad, R., & Ananthi, N. (2022). *Principles and practice of management*. (AGPH Books).
2. Jones, G. R., & George, J. M. (2019). *Essentials of contemporary management*. McGraw-hill.
3. Robbins, S. P., DeCenzo, D., Coutler, M., & Woods, M. (2022). *Management: the essentials*. University Of Tasmania.
4. Prasad, L. M. (2020). *Principles and practice of management*. Sultan Chand & Sons.
5. Singh, C., & Khatri, A. (2024). *Principles and Practices of Management and Organizational Behavior*. Taylor & Francis.

Applied Physics

Course code: PHY-103

Credit Hours: 02

Pre-requisite: Nil

Objectives

The main objective of the course is to provide basic information about Mechanics, Electricity, Magnetism, Electromagnetism, Waves and oscillations, optics, Electronics to the technology students. The course gives the students a sound knowledge of Physics with its applications to problems of practical nature.

Learning Outcomes

- Understanding basic concepts of units, vectors, and scalars, along with measurements and uncertainties. **PLO-1**
- Application of Newton's laws of motion, work, kinetic energy, and gravitation in various scenarios. **PLO-2**

- Exploring electricity concepts, including conductors, insulators, electrostatic force, capacitors, dielectrics, and DC circuits. **PLO-3**
- Study of magnetism, covering magnetic fields, force, energy, inductors, and magnetic materials. Additionally, an introduction to semiconductors, including energy levels, hole concept, and PNP/NPN junction transistors and LEDs. **PLO-4**

Course Outline

Unit 1. Physics Fundamentals

Basic concept of units, vectors and scalars, measurements and uncertainties, Addition of vectors by graphical and component method. Multiplication of vectors, vectors in three dimensions,

Unit 2. Newton's Laws and Relativity

Newton's laws of motion and their applications, Work and Kinetic Energy, Gravitation, Circular motion, projectile motion, orbits of planets, linear and angular momenta, basic concepts of general and special theory of relativity.

Unit 3. Electricity

Conductors and Insulators, Electrostatic Force, Capacitors and Dielectrics, Capacitance, Energy store in capacitor (Capacitor as memory device), DC Circuits, Measuring V, I, R, RC Circuits.

Unit 4. Magnetism

Magnetic Fields, , Magnetic Force, Magnetic Field, Magnetic Field Energy, inductors and inductance, energy stored in inductor (inductor as memory device) magnetic materials.

Unit 5. Semiconductors

Semi-Conductors Energy levels in a semi-conductor, Hole concept, Intrinsic and Extrinsic regions, PNP, NPN junction Transistor, LEDs.

Recommended Books/Reference Material

1. Beiser A. & Hademenos G. J. (2012). *Applied physics*. McGraw Hill.
2. Giambattista A. Richardson B. M. C. & Richardson R. C. (2020). *Physics*. McGraw-Hill Education.
3. Halliday, D., Resnick, R., & Walker, J. (2021). *Fundamentals of physics*, Extended (12th ed.). Wiley.
4. Hecht E. (2021). *College physics*. McGraw Hill Education.
5. Serway, R. A., & Jewett, J. W. (2018). *Physics for scientists and engineers* (10th ed.). Cengage Learning.

Applied Physics Lab

Course code: PHY-103L

Credit Hours: 01

Pre-requisite: Nil

Objectives

The course objectives are to enable students to comprehend and apply fundamental principles of measurement, elasticity, electrical circuits, and logic gates. They should develop the ability to conduct experiments, analyze data, and manipulate instruments for various measurement and electrical applications, fostering a solid foundation in experimental physics and electronics.

Learning Outcomes

- Demonstrate a solid understanding of fundamental principles in applied physics, including mechanics, thermodynamics, and electromagnetism. **PLO-1**
- Apply mathematical and computational techniques to analyze and solve real-world problems in various branches of applied physics. **PLO-4**
- Develop in team practical skills in laboratory experiments, data acquisition, and analysis, enhancing the ability to apply theoretical concepts to hands-on situations. **PLO-6**

- Communicate effectively, both orally and in writing, about complex physics concepts, experimental results, and their applications in practical scenarios. **PLO-5**

Course Outline

1. Study and understand the working principle of Vernier caliper and Screw Gauge.
2. Study Hooke's Law using the mass-spring system, determining the stiffness (k -value) of the spring.
3. Investigate the relationship between the length of a pendulum and its period of oscillation.
4. Determine the internal resistance of a galvanometer using the half deflection method.
5. Experiment with various resistors and voltage sources to verify Ohm's law ($V = IR$) by measuring voltage, current, and resistance in a circuit.
6. Convert a galvanometer into a voltmeter.
7. Convert a galvanometer into an ammeter.
8. Study the series and parallel configurations of capacitors and resistors and verify binary truth tables using logic gates.

