Outcome Based Education (OBE) Curriculum

PROGRAM NAME
BACHELOR OF COMPUTER SCIENCE AND ENGINEERING
Department of Computer Science and Engineering
FACULTY OF SCIENCE AND ENGINEERING

University of Information Technology & Sciences (UITS)

Session

2023-2024, 2024-2025, 2025-2026, 2026-2027

Outcome-Based Curriculum
(Revised in March–2024)

University of Information Technology & Sciences (UITS)
Holding 190, Road 5, Baridhara J-Block, Gulshan-2, Dhaka-1212

PART A

1. Title of the Academic Program

Bachelor of Science in Computer Science and Engineering (B. Sc. in CSE)

2. Name of the University

University of Information Technology and Sciences (UITS), Dhaka

3. Vision of UITS

To be one of the most impeccable universities, where the graduates can blend theory and practice together.

4. Mission of UITS

The University of Information Technology & Sciences will endeavor

- To provide a comprehensive education by fully developing the intellectual and personal strengths of its students while allowing knowledge to become more accessible to the larger community.
- To explore higher education services in an experiential learning environment, critical thinking, creativity, innovation, scholarly endeavors, and the enhancement of comprehensive knowledge.
- To impart a flexible and supportive intellectual environment that retains and nurtures scholars, students, and staff of the highest caliber. This environment helps enhance learning and freedom of thought, inquiry, and expression.
- To generate and disseminate knowledge to strengthen our society and the environment.
- To support student affiliation and student development with local and international organizations for Project and Research collaboration through the research center.
- To create new future values by taking on challenging and innovative research.

5. Name of the Program Offering Entity

Department of Computer Science and Engineering (CSE)

6. Vision of the Department

To scaffold the next generation of engineers and scientists in a student-centered learning environment to reach digital fluency in Computer Science & Engineering. The challenge is to make the students competent and skilled leaders in the wake of the ever-changing and challenging global work environment of the 21st century.

7. Mission of the Department

- To provide outstanding education, training and research to the students with a view to making them good human beings as well.
- To build skilled engineers who can efficiently serve the society and nation as a whole.
- To enhance research activities to global level and also maintain industrial collaboration.

8. Objectives of the Department

- To produce capable graduates for the ICT sector in order to materialize the dream of digital Bangladesh.
- To promote multidisciplinary research among the faculty members and students.
- To enhance industry academia collaborations.
- To ensure accreditation of the programs under the department.
- To promote scholarly activities and ranking of the department.

9. Name of the Degree

Bachelor of Science in Computer Science and Engineering (B. Sc. in CSE)

10. Description of the Program

The Department of CSE offers a program of B. Sc. in Computer Science and Engineering. It is a 144 credit-hour program requiring about four years to complete. Out of these 144 credits, there are 92 credits of core courses, 10 credits of general education and 23 credits of basic science and mathematics courses. Computer Science and Engineering is among the primary functions of the University. University undertakes research programmers sponsored by UITS and other outside organizations, e.g., University Grants Commission (UGC), BASIS. The expertise of the University teachers and the laboratory facilities of the University are also utilized to solve problems of and to provide up-to-date engineering and technological knowledge to the various organizations of the country. The University is persistent in its effort to improve its research facilities, staff position and courses, and curricula to meet the growing technological challenges confronting the nation.

11. Graduate Attributes

Graduate attributes referred to in this curriculum are described in terms of i) knowledge profile, ii) Range of Complex Engineering Problem Solving, iii) Range of Complex Engineering Activities. These graduate attributes are specified in Table 1, Table 2 and Table 3 below.

Table 1: Knowledge Profile

	Attributes
K1	A systematic, theory-based understanding of the natural sciences applicable to the discipline.
K2	Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline.
K3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
K4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline: much is at the forefront of the discipline.
K5	Knowledge that supports engineering design in a practice area.

K6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
K7	Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer's professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability.
K8	Engagement with selected knowledge in the research literature of the discipline.

Table 2: Range of Complex Engineering Problem Solving

Attribute	Complex Engineering Problems have characteristic P1 and some or all of P2 to P7
Depth of knowledge required	**P1:** Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical Approach
Range of conflicting requirements	**P2:** Involve wide-ranging or conflicting technical, engineering and other issues
Depth of analysis required	**P3:** Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
Familiarity of issues	**P4:** Involve infrequently encountered issues
Extent of applicable codes	**P5:** Are outside problems encompassed by standards and codes of practice for professional engineering
Extent of stakeholder involvement and conflicting requirements	**P6**: Involve diverse groups of stakeholders with widely varying needs
Interdependence	**P7**: Are high level problems including many component parts or sub-problems

Table 3: Range of Complex Engineering Activities

Attribute	**Complex activities** mean (engineering) activities or projects that have some or all of the following characteristics:
Range of resources	**A1**: Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies)
Level of interaction	**A2**: Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues
Innovation	**A3**: Involve creative use of engineering principles and research-based knowledge in novel ways
Consequences for society and the environment	**A4**: Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation
Familiarity	**A5**: Can extend beyond previous experiences by applying principles-based approaches

12. Program Educational Objectives (PEOs)

Within 3 to 5 years after graduation, the graduates of the program are expected to:

PEO1: Establish themselves as competent professionals/entrepreneurs in the field of Computer Science and Engineering and engage themselves in learning and solving challenging problems in this evolving computational field.

PEO2: Continue to learn and apply multidisciplinary approaches to solving complex engineering problems and participate in multidisciplinary research and innovation.

PEO3: Engage themselves in a self-learning manner which will make them independent at the time of learning and helps to enhance their professional/entrepreneurial careers.

PEO4: Contribute substantially to the society in sustainable upliftment of quality of life through the application of professional/entrepreneurial skills and expertise in a manner that conforms to the ethical and sustainability standards.

13. Program Learning Outcomes (PLOs)

PLO1. Engineering knowledge: Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in K1 to K4 respectively to the solution of complex engineering problems.

PLO2. Problem analysis: Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (K1 to K4)

PLO3. Design/development of solutions: Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (K5)

PLO4. Investigation: Conduct investigations of complex problems using research-based knowledge (K8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

PLO5. Modern tool usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering problems, with an understanding of the limitations. (K6)

PLO6. The engineer and society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems. (K7)

PLO7. Environment and sustainability: Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex engineering problems in societal and environmental contexts. (K7)

PLO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (K7)

PLO9. Individual work and teamwork: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

PLO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PLO11. Project management and finance: Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PLO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

14. Mapping mission of the university with PEOs

PEOs	Mission 1	Mission 2	Mission 3	Mission 4	Mission 5	Mission 6
PEO1	√	√				
PEO2					√	√
PEO3			√			
PEO4				√		

15. Mapping PLOs with the PEOs

PLOs	PEO1	PEO2	PEO3	PEO4
PLO 1	3	3	2	1
PLO 2	3	3	2	1
PLO 3	3	3	2	1
PLO 4	3	2	2	1
PLO 5	2	1	1	1
PLO 6	1	1	2	3
PLO 7	1	1	2	3
PLO 8	1	1	1	3
PLO 9	2	3	1	3
PLO 10	2	3	2	2
PLO 11	1	3	2	3
PLO 12	1	1	3	3