Recommended Books/Reference Material

1. Giambattista A. Richardson B. M. C. & Richardson R. C. (2020). *Physics*. McGraw-Hill Education.
2. Halliday, D., Resnick, R., & Walker, J. (2021). *Fundamentals of physics*, Extended (12th ed.). Wiley.
3. Hecht E. (2021). *College physics*. McGraw Hill Education.
4. Loyd, D. H. (2008). *Physics laboratory manual*. Thomson Higher Education.
5. Smith, W. F. (2020). *Experimental physics: principles and practice for the laboratory*. Taylor and Francis.
6. Wilson, J. D., & Hernández-Hall, C. A. (2014). *Physics laboratory experiments*. Cengage Learning.

Professional Practice

BS-Computer Science

Course code: CS-209

Credit Hours: 02

Pre-requisite: Nil

Objectives

Understand and appreciate the meaning of ethics, values and attitudes. Be guided in their ethical thinking and considerations as they relate in the cyber world. Be aware of the different ethical dilemma/issues in the cyber world. Appreciate and internalize the code of conduct of an I. T. Professional. Be familiar with the various Laws that penalizes cybercrimes.

Learning Outcomes

- **Understand** the Principle of Management and Industrial Relation (**C2 Understand PLO-1**).
- **Understand** of the engineer's responsibilities to the Profession (**C2 Understand PLO-2**).
- **Perform** professional codes of conduct to day-to-day situations that arise in business (**C2 Understand PLO-8**).
- **Practice** of government legislation affecting work, e.g. safety, health (**A5 Internalizing PLO-9**)
- **Develop** Soft Skills (**C6 Create PLO-10**).

Course Outline

Unit 1. Introduction

What is the Profession/Vocation, Professional, Professionalism, Self-Marketing as a Professional Life Management, Benefits and Obstacles to Life Management, How to make Successful life, Individual Grooming. Goal Setting Techniques Self-Management: Time Management, Benefits and Obstacles to Effective Time Management, 7 Habits of Highly Effective People.

Unit 2. Effective Leadership, Groups and Teams

Effective Leadership Process: What is Leadership, Roles and Activities of a Leader, Leadership Skills Groups and Teams: Groups and Teams, Benefits of Teamwork, Types of Groups? Profession Basics: What is the Profession/Vocation, Professional, Professionalism, Self-Marketing as a Professional?

Unit 3. Computing Profession

Computing Profession: What is Computing, Different Domain of Computing and their Objectives Computing Core Skills: Domain of IT in Computing: IT Core Areas and Future of IT Accreditation Bodies and Professional Societies Historical, Social and Economic context of Computing Professional Ethics ACM code of ethics and professional Code of Conduct ACM/IEEE Software Engineering code of Ethics and Professional Practices.

Unit 4. Professional Practice Concepts

Performance through Job Design: Job, Career and career path, Soft Skills Basics: Skills for Competitive Edge for this fast pace World, Interviews, Types of Interviews, Interview Techniques, Resume Writing Presentations: Powerful Presentation Techniques and Powerful Presentation Skills Meetings: Components of Effective and Productive Meetings, Organogram, Entrepreneurship and Entrepreneur. Software Industries and Software Houses.

Unit 5. Computer Misuse and Criminal Law

Computer Misuse and Criminal Law: Cyber Law, Cyber Crime, Misuse of Computing Information Security and privacy Health and Safety at Work Intellectual Property Rights, Copy Rights, Patents. Concept of Social Responsibilities.

Recommended Books/Reference Material

1. Dodig-Crnkovic, G., & Feldt, R. (2009). Professional and Ethical Issues of Software Engineering Curricula. 2010.

2. Foster, E., & Towle Jr, B. (2021). Software engineering: a methodical approach. Auerbach Publications.
3. Mann, S. (2023, December). Searching for Computing's Soul: Professional Practice and the Future of Computing Education. In Proceedings of the 16th Annual ACM India Compute Conference.

Discrete Structures

BS-Computer Science

Course code: CS-123

Credit Hours: 03

Pre-requisite: Nil

Objectives

Introduces the foundations of discrete mathematics as they apply to Computer Science, focusing on providing a solid theoretical foundation for further work. Further, this course aims to develop understanding and appreciation of the finite nature inherent in most Computer Science problems and structures through study of combinatorial reasoning, abstract algebra, iterative procedures, predicate calculus, tree and graph structures. In this course more emphasis shall be given to statistical and probabilistic formulation with respect to computing aspects.

Learning Outcomes

- **Apply** the rules of Discrete Mathematics to Computer Science (**C3 Apply PLO-4**).
- **Understand** various strategies for composing mathematical proofs (**C2 Understand PLO-2**).
- **Analyze** various strategies for composing mathematical proofs (**C4 Analyze PLO-3**).

Course Outline

Unit1. Introduction

Sets, Methods to represent them, Set Operations, Functions, Domain and Range, One to One, Onto and Bijective Functions, Relations, Inverse and Composition of functions. Some important Functions, Sequences, Summations.

Unit2. Logics

Introduction to Logics, Propositions and Predicates, Logical Operators, Propositional Equivalences, Predicates and Quantifiers, Rules of Inference, Methods of proofs.

Unit3. Algorithms & Number Theory

Algorithms, Searching Algorithms and Sorting Algorithms, Number Theory, Direct Proofs, proofs by contradiction, Mathematical Reasoning: Proof Strategy, Sequences and Summations

Unit 4. Graphs & Trees

Graphs, Graph Terminologies and some special types of graphs, Representing Graphs, Connectivity of Graphs, Applications of Trees, Tree Traversal, Spanning Trees, Minimum Spanning Trees.

Unit 5. Relations

Relations, Mathematical Induction and recursion Problems, Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations.

Recommended Books/Reference Material

1. Kenneth, O. (2019). Elements of modern mathematics. Dover Publications.
2. O'Regan, G. (2021). Guide to discrete mathematics. Springer International Publishing.
3. West, D. B. (2021). Combinatorial mathematics. Cambridge University Press.

Islamic Studies

Course Code: ISL-101

Credit Hours: 02

Pre-Requisites: Nill

Objectives

Students will be able to demonstrate enhanced knowledge of Islamic Fundamentals, beliefs, practices, historical development, spiritual values and Ethical Principles. Describe Basic sources of Islamic Law and their application in daily life. Also, Identify and discuss contemporary issues being faced by the Muslim world Including Social Challenges, Gender Role and Interfaith dialogue.

Learning Outcomes

- Evaluate and discuss their understanding about the beliefs, history and Ethical values of Islam. **PLO-10**
- Be able to apply and relate the Articles of faith in their life according to present world. **PLO-9**
- Be able to analyze the importance of Quran and Sunnah in their life and also to refute many relating misconceptions **PLO-2**
- Engage in Discussions and write about Contemporary issues specifically related to Women. **PLO-7**

Course Outline:

Unit 1. Introduction to Islam

Definition of Islam and its core Beliefs (Tawheed, Akhirat and Risalat), Pillars of Islam and their significance (Tawheed, Prayers, Fasting, Zakat & Hajj), The Holy Quran (Introduction, Revelation & Compilation), Sunnah & Hadith (Introduction, Revelation & Compilation)

Unit 2. Seerah of the Holy Prophet pbuh

Life of Prophet pbuh in Makkah, Life of Holy Prophet pbuh in Medina, Diverse roles of Holy Prophet pbuh (individual, leader, peacemaker, educator etc)

Unit 3. Islamic History and Civilization

World before Islam, The Rashidun Caliphate and its expansion, Contributions of Muslim Scientists and Philosophers.

Unit 4. Islamic Jurisprudence

Fundamental sources of Islamic Jurisprudence, Major Schools of Islamic Jurisprudence, Significance & principle of Ijtihaad

Unit 5. Family & Society in Islam

Status and Rights of Women in Islam, Marriage, Family & Gender roles in Muslim Society, Family values and Structure in Muslim Society

Unit 6. Islam & Modern world

Relevance of Islam in Modern World. (Islamophobia, Interfaith dialogue & Multiculturalism), Islamic viewpoint towards socio-cultural and technological changes.

Recommended Books/Reference Material

1. Ahmed, Dr. A. (1996). *Women & Social Justice: An Islamic Paradigm*, The Islamic Foundation UK
2. Ahmed, K. (1971) *Islami Nazria e Hayat*, Karachi University press.
3. Ahmed, K. (1980). *Islam, Its meaning & message*, The Islamic Foundation UK.
4. Al-Mubarikpuri, M. S. (2002), *Al Raheeq ul Makhtoom (The Sealed Nector)*, Dar ul Salam.
5. Al-Suhaym, Dr. M.B., A. (2006) *Islam, Its foundation & concepts*, Darussalam
6. An Introduction to Islamic Theology by John Renard.
7. Bokhari, A.S, Zafar, M.D., Prof. Shakir, A.S. (2021). *A textbook of Islamic Education*, Akram Printing Press, Lahore.
8. Hussain, M. *The Five Pillars of Islam: A Framework for Islamic Values and Character building*, Kube Publishing, The Islamic Foundation UK
9. Maududi, Abul A. (2008). *Islamic Civilization Foundations, Beliefs & Principles*, Kube Publishing, Islamic Foundation UK
10. Maududi, Abul. A. (2007). *Towards understanding Islam*, The Islamic foundation UK
11. Phillip, Dr. A. A., B. (2018) *Islamic Studies*, International Islamic Publishing House.
12. Prof. Dr. Chaudary, M.N., Prof. Malik, M.A (2022). *Tafheem e Islamiyat*, Qureshi Brothers Publishers, Lahore.

Ethics (in lieu of Islamic Studies)

Course Code: ETH-101

Course Title: Ethics

Credit Hours: 2

Pre-Requisite: Nil

Objectives:

Upon successful completion of the course, students will be able to know the basics of Ethics & Morality and develop Ethical approach, Identify the concept of Ethics in Different Religions & Relate the ethical values with their lives business ethics, journalism ethics etc.