3- Strong Correlation, 2- Medium Correlation, 1 -Low Correlation

16. Mapping courses with the PLOs

Course Code	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
GED0311313	√	√										
GED0413321	√	√	√	√	√	√	√	√				
GED0421323	√	√	√	√				√				
GED0223421	√	√						√		√		
MATH054111111	√	√	√									
MATH054112121	√	√	√									

MATH0541211	√	√	√									
MATH0542213		√	√	√								
MATH0541221	√	√	√									
PHY0533121	√	√		√	√							
PHY0533122	√	√		√	√							
CHEM0531175	√											
ME0715122	√	√			√							
CSE0613111		√			√							
CSE0613112	√		√		√							
CSE0613121	√	√	√									
CSE0613122	√		√									
CSE0541123	√	√	√									
CSE0613211	√	√	√	√								
CSE0613212	√		√									
CSE0613214			√	√	√							
CSE0611215	√	√	√									
CSE0611216	√	√	√							√		
CSE0613221	√	√	√									
CSE0613222	√		√									
CSE0612223	√	√		√						√		
CSE0612215	√	√	√									
CSE0612216	√	√	√									
CSE0541227	√	√	√	√								
CSE0613311	√	√	√	√								
CSE0613312		√	√		√							
CSE0612313	√	√	√							√		

CSE0612314	√	√	√									
CSE0613225	√	√	√	√		√						
CSE0613226			√		√				√			
CSE0611317	√			√								√
CSE0611319	√	√	√									
CSE0613321	√	√	√									
CSE0613322	√	√	√									
CSE0611323	√	√	√	√	√							
CSE0611324	√	√	√	√	√				√			
CSE0612325	√	√										
CSE0612326	√	√										
CSE0611327	√	√	√		√							
CSE0611328			√		√							
CSE0611342	√	√	√	√								
CSE0613316	√	√			√	√			√		√	√
CSE0611411	√	√	√	√								
CSE0611412	√	√	√									
CSE0613414	√	√	√				√				√	√
EEE0713111	√		√		√							
EEE0713112	√		√		√							
EEE0714223	√	√										
CSE0613400		√	√	√	√	√	√	√	√	√	√	√
CSE0613416					√	√		√	√	√		√
CSE0613204	√	√										
CSE0613208	√		√		√							
CSE0611302												
CSE0611304		√	√		√							
CSE0619492	√											
CSE0613494	√	√		√		√	√					
CSE0612401	√	√										

CSE0612402	√	√	√	√								
CSE0612403	√	√										
CSE0612404	√	√										
CSE0613405												
CSE0613406		√		√								
CSE0613407	√	√										
CSE0613408	√	√										
CSE0611431	√	√										
CSE0611432			√	√	√							
CSE0611433	√	√	√							√		
CSE0611434				√					√	√		
CSE0611435	√	√	√		√							
CSE0611436	√		√		√							
CSE0611437	√	√	√							√		
CSE0611438	√	√										
CSE0612439	√											
CSE0612440	√											
CSE0611453	√	√										
CSE0611454	√	√										
CSE0612457	√	√	√	√	√							
CSE0612458	√	√			√			√			√	
CSE0611459	√	√		√								
CSE0611460		√	√	√	√	√						
CSE0613443	√	√		√			√					
CSE0613444	√	√		√		√	√					
CSE0613445	√	√		√			√					
CSE0613446	√	√										
CSE0613447	√	√		√			√					
CSE0613448	√	√										

CSE0612449	√	√		√			√					
CSE0612450	√	√										
CSE0612451	√	√	√	√								
CSE0612452	√	√	√	√								
CSE0612453	√	√	√	√								
CSE0612454	√	√	√	√								
CSE0612463	√		√	√	√							
CSE0612465	√	√										
CSE0612466	√	√	√									
CSE0612469	√	√	√									
CSE0612470			√		√							
CSE0612471	√	√	√									
CSE0612472	√	√	√		√							
CSE0612475	√	√	√									
CSE0612476	√	√	√									
CSE0612477	√	√	√							√		
CSE0612478		√	√	√	√							
CSE0611473		√	√	√								
CSE0611474	√		√	√								
CSE0619481	√	√	√									
CSE0619482	√		√		√							
CSE0611483	√	√	√	√						√		
CSE0611484		√	√									
CSE0611485	√		√	√								
CSE0611486			√	√								
CSE0619487	√	√	√	√	√	√	√			√	√	
CSE0619488	√	√	√		√	√				√	√	

PART B

17. Structure of the Curriculum

a) Duration of the program

Years: Four
Semesters: Eight
There are two semesters in a year and each semester consists of 6 months.

b) Admission Requirements

According to the UGC rules, applicants must have at least 2nd Division or GPA 2.5 in both SSC and HSC. If there is any GPA 2.00 in SSC/HSC, then the total GPA must have to be GPA 6.00. On the other hand, for O level & A level, at least for 5 subjects in O level and 2 subjects in A-level, the applicants must have GPA 4.00 or B Grade in 4 subjects & GPA 3.5/C Grade on the other 3 subjects. Regarding Freedom Fighters children, the total GPA may be considered as 5.00 for each applicant.

Admission Policy

- **Application:** Applicant needs to collect and submit the filled-up Application Form to the Admission Office at UITS. On a specified schedule, applicants are required to sit for a written test, and only the applicant who passes the written test will be called for Viva to get admitted in the first Semester. For further query, applicants are advised to contact the Admission Office at UITS.
- **Foreign Application:** Applicants from a foreign country can contact through their concerned Embassy/High Commission.
- **Fresh Student / Credit Transfer:** Applicants who have passed his/her HSC and intended to get admission in any Bachelor program are treated as Fresh Student. An applicant who has been studying in other Universities can transfer Credits at UITS. Credits from listed Universities are accepted, and 40% of the total Credit required to complete the degree at UITS are accepted. Students having completed any course of Bachelor's degree from another recognized university are eligible for the waiver provided that he/she obtains at least a 'C+' grade in that specific course. For further query, Applicant is advised to contact the Admission Office at UITS.

c) Total minimum credit requirement to complete the program

A total of 144 credits are required to be earned to complete the program.

d) Total class weeks in a Year/semester

The Department of Computer Science and Engineering offers a 4-years program of Bachelor of Science in Computer Science and Engineering (CSE). Each year will be divided into two semesters. Each semester will have a duration of six months. Students shall be evaluated in each semester. A semester will be segmented into class-weeks, preparatory leave, and semester-end examination. The total time distribution for major academic activities is as follows:

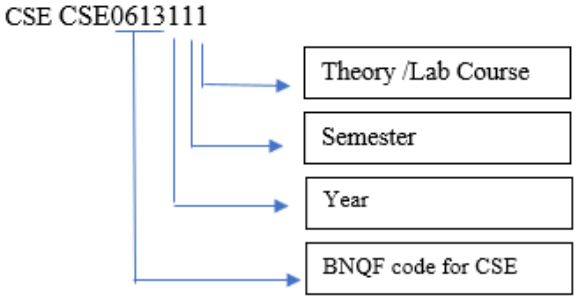
Sl.	Segment	Period	Length
01	Classes	Week 1 to Week 7	7 Weeks