Learning Outcomes:

- Students will be able to demonstrate their understanding about the meaning of Ethics and Morality.
- Analyze the Similarities and Differences between ethical teachings of various religions.
- Develop sense of belongingness to the ethical values as a student, being member of the society etc

Course Outline:

Unit 1: Meaning and Scope of Ethics

Meaning and Definition of Ethics and Morality, Difference between Ethics and Morality, Relation of Ethics with: Religion, Science, Law.

Unit 2: Historical development of Morality

Instinctive Moral Life, Customary Morality, Reflective Morality.

Unit 3: Moral Theories, Moral Ethics and Society

Hedonism (Mill), Intuitionism (Butler), Kant's Moral Theory, Freedom and Responsibility, Tolerance, Justice, Punishment.

Unit 4: Moral Teaching of Major Religions

Judaism, Christianity, Islam, Islam and Minorities.

Unit 5: Professional Ethics

Medical Ethics, Ethics of Student, Ethics of Teacher, Business Ethics.

Recommended Books/ Reference Material:

1. R. Shafer-Landau. (2020). *The Fundamentals of Ethics*, 5th Edition.
2. S. Blackburn. (2021). *Ethics: A Very Short Introduction (Very Short Introductions)* 2nd Edition.
3. S. Liautaud, L. Sweetingham. (2022). *The Power of Ethics: How to Make Good Choices in a Complicated World*.
4. S. M. Cahn, P. Markie. (2019). *Ethics: History, Theory, and Contemporary Issues*, 7th Edition.

Civic and Community Engagement

Course Code: CCE-497

Credit Hours: 02

Pre-requisite: Nil

Objectives

This course is designed to provide students with fundamental knowledge about civics, citizenship and community engagement. In this course the students will learn about the essential of civil society, government, civic responsibilities, inclusivity and effective ways to participate in shaping the society which will help them apply the theoretical knowledge to the real-world situation to make a positive impact on their communities.

Learning Outcomes

By the end of this course, student will be able to:

- Demonstrate fundamental understanding of civics, government, citizenship and civil society. **PLO-9**
- Understand the concept of community and recognize the significance of community engagement for individuals and groups. **PLO-6**

- Recognize the importance of diversity and inclusivity for societal harmony and peaceful co-existence. **PLO-8**

Course Outline

Unit 1. Civics and Citizenship

Concepts of civics, citizenship, and civic engagement. Foundations of modern society and citizenship. Types of citizenship: active, participatory, digital etc.

Unit 2. State, Government and Civil Society

Structure and function of government in Pakistan. The relationship between democracy and civil society. Right to vote and importance of political participation and representation.

Unit 3. Rights and Responsibilities

Overview of fundamental rights and liberties of citizens under constitution of Pakistan 1973. Civic responsibilities and duties. Ethical consideration in civic engagement (accountability, non-violence, peaceful dialogue, civility etc.).

Unit 4. Community Engagement

Concept, nature and characteristics of community. Community development and social cohesion. Approaches to effective community engagement. Case studies of successful community driven initiatives.

Unit 5. Advocacy and Activism

Public discourse and public opinion. Role of advocacy in addressing social issues. Social action movements.

Unit 6. Digital Citizenship and Technology

The use of digital platform for civic engagement. Cyber ethics and responsible use of social media. Digital divides and disparities (access, usage, socio-economic, geographic etc.) and their impact on citizenship.

Unit 7. Diversity, Inclusion and Social Justice

Understanding diversity in society (ethnic, cultural, economic, political etc.). Youth, women and minorities engagement in social development. Addressing social inequalities and injustices in Pakistan. Promoting inclusive citizenship and equal rights for social harmony and peaceful co-existence.

Suggested Practical Activities (Optional)

Apart of the overall learning requirements, the course may have one or a combination of the following practical activities

1. **Community Storytelling:** Students can collect and share stories from community members. This could be done through oral histories, interviews or multimedia presentations that captured the lived experiences and perspectives of diverse individuals.
2. **Community Event Planning:** Student can organize a community event or workshop that addresses a specific issue or foster community interaction. This could be a health fair, environmental cleanup, cultural festival or educational workshop
3. **Service Learning:** Student can collaborate with a local nonprofit organization or community group. They can actively contribute by volunteering their time, and skills to address a particular community need, such as tutoring, mentoring or supporting vulnerable population.
4. **Cultural Exchange Activities:** Student can organize a cultural exchange event that celebrates the diversity within the community. This could include food tastings, performances and presentations that promote cross cultural understanding.

Recommended Books/Reference Material

1. Džankić, J., & VINK, M. P. (2022). Citizenship & migration.
2. Kymlicka, W. and Norman, W. (2010). *Citizenship in Diverse Societies*. University Press, United Kingdom.
3. Mackert, J., & Turner, B. S. (2017). The Transformation of Citizenship, Volume 2. Boundaries of Inclusion and Exclusion.
4. Mattson, K. (2017). *Digital Citizenship in Action: Empowering Students to Engage in Online Communities*. : International Society for Technology in Education, United Kingdom.
5. McGraw-Hill Education, (2009). *Civics Today: Citizenship, Economics, & You*, Student Edition. United States.