02	Mid Term	Week 8	1 Week
03	Classes	Week 9 to Week 15	7 Weeks
04	Preparatory leave and final examination	Week 16-18	3 Weeks
		Total	**18 eeks**

During class-weeks, if classes are not held in any particular week due to reasons beyond the control of the university, the week shall deem to be an effective class-week, if a number of working days is equal two or more than three.

e) Course Designation and Numbering System:

A course will be represented by course number, course title, credit hours and contact hours per week (Theory or Lab). Each course is designated by BNQF code identifying the B. Sc. program offered followed by a 7digit number having the following interpretation:



The first Four digit correspond to BNQF code for CSE and fifth and sixth digits correspond to the year and semester in which the students typically take the course. The last digits is an odd number for theoretical courses and an even number for laboratory courses.

f) Minimum CGPA requirements for graduation

The performance of a student will be evaluated in terms of semester grade point average (GPA) and cumulative grade point average (CGPA) which is the grade average for all the semesters. To be awarded a B.Sc. degree, a student has to obtain a minimum Cumulative Grade Point Average (CGPA) of 2.25.

g) Maximum academic years of completion

Six years

h) Category of Courses

The undergraduate students of the Department of Computer Science and Engineering have to follow the course schedule given below. The letter prefix in any course number indicates the Department offering the course viz. CSE for Computer Science and Engineering, EEE for Electrical Engineering, ME for Mechanical Engineering, PHY for Physics, MATH for Mathematics, GED for General Education. The last digit represents whether the course is theory or lab.

LIST OF COURSE

General Education Courses

Code	Topics	Theory Credit	Lab Credit
GED0232111	Communicative English	3	1
GED0222121	Bangladesh Studies: History and Culture	2	

(Any Two)

Code	Topics	Theory Credit	Lab Credit
GED0411311	Financial & Managerial Accounting	2	
GED0311313	Engineering Economics	2	
GED0413321	Industrial and Operation Management	2	
GED0421323	Business Law	2	
GED0223421	Professional Ethics and Communication for Engineering	2	

Basic Science and Mathematics

Code	Topics	Theory Credit	Lab Credit
MATH0541111	Differential and Integral Calculus	3	
MATH0541121	Ordinary and Partial Differential Equations	3	
MATH0541211	Coordinate Geometry, Linear Algebra and Vector Analysis	3	

MATH0542213	Probability and Statistics	3	
MATH0541221	Complex Variables, Fourier Analysis and Laplace Transform	3	
PHY0533121	Engineering Physics	3	1
CHEM0531175	Engineering Chemistry	3	
ME0715122	Engineering Drawing		1
	Total	**21**	**2**

Core Courses			
Code	**Topics**	**Theory Credit**	**Lab Credit**
CSE0613111	Structured Programming Language	3	1.5
CSE0613121	Object Oriented Programming Language	3	1.5
CSE0541123	Discrete Mathematics	3	
CSE0613211	Data Structures and Algorithms I	3	1.5
CSE0613124	Web Application Design		1.5
CSE0611215	Digital Logic Design	3	1
CSE0613221	Data Structures and Algorithms II	3	1.5
CSE0612223	Data Communication	3	
CSE0612215	Database Management Systems	3	1.5
CSE0541227	Numerical Methods and Analysis	3	
CSE0613311	Artificial Intelligence	3	1
CSE0612313	Computer Networks	3	1
CSE0613225	Software Engineering and System Analysis	3	1.5
CSE0611317	Computer Architecture	3	
CSE0611319	Theory of Computation	2	
CSE0613321	Compiler	3	1

CSE0611323	Microprocessors, Microcontrollers and Assembly Language	3	1
CSE0612325	Cyber Security	3	1
CSE0611327	Computer Graphics & Multimedia	3	1.5
CSE0611342	Simulation & Modeling Lab		1
CSE0613316	Software Project Design and Development Lab		1.5
CSE0611411	Operating Systems	3	1
CSE0613414	Scientific Research & Methodologies Lab		1
EEE0713111	Fundamental of Electrical Engineering	3	1
EEE0714123	Electronic Devices and Circuits	3	1
	Total	**62**	**24.5**

Final Year Project		
Code	**Topics**	**Credit**
CSE0613400	Thesis/CAPSTONE Project	4.5
CSE0613416	Industrial Attachment	1

Elective Courses			
Elective I (Any Three Course)			
CSE0613204	Advanced Problem-Solving Strategies Lab		1
CSE0613208	Internet Programming Lab		1
CSE0611302	Prototype and User Experience Design Lab		1
CSE0611304	Linux Programming Lab		1
CSE0619492	Technical Writings and Presentation Lab		1
CSE0613494	Software Project Management Lab		1
Elective II (Any one Course with Lab)			
CSE0612401	Internet of Things	3	1
CSE0612403	Foundation of Data Science	3	1

CSE0613405	Mobile Application Development	3	1
CSE0613407	Geographical Information Systems & Applications	3	1
CSE0612497	Graph Theory	3	1

Specialization Groups (Any Three Courses)			
A student will select a Specialization group. From that group s/he will choose three courses from the selected group.			
Code	**Topics**	**Theory Credit**	**Lab Credit**
Intelligent Systems			
CSE0611431	Machine Learning	3	1
CSE0611433	Pattern Recognition	3	1
CSE0611435	Computer Vision	3	1
CSE0611437	Digital Image Processing	3	1
CSE0612439	Information Retrieval	3	1
CSE0611451	Neural Networks	3	1
CSE0611453	Theory of Fuzzy Systems	3	1
CSE0612455	Data Mining & Warehouse	3	1
CSE0612457	Big Data Analytics	3	1
CSE0611459	Bioinformatics & Computational Biology	3	1
Software Engineering			
CSE0613441	Software Requirements Specification and Analysis	3	1
CSE0613443	Software Project Management	3	1
CSE0613445	Software Testing & Quality Assurance	3	1
CSE0613447	Software Security and Maintenance	3	1
CSE0612449	Enterprise Resource Planning & Content Management System	3	1
CSE0612451	Software Measurement and Metrics	3	1
CSE0612453	Software Architecture and Design	3	1
CSE0612495	Innovation Management and Entrepreneurship	3	1
Networks & Security			
CSE0612461	Satellite Communications	3	1
CSE0612463	Telecommunication Systems Engineering	3	1
CSE0612465	Mobile & Wireless Networks	3	1

CSE0612467	Optical Fiber Communications	3	1
CSE0612469	Computer Data & Network Security	3	1
CSE0612471	Cloud Computing and Distributed System	3	1
CSE0612475	Cryptography	3	1
CSE0612477	Digital Signal Processing	3	1
CSE0612479	Network Operations and Management	3	1
Systems and Hardware			
CSE0611473	Real-time Control Systems	3	1
CSE0619481	Robotics	3	1
CSE0611483	Human Computer Interaction	3	1
CSE0611485	Embedded Systems	3	1
CSE0619487	VLSI	3	1

18. Year/Level/Semester/Term wise distribution of courses

19. Year/Level/Semester/Term wise distribution of courses

Semester wise Course list				
Semester 01				
Code	**Topics**	**Theory Credit**	**Lab Credit**	**Total**
CSE0613111	Structured Programming Language	3		
CSE0613112	Structured Programming Language Lab		1.5	
MATH0541111	Differential and Integral Calculus	3		
CHEM0531175	Engineering Chemistry	3		
GED0232111	Communicative English	3		
GED0232112	Communicative English Lab		1	
EEE0713111	Fundamental of Electrical Engineering	3		
EEE0713112	Fundamental of Electrical Engineering Lab		1	
GED0222121	Bangladesh Studies: History and Culture	2		
	Total	**17**	**3.5**	**20.5**

Semester 02				
Code	**Topics**	**Theory Credit**	**Lab Credit**	**Total**
CSE0613121	Object Oriented Programming Language	3		
CSE0613122	Object Oriented Programming Language Lab		1.5	
CSE0541123	Discrete Mathematics	3		
PHY0533121	Engineering Physics	3		
PHY0533122	Engineering Physics Lab		1	
MATH0541121	Ordinary and Partial Differential Equations	3		
ME0715 122	Engineering Drawing		1	
CSE0613124	Web Application Design Lab		1.5	
EEE0714123	Electronic Devices and Circuits	3		
EEE0714124	Electronic Devices and Circuits Lab		1	
	Total	**15**	**6**	**21**

Semester 03				
Code	**Topics**	**Theory Credit**	**Lab Credit**	**Total**
CSE0613211	Data Structures and Algorithms, I	3		
CSE0613212	Data Structures and Algorithms I Lab		1.5	
CSE0611215	Digital Logic Design	3		
CSE0611216	Digital Logic Design Lab		1	

CSE0612215	Database Management System	3		
CSE0612216	Database Management System Lab		1.5	
MATH0541211	Coordinate Geometry, Linear Algebra, and Vector Analysis	3		
MATH0542213	Probability and Statistics	3		
	Total	**15**	**4**	**19**

Semester 04				
Code	**Topics**	**Theory Credit**	**Lab Credit**	**Total**
CSE0613221	Data Structures and Algorithms II	3		
CSE0613222	Data Structures and Algorithms II Lab		1.5	
CSE0612223	Data Communication	3		
CSE0613225	Software Engineering and System Analysis	3		
CSE0613226	Software Engineering and System Analysis Lab		1.5	
CSE0541227	Numerical Methods and Analysis	3		
MATH0541221	Complex Variables, Fourier Analysis and Laplace Transform	3		
CSE***	Elective I		1	
	Total	**15**	**4**	**19**

Semester 05				
Code	**Topics**	**Theory Credit**	**Lab Credit**	**Total**

CSE0613311	Artificial Intelligence	3		
CSE0613312	Artificial Intelligence Lab		1	
CSE0612313	Computer Networks	3		
CSE0612314	Computer Networks Lab		1	
CSE0613316	Software Project Design and Development Lab		1.5	
CSE0611317	Computer Architecture	3		
CSE0611319	Theory of Computation	2		
GED***	General Education (Any one)	2		
CSE***	Elective I		1	
	Total	**13**	**4.5**	**17.5**

Semester 06				
Code	**Topics**	**Theory Credit**	**Lab Credit**	**Total**
CSE0613321	Compiler	3		
CSE0613322	Compiler Lab		1	
CSE0611323	Microprocessors, Microcontrollers and Assembly Language	3		
CSE0611324	Microprocessors, Microcontrollers and Assembly Language Lab		1	
CSE0612325	Cyber Security	3		
CSE0612326	Cyber Security Lab		1	
CSE0611327	Computer Graphics & Multimedia	3		
CSE0611328	Computer Graphics & Multimedia Lab		1.5	

CSE***	Specialization Course 1	3		
CSE***	Specialization Course 1 Lab		1	
	Total	**15**	**5.5**	**20.5**

Semester 07				
Code	**Topics**	**Theory Credit**	**Lab Credit**	**Total**
CSE0611411	Operating Systems	3		
CSE0611412	Operating Systems Lab		1	
CSE0613414	Scientific Research & Methodologies Lab		1	
CSE0611416	Simulation & Modeling Lab		1	
CSE0613400	Thesis/CAPSTONE Project		4.5	
CSE***	Elective II	3		
CSE***	Elective II Lab		1	
CSE***	Specialization Course 2	3		
CSE***	Specialization Course 2 Lab		1	
GED***	General Education (Any one)	2		
	Total	**11**	**9.5**	**20.5**

Semester 08				
Code	**Topics**	**Theory Credit**	**Lab Credit**	**Total**
CSE***	Elective I		1	

CSE***	Specialization Course 3	3		
CSE***	Specialization Course 3 Lab		1	
CSE0613416	Industrial Attachment		1	
	Total	**3**	**3**	**6**
	Total (All Semester)	**104**	**40**	**144**

PART C

20. Description of all courses

❖ Semester 01

19.1.1 Structured Programming Language

Course Code: CSE0611311 **Course Title:** Structured Programming Language

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course introduces computer programming and problem-solving in a structured program logic environment. Topics include language syntax, data types, program organization, problem-solving methods, algorithm design, and logic control structures. Upon completion, students should be able to manage files with operating system commands, use top-down algorithm design, and implement algorithmic solutions in a programming language.

Course Learning Outcomes

CLO1	**Explain** the need of programming languages and problem-solving techniques.
CLO2	**Analyze** programming skills using the fundamentals of Structured Programming Language.
CLO3	**Apply** practical knowledge to develop solutions to complex engineering problems.

Course Content

Computer programming and problem solving in a structured program logic environment; Language syntax, data types, program organization, problem-solving methods, algorithm design, and logic control structures; Files with operating system commands, use top-down algorithm design, and implement algorithmic solutions in a programming language.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1		√										
CLO2					√							
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination

Book References

1. Teach yourself c by Herbert Schildt, 3rd Edition.

2. Programming in ANSI C by E. Balagurusamy, 7th Edition.

19.1.2 Structured Programming Language Lab

Course Code: CSE0611312	**Course Title:** Structured Programming Language Lab
Credits: 1.5	**Credit Hour:** 3 hours per week

Rationale of the Course

This course introduces computer programming and problem solving in a structured program logic environment. Topics include language syntax, data types, program organization, problem-solving methods, algorithm design, and logic control structures. After completion students should be able to manage files with operating system commands, use top-down algorithm design, and implement algorithmic solutions in a programming language.

Course Learning Outcomes

CLO1	**Obtain** adequate knowledge on the need of programming languages and problem-solving techniques.
CLO2	**Develop** programming skills using the fundamentals and basics of C Language.
CLO3	**Analyze** complex problems, to construct solutions (algorithms) and to code those.