6. Weinstock, D. (2017). Citizenship and Cultural Diversity. The Oxford Handbook of Citizenship.
7. Youniss, J. and Levine, J. (2009). *Engaging Young People in Civic Life*. Vanderbilt University Press, Ukraine.

Entrepreneurship

General Education

Course Code: MGT-108

Credit Hours: 02

Pre-requisite: Nil

Description

This course is designed to promote entrepreneurial spirit and outlook among students, encouraging them to think critically, identify opportunities, and transform their ideas into successful ventures. It aims at imparting them with the requisite knowledge, skills, abilities, enabling them to seize the identified opportunities for initiating ventures and successfully navigating the challenges that come with starting a business and managing it. The course covers topics relevant to entrepreneurship including setting up and initiation of business, market research, opportunity identification, business planning, financial literacy for managing finances and securing funding, marketing and sales, team building and innovation.

Learning Outcomes

By the end of this course, students shall have:

- Knowledge of fundamental entrepreneurial concepts, skills and process.
- Understanding on different personal, social and financial aspects associated with entrepreneurial activities.
- Basic understanding of regulatory requirements to set up an enterprise in Pakistan, with special emphasis on export businesses;
- Ability to apply knowledge, skills and competencies acquired in the course to develop a feasible business plan.

Course Outline

Unit 1. Introduction to Entrepreneurship:

Definition and concept of entrepreneurship. Why to become an entrepreneur? Entrepreneurial process. Role of entrepreneurship in economic development.

Unit 2. Entrepreneurial Skills:

Characteristics and qualities of successful entrepreneurs (including stories of successes and failures). Areas of essential entrepreneurial skill and ability such as creative and critical thinking, innovation and risk taking abilities etc.

Unit 3. Opportunity Recognition and Idea Generation:

Opportunity identification, evaluation and exploitation. Innovative idea generation techniques for entrepreneurial ventures.

Unit 4. Marketing and Sales

Target market identification and segmentation. Four P's of Marketing. Developing a marketing strategy. Branding.

Unit 5. Financial Literacy:

Basic concepts of income, savings and investments. Basic concepts of assets, liabilities and equity. Basic concepts of revenue and expenses. Overview of cash-flows. Overview of banking products including Islamic modes of financing. Sources of funding for startups (angel financing, debt financing, equity financing etc.).

Unit 6. Team Building for Startups:

Characteristics and features of effective teams. Team building and effective leadership for startups.

Unit 7. Regulatory Requirements to Establish Enterprises in Pakistan:

Types of enterprises (e.g., sole proprietorship; partnership: private limited companies etc.). Intellectual property rights and protection. Regulatory requirements to register an enterprise in Pakistan, with special emphasis on export firms. Taxation and financial reporting obligation.

Suggested Practical Activities (Optional)

As part of the overall learning requirements, students shall be tasked with creating and presenting a comprehensive business plan at the end of the course for a hypothetical or real business idea. This practical exercise shall allow them to apply the knowledge, skills and competencies acquired in the course to develop a feasible business plan.

Recommended Books/ Reference Material

1. "Entrepreneurship: Successfully Launching New Ventures" by Bruce R. Barringer and R. Duane Ireland.

2. "Entrepreneurship: Theory, Process, and Practice" by Donald F. Kuratko.
3. "New Venture Creation: Entrepreneurship for the 21st Century" by Jeffry A. Timmons, Stephen Spinelli Jr., and Rob Adams.
4. "Entrepreneurship: A Real-World Approach" by Rhonda Abrams.
5. "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" by Eric Ries.
6. "Effectual Entrepreneurship" by Stuart Read, Saras Sarasvathy, Nick Dew, Robert Wiltbank, and Anne-Valérie Ohlsson.

PAKISTAN STUDIES

Course Code: PAK-104

Credit Hours: 02

Pre-requisite: Nil

Objectives

This course is designed to provide students with a comprehensive exploration of Pakistan's identity, spanning geographical, historical, and cultural dimensions. It delves into the diverse landscapes, ancient civilizations, and rich cultural heritage that define Pakistan. Moreover, it examines the socio-cultural and political transformations in Pakistan over time including democratic transitions and military interventions. The aim of this course is to inculcate in students a nuanced understanding of Pakistan's past, present, and potential future trajectories, enabling them to critically evaluate the complex dynamics shaping the nation's development.

Learning Outcomes

After studying this course, the student will be able to:

- Have enhanced knowledge of the geographical, historical, and political aspects of Pakistan.**PLO-1**
- Understand the society and culture of Pakistan.**PLO-2**
- Understand and explain the socio-economic developments in Pakistan.**PLO-8**
- Explore contemporary issues and challenges faced by Pakistan and their implications for the future. **PLO-10**

Course Outline

Unit 1. Introduction to Pakistan

Geographical location and significance. Historical background: Ancient civilizations in the region. Factors leading to the creation of Pakistan.