Course Content

Control Structures, Loops, Array, String, Recursion, Function, File handling, Dynamic Memory Allocation, Advance Programs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2					√							
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Class Test
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test

Book References

1. Teach yourself c by Herbert Schildt, 3rd Edition.

2. Programming in ANSI C by E. Balagurusamy, 7th Edition.

19.1.3 Differential and Integral Calculus

Course Code: MATH0541111 **Course Title:** Differential and Integral Calculus

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course aims to develop basic math skills in calculus. Analyze functions using limits, derivatives and integrals. Analyze derivatives for graphing algebraic and trigonometric functions and to solve optimization problems. Evaluate definite and indefinite integrals and use them in applications.

Course Learning Outcomes

CLO1	**Compute** limits, derivatives, and integrals.
CLO2	**Analyze** functions and their graphs by using derivatives
CLO3	**Apply** the concept of integration to evaluate geometric area and solve other applied problems.

Course Content

Differential Calculus: Differential Calculus: Limits, continuity and differentiability; Successive differentiation of various types of functions; Leibnitz`s Theorem; Rolle`s Theorem; Mean value theorem in finite and infinite forms; Lagrange`s form of remainders; Cauchy`s form of remainder; Evaluation of indeterminate forms by L` Hospitals rule; Partial differentiation; Euler`s Theorem; Maximum and minimum values of functions of single variable.

Integral Calculus: Definition of integration; Integration by the method of substitutions; Integration by parts; Standard integrals; Integration by the method of successive reduction; Definite integrals

and its properties and use in summing series; Wallis' formula, improper integrals. Beta function and Gamma function; Trapezoidal rule, Simpson's rule, Jocobian, multiple integrals and its application.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz

Book References

1. Calculus by Anton, 10th Edition.

19.1.6 Engineering Chemistry

Course Code: CHEM 0531175 **Course Title:** Engineering Chemistry

Credit: 03 **Credit Hour**: 3 hours per week

Rationale of the Course

This course is a basic chemistry course covering the field of inorganic, organic and physical chemistry. The course emphasizes on the basic concepts, theories and solves quantitative problems which can be applied in a wide spectrum of engineering disciplines.

Course Learning Outcomes

CLO1	**Define** different basic parameters in the field of inorganic, organic and physical chemistry i.e., atomic structure, periodic table, chemical bonding, acids and bases, chemical equilibrium, thermo-chemistry and different types of solutions, phase rule etc.
CLO2	**Explain** different basic theories in the field of selective organic reactions such as Oxidation-reduction, Substitution, Addition, Polymerization, Alkylation reactions etc.
CLO3	**Solve** quantitative problems in the field of inorganic, organic and physical chemistry i.e., solutions, thermochemistry, chemical kinetics, electrical properties of solution etc.

Course Content

Atomic Structure: Concepts of atomic structure, Different atom models, quantum theory and electronic configurations, Heisenberg's uncertainty principle

Periodic Table: Periodic classification of elements, Periodic properties of elements, Properties and uses of noble gases

Chemical Bonding: Types and properties of chemical bonding, Lewis theory, VBT, MOT, Hybridization and shapes of molecules

Selective organic reactions: Oxidation-reduction, Substitution, Addition, Polymerization, Alkylation reactions

Phase Rule: Basic terms and phase rule derivation, Phase diagram of water and carbon dioxide

Solutions: Solutions and their classification, Unit expressing concentration, Colligative properties and dilute solutions, Raoult's law, Van't Hoff's law of osmotic pressure

Thermochemistry: Laws of thermochemistry, Enthalpy, Hess's law, Heat of formation, Kirchoff's equations, Heat of neutralization, Heat of reaction

Chemical Kinetics: Order and rate of reaction, Pseudo and zero order reaction, Half-life, Determination and factors affecting the rate of a reaction, First order reaction, Second order reaction, Collision theory, Transition state theory

Chemical Equilibrium: Equilibrium law/constant, Kp and Kc, Homogeneous and heterogeneous equilibrium, Van't Hoff's reaction isotherm, Le Chatelier's principle

pH & Buffer Solution: Different concepts of acids-bases, Buffer solution, Mechanism of buffer solution, Henderson-Hasselbalch equation, Water chemistry and pH of water

Electrical properties of solution: Conductors & nonconductors, difference between electrolytic and metallic conduction, electrolytic conductance, Factors influencing the conductivity of electrolytes, Kohlrausch Law & conductometric titrations.

Chemical corrosion: introduction to chemical corrosion, corrosion of metals and alloys in dry and wet environments, mechanism of corrosion, atmospheric and soil corrosion and their preventive measures.

Chemistry of environmental pollution: environment and its characteristics, chemistry of metal and non-metal pollutants, analytical techniques used in determination of pollutants, concepts of DO, BOD, COD and threshold odor number, chemistry involved in water treatment plants, quality of industrial waste water.

Polymers: chemistry of polymerization, different types of polymers and their properties, polymer degradation, elastomers and composite materials.

Paints and varnishes: introduction to paints and varnishes, pretreatment of the surface, metallic and non-metallic and organic protective coating and their uses.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Classroom instruction, Active learning, Practical example.	Examination, Class Test, Assignment.
CLO2	Classroom instruction, Active learning, Practical example.	Examination, Class Test, Assignment.
CLO3	Classroom instruction, Active learning, Practical example.	Examination, Class Test, Assignment.

Book References:

1. "Engineering Chemistry" by P.C. Jain and Monica Jain - 16th Edition

2. "Engineering Chemistry" by Gopalan and Senthil Kumar - 4th Edition

19.2.4 Fundamental of Electrical Engineering

Course Code: EEE 0713111 **Course Title:** Fundamental of Electrical Engineering

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course aims to introduce and analyze different types of electrical circuits. This course introduces system units and circuit types, basic laws and some theorems regarding electrical circuits. This course helps the students to familiarize with the type of circuits, system unit, charge, current, voltage, power and basic laws of electrical circuits, calculate branch currents and loop voltages using mesh and node analysis respectively and also learn the circuit theorem to analyze circuits., fundamental concepts of instantaneous current, voltage, power, phasors and complex quantities, impedance, real and reactive power.

Course Learning Outcomes

CLO1	**Explain** different system units and circuit types.
CLO2	**Determine** the voltage and current using basic laws, mesh analysis and nodal analysis for electrical circuits.
CLO3	**Apply** circuit theorem to analyze electrical circuits.
CLO4	**Analyze** AC Circuits, AC power transfer, phasor diagram for various alternating current circuits

Course Content

Fundamental electrical concepts and measuring units. Direct current: voltage, current, resistance, and power. Laws of electrical circuits and methods of network analysis; Introduction to magnetic circuits. Alternating current: instantaneous and r.m.s. Current, voltage and power, average power for various combinations of R, L and C circuits, phasor representation of sinusoidal quantities.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3			√									
CLO4				√								

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy

CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References

1. Fundamentals of Electric Circuits by Alexander & Sadiku, 4th Edition

19.2.5 Fundamental of Electrical Engineering Lab

Course Code: EEE0713112 **Course Title:** Fundamental of Electrical Engineering Lab

Credits: 01 **Credit Hour:** 2hours per week

Rationale of the Course

This course introduces hands-on experience to the students so that they are able to put theoretical concepts to practice. After completion, students should be able to analyze the concept of circuit laws. They are also able to solve the electrical network using mesh and nodal analysis by applying network theorems.

Course Learning Outcomes

CLO1	**Explain** basic laboratory equipment such as multimeters, power supplies, signal generators and oscilloscope and techniques to measure various electrical quantities
CLO2	**Demonstrate** the concept of circuit laws and network theorems by constructing basic electrical circuits.
CLO3	**Analyze** the results of different constructed circuits.

Course Content

Familiarization with electrical components, instruments and understanding the concept of Resistor's color code and equivalent resistance of simple circuits. Verification of ohm's law, Kirchhoff's voltage law, Kirchhoff's current law. Application of various theorems like Superposition theorem, Thevenin's theorem, Norton's theorem. Studying the characteristics of R-C series circuits, R-L-C series circuits, R-L-C Parallel circuits, Resonance of R-L-C series circuits by varying C.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2					√							
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Exercise, Group Discussion	Observation, lab report, Quiz
CLO2	Exercise, Mini Project, Group Discussion	Observation, lab report, viva
CLO3	Exercise, Mini Project	Observation, lab report, lab test

Book References

1. Fundamentals of Electric Circuits by Alexander & Sadiku, 4th Edition

❖ Semester 02

19.2.1 Object Oriented Programming Language

Course Code: CSE0613121 **Course Title:** Object Oriented Programming Language

Credits: 03 **Credit Hours:** 3 hours per week

Rationale of the Course

This course aims are to implement object-oriented designs with Java, identify Java language components and how they work together in applications, design and program stand-alone Java applications, learn about extending Java classes with inheritance, dynamic binding and gain knowledge about exception handling.

Course Learning Outcomes

CLO1	**Demonstrate** programming skills using the fundamentals of Object-Oriented Programming Language.
CLO2	**Analyze** major elements of object-oriented programming such as class, object and interface.
CLO3	**Construct** realistic solutions for the real-world problems using the Object-Oriented approach.

Course Content

Philosophy of Object Oriented Programming (OOP); Advantages of OOP over structured programming; Encapsulation, classes and objects, access specifiers, static and non-static members; Constructors, destructors and copy constructors; Array of objects, object pointers, and object references; Inheritance: single and multiple inheritance; Polymorphism: overloading, abstract classes, virtual functions and overriding; Exceptions; Object Oriented I/O; Template functions and classes; Multi-threaded Programming.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Outcomes (POs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Exercise	Examination, Assignment, Class Test
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test

Book References:

1. Java: The Complete Reference by Herbert Schildt, 10th Edition

2. Programming with java by E. Balagurusamy, 3rd edition

19.2.2 Object Oriented Programming Lab

Course Code: CSE0613122 **Course Title**: Object Oriented Programming Lab

Credits: 1.5 **Credit Hour**: 3hours per week

Rationale of the Course

The course aims are to introduce the concepts of object-oriented programming to students with a background in the procedural programming paradigm. The course begins with a brief review of console input/output with emphasis on structured data types and array processing. It then moves on to introduce the object-oriented programming paradigm, focusing on the definition and use of classes along with the fundamentals of object-oriented design.

Course Learning Outcomes

CLO1	**Implement** the concepts of object-oriented programming principles.
CLO2	**Design** event-driven programs that respond to user events.
CLO3	**Construct** object-oriented solutions for software systems involving fundamental object-oriented concepts.

Course Content

This lab reinforces understanding of basic object-oriented programming concepts including encapsulation and information-hiding; separation of behavior and implementation; classes, subclasses, inheritance; polymorphism; exception handling and event handling and their expression in Java. It also provides practice using non-object aspects of Java (loops, conditionals, etc.).

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Presentation, Exercise, Group Discussion	Observation, Quiz, Viva
CLO2	Exercise, Group Discussion, Mini Project	Observation, Lab Test
CLO3	Exercise, Group Discussion, Mini Project	Observation, Lab Test, Presentation

Book References:

1. Java: The Complete Reference by Herbert Schildt, 10th Edition

2. Programming with java by E. Balagurusamy, 3rd edition

19.2.3 Discrete Mathematics

Course Code: CSE0541123 **Course Title:** Discrete Mathematics

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course aims are to develop logical thinking and its application to computer science, to enhance the ability to reason and ability to present a coherent and mathematically accurate argument, to understand and conduct mathematical proofs for computation and algorithms.

Course Learning Outcomes

CLO1	**Construct** simple mathematical proofs and possess the ability to verify them
CLO2	**Express** and **specify** the basic mathematical properties and objects.
CLO3	**Acquire** ability to describe computer programs (e.g., recursive functions, algorithms, graph theory) in a formal mathematical manner
CLO4	**Apply** basic counting techniques to solve combinatorial problems

Course Content

This course introduces Basic Mathematical Notions: Logic, Sets, Relations, Functions, Proofs; Abstract Orders: Partial Orders, Lattices, Boolean Algebra, Well Orders.; Counting & Combinatorics: Pigeonhole Principle, The Principle of Inclusion and Exclusion, Recurrence Relations, Permutations and Combinations, Binomial Coefficients and Identities; Number Theory: Mathematical Induction, Divisibility, The Greatest Common Divisor, The Euclidean Algorithm, Prime Numbers, integers, Fundamental Theorem of Arithmetic, Modular Arithmetic, Arithmetic with a Prime Modulus, Arithmetic with an Arbitrary Modulus, The RSA Algorithm; Groups and Fields: Basics, Isomorphism theorems, Chinese Remainder Theorem, Finite Fields; Graph Theory: Graph Terminology and Special Types of Graphs, Bipartite Graphs and Matching, Representation of Graphs, Connectivity, Euler and Hamilton Paths and Cycles, Planar Graphs, Graph Coloring, Trees.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Class Test
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test
CLO4	Lecture, Exercise, Assignment	Examination, Class Test

Book References

1.Discrete Mathematics and Its Applications by Kenneth H. Rosen, 7th Edition

19.1.4 Engineering Physics

Course Code: PHY 0533121 **Course Title:** Engineering Physics

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

Introduce students to the basic concepts of waves, optics and thermal physics. To help students develop an understanding of the principles taught as well as analytical problem-solving ability. To Gain an understanding of the basic principles and the experimental basis of the various fields of physics and the logical relationships of the various fields.

Course Learning Outcomes

Upon completion of the subject, students will be able to:

CLO1	**Relate** position, velocity, and acceleration in simple harmonic motion.
CLO2	**Describe** laws of thermodynamics, kinetic theory of gases, waves and oscillation, reflection, refraction, interference, diffraction, polarization of light.
CLO3	**Solve** problems with moderate mathematical complexity related to propagation of periodic waves, thermodynamics, kinetic theory of gasses and properties of light.

Course Content

Waves and Oscillations: Waves and oscillation, Differential equation of SHM, Combinations of harmonic motions with special cases. Energy considerations in SHM, Spring-Mass system, Simple pendulum, Torsional pendulum, compound pendulum, Two-body oscillations, Reduced mass, forced oscillation and resonance, Progressive wave, Standing waves, construction of standing wave.