Unit 2 Political History of Pakistan

Formative phase. Military interventions and democratic transitions.

Unit 3. Geography of Pakistan

Physiography: Mountains, plains, plateaus, deserts, valleys and coastal areas. River systems: Indus River and its tributaries. Climatic regions of Pakistan.

Unit 4. Society and Culture of Pakistan

Socio-cultural diversity. Languages and literature of Pakistan

Unit 5. Economic Development of Pakistan

Agriculture and industrial sectors of Pakistan. Economic challenges of Pakistan.

Unit 6. Contemporary Issues

Foreign relations of Pakistan. Security challenges: terrorism, extremism, and regional conflicts. Environmental problems and sustainable development (SDGs). Media and social change.

Recommended Books/ Reference Material

1. "Jinnah of Pakistan" by Stanley Wolpert
2. "The Sole Spokesman: Jinnah, the Muslim League, and the Demand for Pakistan" by Ayesha Jalal
3. "The struggle for Pakistan" by Ishtiaq Husain Qureshi
4. "Pakistan, the Formative Phase, 1857-1948" by Khalid B. Sayeed

5. "Pakistan Studies: A Book of Readings" by Sikandar Hayat
6. "Constitutional and Political History of Pakistan" by Hamid Khan
7. "Trek to Pakistan" by Ahmad Saeed and Kh. Mansur Sarwar
8. "Pakistan: A Modern History" by Ian Talbot
9. "Politics in Pakistan: The Nature and Direction of Change" by Khalid B. Sayeed
10. "Physical Geography of Pakistan" by Umar Jahangir
11. "A Geography of Pakistan: Environment, People, and Economy" by Fazle Karim Khan
12. "Pakistan's Foreign Policy: An Historical Analysis" by S. M. Burke
13. "Separatism in East Pakistan" by Rizwan Ullah Kokab
14. "Being Pakistani: Society, Culture and the Arts" by Raza Rumi
15. "Pakistan's Cultural Heritage: Socio-Economic and Technological Aspects" edited by Abdul Jabbar Khan
16. "Language and Politics in Pakistan" by Tariq Rahman
17. "Sociology" by Horton and Hunt
18. "Pakistan in the Twentieth Century: A Political History" by Lawrence Ziring
19. "Economic Development of Pakistan" by Ishrat Husain
20. "Issues in Pakistan's Economy" by S. Zaidi

27.List of Mandatory Courses of IT

Sr#	Course Code	Course Title	Pre-Requisite	Credit Hours
1	UHQ-101 / ETH-103	Understanding of Holy Quran- I/ Ethics-I	Nil	1 (1-0)
2	UHQ-102 / ETH-104	Understanding of Holy Quran- II/ Ethics-II	Nil	1 (1-0)
3	INT-499	Internship	Nil	3

28.Course Outlines for Mandatory Courses of IT

Understanding of Quran/ Fehm e Quran

Course Title: Understanding of Quran - I

Course Code: UHQ-101

Credit Hours: 1

Contact Hours: 3 per week

Weeks: 15-16 (45-48 hours)

Pre-Requisites: Nill

Course Objectives:

This course will enable the students to understand the Holy Quran by learning Arabic in a simple and easy way. Through relating their basic Urdu vocabulary with Quran, and without engaging them in complex Arabic Grammer, Sarf or Balagha. Students will gradually build the skills to read and understand Quranic verses directly—without needing translation. The course focuses on making Arabic accessible for everyone, even those with no prior background.

Learning Outcomes:

This course will enable the students to:

1. Develop the ability to understand basic words of the Quran, phrases and sentences that do not contain verbs (unit 1 to 5 of Muallim ul Quran Book) and then sentences having present tense (first half of unit 6 of Muallim ul Quran Book). **PLO-1**
2. Acquire a strong foundation for understanding long verses of the Quran with clarity. **PLO-2**
3. Comprehend Quranic vocabulary, particles (operative & non operative particles), compounds (Adjective & Possessive compound), pronouns (singular & plural) and types of plurals through hundreds of Quranic sentences. **PLO-7**
4. Recognize and understand different styles of Quranic sentences, including nominal sentence, emphatic sentence, double emphatic sentence, negative sentence, interrogative sentence, oath –based sentences. **PLO-9**
5. Strengthen understanding of fundamental Quranic linguistic styles, expressions and

idioms. **PLO-10**

6. Understand at least 30 to 40 % of each page of the Holy Quran. **PLO-8**

Course Outline:

Unit 1: Simple Quranic Words

Muallim ul Quran: Book 1: Unit: Lesson 1-19

Unit 2: Words that comes before (The simple Quranic words)

Muallim ul Quran: Book 1: Unit#2: Lesson 1-13

Unit 3: Quranic words in terms of their relationship and characteristics

Muallim ul Quran: Book 1: Unit#3: Lesson 1-10

Unit 4: Singular Pronouns

Muallim ul Quran: Book 2: Unit#4: Lesson 1-17

Unit 5: Singular pronouns & Demonstrative Pronouns

Muallim ul Quran: Book 2: Unit#5: Lesson 1-23

Unit 6: Present Tense

Muallim ul Quran: Book 3: Unit#6: Lesson 1-5

Reference Books:

1- بشير، دكتور. عبید الرحمن - معلم القرآن - اسلام آباد: دار العلم، ۲۰۲۴. جلد ۱، ۲ & ۳

Ethics (in lieu of Understanding of Quran)

Course Title: Ethics-I

Course Code: ETH-103

Credit hours: 1

Contact Hours: 3 per week

Weeks: 15-16 (45-48 hours)

Pre-Requisites: Nil

Objectives

Upon successful completion of the course, students will be able to know the basics of ethics, & know how to develop an ethical approach. Also, analyze the importance of ethics and ethical values for a human being. And identify the Semitic & Non-Semitic Religions. Moreover, develop the concept of ethics in Semitic & Non-Semitic religions. Also, analyze the similarities and differences between ethical teachings of various religions.

Learning Outcomes:

- Students will be able to demonstrate their understanding about the concept of ethics & ethical approach.
- Analyze the difference between the concept of ethics in Semitic and Non-Semitic religions.

Course Outline:

Unit 1: Introduction and Importance of Ethics & Basic Ethical Principles

Definition of Ethics, Importance of Ethics, Beneficence, Non-maleficence, Autonomy, Justice as basic ethical behaviors.

Unit 2: Theories of Moral Standards

Moral Standards as Law, Moral Standards as Pleasure, Moral standards as Perfection. (Theories of various philosophers such as Kant, Spencer, John S. Mackenzie etc)

Unit 3: The concept of Ethics in Major Religions- Christianity, Judaism

Introduction of the Religion, Its Basic Concepts and major ethical teachings.

Unit 4: The concept of Ethics in Major Religions- Hinduism & Buddhism

Introduction of the Religion, Its Basic Concepts and major ethical teachings.

Unit 5: The concept of Ethics in Major Religions- Islam

Introduction of the Religion, Its Basic Concepts and major ethical teachings.

References/Recommended Books:

Books

1. Davis, N.K. (2023). *Elements of Ethics*, Legare Street Press.
2. Edmonds,D. (2019). *Ethics and the Contemporary World*, Taylor & Francis,
3. Hastings, J. Alexander, J. Gray S.L. (2023). *The Encyclopedia of Religion and Ethics*, Creative Media Partners, LLC
4. Robinson, D.Garratt C. (2008). *Introducing Ethics-a Graphic Guide*, Icon Books ltd.Uk.
5. اخلاق اور فلسفہ اخلاق، سیوہاروی، حفظ الرحمن، ندوۃ المصنفین، دہلی، ۱۹۷۶
6. دنیا کے بڑے مذاہب، فاروقی، عماد الحسن، مکتبہ جامعہ لمیٹڈ، دہلی، ۱۹۸۶

Websites & Articles

1. Articles on Ethics www.infotrak-college.com
2. Brown. (2017). The ethical dimensions of Global Environmental Issues. American Academy of Arts and Sciences. Retrieved July 7 ,2017 from amacad.org
3. Business Ethics Magazine www.business-ethics.com/annual.htm
4. Bussmann, J. (2016). Top 9 ethical Issues in artificial intelligence. Retrieved 7 July2017 from world Economic Forum weforum.org
5. Ethics and Religion, Shefali Narange <http://www.paperpublications.org/>
6. <http://www.jstor.com/stable/resrep12025.7>
7. <http://www.learnwell.org/ethicalproblems.htm>
8. Institute for Global Ethics www.globalethics.org
9. Klimes, Rudolf e. (2000). Ethical Problems.
10. Ten Ethical Problems of the Present World <https://www.lifepersona.com/10-ethical-problems-of-the-present-world>
11. Ward, Stephen J.A (March 2005). “Philosophical Foundations for Global Journalism Ethics” Journal of Mass Media Ethics:20(1)

Understanding of Quran/ Fehm e Quran

Course Title: Understanding of Quran - II

Course Code: UHQ-102

Credit Hours: 1

Contact Hours: 3 per week

Weeks: 15-16 (45-48 hours)

Pre-Requisites: Nill

Course Objectives:

This course will enable the students to understand the Holy Quran by learning Arabic in a simple and easy way. Through relating their basic Urdu vocabulary with Quran, and without engaging them in complex Arabic Grammar, Sarf or Balagha. Students will gradually build the skills to read and understand Quranic verses directly—without needing translation. The course focuses on making Arabic accessible for everyone, even those with no prior background.