Heat and Thermodynamics: Temperature, heat and work, Zeroth law of thermodynamics, temperature scales, first law of thermodynamics with applications. Ideal gas, Thermodynamic processes, second law of thermodynamics, Carnot's theorem, Carnot's Cycle, Heat engine, calculation of entropy for reversible and irreversible processes. Third law of thermodynamics, T-S diagram, Thermodynamic functions, Maxwell relations, Clausius Clapeyron's equation.

Kinetic theory of Gases: Kinetic theory of gases, kinetic calculation of the pressure, kinetic interpretation of temperature, degrees of freedom, Maxwell's law of Equipartition of energy, mean free path. Maxwell's distribution of molecular speeds, Specific heat of an ideal gas.

Optics: Classification of lens, power of a lens, focal length, equivalent focal length, aberration. Theories of light, wave front, Hygen's principle of wave propagation with application. Double refraction, Critical angle, Total internal reflection, Snell's law, refractive index, Principle of superposition, Interference of light, Coherent source, different methods for producing coherent source, Young's double slit experiment, Condition of dark and bright fringe, Fresnel biprism, Michelson Interferometer, Newton's ring experiment, Diffraction, Fraunhofer diffraction by single slit and Double slit, condition of maxima and minima, Diffraction grating, resolving power, grating, dispersive power, Polarization, Classification of polarized light. Production and analysis of polarized light. Double refraction, Optical activity, Brewster's law, Malus Law.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lectures, Discussion with the students, Demonstration, Problem Solving in the class, Interactive teaching, Question and Answer.	Class Tests, Mid Term exam
CLO2	Lectures, Discussion with the students, Demonstration, Problem Solving in the class, Interactive teaching, Question and Answer.	Class Tests, Term Final Exam
CLO3	Lectures, Discussion with the students, Demonstration, Problem Solving in the class, Interactive teaching, Question and Answer.	Class Tests, Term Final Exam

Book References:

1. Fundamentals of Physics by D. Halliday, R. Resnick, and J. Walker, John Wiley, 6th Edition

19.1.5 Engineering Physics Lab

Course Code: PHY0533122 **Course Title:** Engineering Physics Lab

Credits: 01 **Credit Hour:** 2 hours per week

Rationale of the Course

Introduce students to the basic concepts experimentally of waves, optics and thermal physics. Help students develop an understanding of the principles taught as well as analytical problem-solving ability. The knowledge about waves, optics and thermodynamics is to acquaint the students with the basic phenomenon/concepts of Physics, the students face during the course of their study in the industry and engineering field. The student will be able to understand the new developments and breakthroughs efficiently in engineering and technology.

Course Learning Outcomes

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

CLO1	**Apply** knowledge of the waves, Optics and thermodynamics to explain natural physical processes and related technological advances.
CLO2	**Use** an understanding of elementary mathematics along with physical principles to effectively solve problems encountered in everyday life, further study in science/engineering and in the professional world.
CLO3	**Design** experiments and acquire data in order to explore physical principles, effectively communicate results, and critically evaluate related scientific studies.
CLO4	**Evaluate** the contributions of physics to our evolving understanding of global change and sustainability while placing the development of physics in its historical and cultural context.

Course Content

General discussion on all lab equipment, procedure of experiments, theory and overall discussion about PHY 0533111 course, using technique/method of supporting tools (such as spherometer, slide calipers and screw gauge etc.). Determination of the diameter of a piece of wire with screw gauge and find its average cross section. Measurement of the time period of oscillation of a simple pendulum by using a simple harmonic motion method and also find the value of acceleration due to gravity(g). Determination of the stiffness constant and effective mass of the spiral spring. Calculate refractive index of a liquid by pin method using a plane mirror and a convex lens. Determination of the focal length and hence power of a convex lens by using displacement method. Determination of the focal length and hence power of a concave lens by using an auxiliary convex lens.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3					√							
CLO4				√								

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lectures, Discussion with the students, Practical Demonstration, Problem Solving in the class, Interactive teaching, Question and Answer.	Lab performance, Lab report, Quiz, Viva, Lab exam, presentation
CLO2	Lectures, Discussion with the students, Practical Demonstration, Problem Solving in the class, Interactive teaching, Question and Answer.	Lab performance, Lab report, Quiz, Viva, Lab exam, presentation
CLO3	Lectures, Discussion with the students, Practical Demonstration, Problem Solving in the class, Interactive teaching, Question and Answer.	Lab performance, Lab report, Quiz, Viva, Lab exam, presentation
CLO4	Lectures, Discussion with the students, Practical Demonstration, Problem Solving in the class, Interactive teaching, Question and Answer.	Lab performance, Lab report, Quiz, Viva, Lab exam, presentation

Book References:

1. Fundamentals of Physics by D. Halliday, R. Resnick, and J. Walker, John Wiley, 6th Edition

19.2.6 Ordinary & Partial Differential Equations

Course Code: MATH054121 **Course Title:** Ordinary & Partial Differential Equations

Credit: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course aims to recognize ordinary and partial differential equations and its order and linearity. It determines the solution of homogeneous and non-homogeneous first and higher order linear and non-linear ordinary and partial differential equations with constant coefficients. This course includes the solution of systems of linear differential equations, initial and boundary value problems and also analyzes heat, wave and Laplace equations.

Course Learning Outcomes

CLO1	**Solve** a variety of first order and higher order linear and non-linear ordinary differential equations.
CLO2	**Analyze** certain physical problems (tank flow, compound interest, mechanical and electrical vibration), set up their determining differential equations, and then solve.
CLO3	**Explain** the fundamental concepts of Partial Differential Equations (PDE) and solve linear PDE with constant coefficients

Course Content

Ordinary Differential Equation: Degree and order of ordinary differential equations, Formation of differential equations, Solution of first order differential equations by various methods, Solution of first order but higher degree ordinary differential equations, Solution of general linear equations of second and higher orders with constant coefficients, Solution of homogeneous linear equations and its applications.

Partial Differential Equation: Degree and order of ordinary differential equations, Formation of differential equations, Solution of first-order linear partial differential equations by various methods. Solution of general linear partial differential equations of second and higher orders with constant coefficients. The nonlinear Partial Differential equation of order one. Application.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz

Book References

1. Ordinary and Partial Differential Equations written by M.D.Raisinghania, 5th Edition
2. Ordinary and Partial Differential Equations with Special Functions, Fourier Series and Boundary Value Problem by Ravi P. Agarwal , Donal O'Regan, 6th Edition

19.2.7 Engineering Drawing

Course Code: ME0715122 **Course Title**: Engineering Drawing

Credits: 01 **Credits Hour:** 2 hours per week

Rationale of the Course

This course is a part of the engineering foundation. It is targeted to help students visualize the basics of engineering design. It is intended for improving students' approach towards conceptual design.

Course Learning Outcomes

CLO1	**Explain** basic concepts of engineering drawing as an important form of conveying technical information.
CLO2	**Apply** principles of engineering visualization and projection theory to prepare engineering drawings.
CLO3	**Use** conventional and modern tools to draw orthographic projection, sectional views, and isometric views of different mechanical components or assemblies.