Learning Outcomes:

This course will enable the students to:

1. Directly comprehend hundreds of Quranic sentences & verses. **PLO-1**
2. Understand at least 80 to 85 % of each page of the holy Quran. **PLO-2**
3. Understand common verses across different Quranic topics. **PLO-3**
4. Achieve proficiency in the basic and advance linguistic aspects of the Arabic language. **PLO-7**
5. Understand the difference between Quranic verbs in various forms, such as present, past and imperative. **PLO-9**
6. Develop the ability to understand long verses of the holy Quran independently and then comprehend their interpretation. **PLO-10**

Course Outline:

Unit 1: Past Tense

Muallim ul Quran: Book 4: Unit#7: Chapter 1: Lesson 1-9

Unit 2: Past Tense

Muallim ul Quran: Book 4: Unit#7: Chapter 2: Lesson 1-7

Unit 3: Past Tense

Muallim ul Quran: Book 4: Unit#7: Chapter 3: Lesson 1-9

Unit 4: Past Tense

Muallim ul Quran: Book 5: Unit#7: Chapter 4: Lesson 1-5

Unit 5: Past Tense & Passive Voice

Muallim ul Quran: Book 5: Unit#7: Chapter 5 - 9

Unit 6: imperative Verbs for Singulars

Muallim ul Quran: Book 6: Unit#8: Lesson 1-8

Reference Books:

1- بشير، دكتور. عبيد الرحمن - معلم القرآن - اسلام آباد: دار العلم، ٢٠٢٤. جلد ٣، ٤، ٥، ٦

Ethics (in lieu of Understanding of Quran)

Course Title: Ethics-II

Course Code: ETH-104

Credit hours: 1

Contact Hours: 3 per week

Weeks: 15-16 (45-48 hours)

Pre-Requisites: Nill

Objectives

Upon successful completion of the course, students will be able to have better understanding of ethics in various walks of life like in workplace, in business, journalism etc. Moreover, they will be able to be familiarize with Contemporary World's Ethical Issues. And, try to develop answers about them.

Learning Outcomes:

- Students will be able to demonstrate their understanding about the importance of ethics in their lives today.
- Identify Contemporary World's Ethical Issues.
- Create problem solving for these contemporary Ethical issues.

Course Outline:

Unit 1: Professional Ethics & Bioethics

Meaning of Work/Professional Ethics, Professional Ethics and Human Values,
Elements of professional Ethics:

Person attitude, Beliefs about work, Positive Attributes (honesty, integrity,
dedication, commitment, responsibility, interpersonal relationship)

Genetic engineering, Organ Donation, Cloning, Head Transplant

Unit 2: Ethical Conduct in Business Ethics & it's important

Types of Business Ethics, Common Business Ethical Challenges

Conflict of interest, honesty& integrity, whistle blowing, loyalty vs truth

Unit 3: Journalism

Principles of Ethical Journalism:

Truth & Accuracy, Independence, Fairness & Impartiality, Humanity, Public
Accountability

Unit 4: Environmental Ethics

Core Principles of environmental ethics:

Justice & sustainability, Sufficiency & compassion, Solidarity &public
participation, Pollution prevention.

Current issues of environmental ethics:

Pollution, The depletion of natural resources, Loss of biodiversity, Destruction of ecosystem, Global climate change

Unit 5: Social Inequalities

Meaning of Social Inequalities, Issues related to social inequality

Difference in source of income, Health care, Freedom of speech, Gender inequality, Toxic workplace culture, Education, Political representation & participation

Unit 6: Social Media Ethics

Facebook, YouTube, WhatsApp, Instagram, TikTok, Snapchat, LinkedIn, X

Current Ethical issues in social media:

Plagiarism, Fake news, Harassment, Photo ethics, Post without caution, inappropriate behavior privacy

References/Recommended Books:

Books

1. Davis, N.K. (2023). *Elements of Ethics*, Legare Street Press.
2. Edmonds, D. (2019). *Ethics and the Contemporary World*, Taylor & Francis,
3. Hastings, J. Alexander, J. Gray S.L. (2023). *The Encyclopedia of Religion and Ethics*, Creative Media Partners, LLC
4. Robinson, D. Garratt C. (2008). *Introducing Ethics-a Graphic Guide*, Icon Books Ltd.Uk.
5. اخلاق اور فلسفہ اخلاق، سیوہاروی، حفظ الرحمن، ندوة المصنفین، دہلی، ۱۹۷۶
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Websites & Articles

1. Articles on Ethics www.infotracs-college.com

2. Brown. (2017). The ethical dimensions of Global Environmental Issues. American Academy of Arts and Sciences. Retrieved July 7 ,2017 from amacad.org
3. Business Ethics Magazine www.business-ethics.com/annual.htm
4. Bussmann, J. (2016). Top 9 ethical Issues in artificial intelligence. Retrieved 7 July2017 from world Economic Forum weforum.org
5. Ethics and Religion, Shefali Narange <http://www.paperpublications.org/>
6. <http://www.jstor.com/stable/resrep12025.7>
7. <http://www.learnwell.org/ethicalproblems.htm>
8. Institute for Global Ethics www.globalethics.org
9. Klimes, Rudolf e. (2000). Ethical Problems.
10. Ten Ethical Problems of the Present World <https://www.lifepersona.com/10-ethical-problems-of-the-present-world>
11. Ward, Stephen J.A (March 2005). “Philosophical Foundations for Global Journalism Ethics” Journal of Mass Media Ethics:20(1)