Course Content

Introduction to drawing and drawing tools; Lettering; geometric constructions of engineering curves; orthographic projections, sectional views, and isometric views of various solids, mechanical components, and assemblies using conventional and modern drawing tools.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3					√							

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Presentation and Group Discussion	Observation, Viva
CLO2	Exercise and Group Discussion	Observation, Lab report, Quiz
CLO3	Exercise and Group Discussion	Observation, Lab report, Lab test, Viva

Book References:

1. Engineering Drawing and Design by David A. Madsen & David P. Madsen, 3rd Edition

19.3.3 Web Application Design Lab

Course Code: CSE0613214 **Course Title**: Web Application Design Lab

Credits: 1.5 **Credits Hour**: 3 hours per week

Rationale of the Course

This course introduces computer programming and problem solving in a structured program logic environment. Topics include language syntax, data types, program organization, problem-solving methods, algorithm design, and logic control structures. After completion, students should be able to analyze complex engineering problems, apply top-down algorithm design approaches, and implement algorithmic solutions in a programming language.

Course Learning Outcomes

CLO1	**Analyze** the system requirements for web application.
CLO2	**Design** sub-systems regarding client and server-side development through taking critical decisions in real world scenarios.
CLO3	**Evaluate** existing systems and build new systems by applying state of the art technology.

Course Content

Understanding the Client-Server Paradigm and Requirement Engineering, Testing methodologies. Project discussion. Practice lesson on basic HTML and CSS Layout using tag, Table, and CSS Box, Model Review and Front-End technology. Implement different requirements/problems with PHP, Handling Database with MySQL and PHP.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1				√								
CLO2			√									
CLO3					√							

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Exercise, Mini Project, Group Discussion	Observation, lab report, Quiz
CLO2	Exercise, Mini Project, Group Discussion	Observation, lab report, viva
CLO3	Exercise, Mini Project	Observation, lab report, lab test

Book References

1. Web Design With HTML, CSS, JavaScript and jQuery Set by Jon Duckett, 3rd Edition

19.3.6 Electronic Devices and Circuits

Course Code: EEE0714123 **Course Title:** Electronic Devices and Circuits

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course introduces the fundamental concepts of electronic devices including semiconductor diodes, transistors and amplifiers. This course emphasizes on device characteristics and applications of p-n-junction diodes, bipolar junction transistors, field effect transistors, operational amplifiers.

Course Learning Outcomes

CLO1	**Explain** construction, operation, working principles and characteristics of diodes, BJT, FET and operational amplifier, filter, oscillator and switching circuits.
CLO2	**Determine** current, voltage, power and optimal condition and outputs of Diode, BJT, FET and operational amplifier.
CLO3	**Design** circuits using diodes, BJT, FET and operational amplifiers to perform certain tasks.

Course Content

Introduction to semiconductors, p-type and n-type semiconductors; p-n junction diode characteristics; Diode applications: half and full wave rectifiers, clipping and clamping circuits, regulated power supply using Zener diode;

Bipolar Junction Transistor (BJT): the principle of operation, I-V characteristics; Transistor circuit configurations (CE, CB, CC), BJT biasing, load lines;

Field Effect Transistors (FET): the principle of operation of JFET and MOSFET; Depletion and enhancement type NMOS and PMOS; Introduction to CMOS.

Operational Amplifiers (OPAMP): linear applications of OPAMPs, gain, input and output impedances, active filters, frequency response, and noise.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz

Book References

1. Electronic Devices & Circuit Theory by Robert L. Boylestad & Louis Nashelsky, 11th Edition

19.3.7 Electronic Devices and Circuits Lab

Course Code: EEE0714124 **Course Title:** Electronic Devices and Circuits Lab

Credits: 1.0 **Credits Hour:** 2 hours per week

Rationale of the Course

The objective of this course is to introduce the students with various electronic circuits and provide a clear understanding of characteristics of basic electronic components like diode, transistor and amplifiers. The students will have hands on experience on working with electronic circuits upon completion of this course.

Course Learning Outcomes

CLO1	**Familiar** with different construction and working principle of diodes, transistors and operational amplifiers.
CLO2	**Analyze** the characteristics of different electronic devices such as diodes, transistors etc.
CLO3	**Design** simple circuits like rectifiers, clippers, clampers, amplifiers etc.

Course Content

I-V characteristics of p-n junction diode and Zener diode, Half wave and full wave rectifiers, Clipper and clamper circuits. Input and output characteristics of Bipolar Junction Transistor (BJT) and Field Effect Transistor (FET). Inverting and non-inverting operational amplifier.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2					√							
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	**Lecture, Lab Experiment, Group Discussion.**	**Lab Report, Lab Quiz, Viva**
CLO2	**Lecture, Lab Experiment, Group Discussion.**	**Lab Report, Lab Quiz, Viva**
CLO3	**Exercise, Group Discussion**	**Lab Quiz, Viva**

Book References

1. Electronic Devices & Circuit Theory by Robert L. Boylestad & Louis Nashelsky, 11th Edition

❖ Semester 03

19.3.1 Data Structures and Algorithms I

Course Code: CSE0613211 **Course Title:** Data Structures and Algorithms I

Credits: 03 **Credits Hour:** 3 hours per week

Rationale of the Course

This course introduces the structured way of handling data so that a complex problem can be solved in an efficient way. Students will learn to use and link data structures. Also, will know something of all of these (sorting and searching, categorized efficiency in time and memory use, linked list and tree data structures, hash tables, stacks and queues) by the end of the course

Course Learning Outcomes

CLO1	**Explain** the concept of array, stack, queue, linked list, trees and graph.
CLO2	**Design** data structures for various computing applications.
CLO3	**Analyze** computing problems and find appropriate solutions using data structure.

CLO4	**Design** algorithms using efficient data structure.

Course Content

Internal data representation, abstract data types (ADTs), recursion, algorithms for searching and sorting, and primary algorithm analysis, ADTs including lists, stacks, queues, priority queues, trees, sets, and dictionaries, Graphs. Implementing alternative data structures for these ADTs. Advanced data structure: heaps, Fibonacci heaps, B-trees, hashing, storage management.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3				√								
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References

1. Schaum's Outline of Theory and Problems of Data Structures by Seymour Lipschutz, Latest Edition.

2. Data Structure Fundamentals by Md. Rafiqul Islam, M. A. Mottalib, 3rd Edition

19.3.2 Data Structures and Algorithms I Lab

Course Code: CSE0613212 **Course Title**: Data Structures and Algorithms I Lab

Credits: 1.5 **Credits Hour**: 3 hours per week

Rationale of the Course

This course is designed to develop the skills of designing and analyzing linear and nonlinear data structures. It strengthens the ability of the students to identify and to apply the suitable data structure for the given real-world problem. It enables them to gain knowledge in practical applications of data structures. It emphasizes on the trade-offs associated with implementing alternative data structures for these ADTs (Abstract Data Type).

Course Learning Outcomes

CLO1	**Evaluate** different types of ADTs in terms of time and memory complexity
CLO2	**Describe** the design and performance of various searching and sorting algorithms.
CLO3	**Apply** programming techniques to implement the concept of arrays, stacks, queues, linked lists, trees and graph and apply different operations on those ADTs

Course Content

Data structures for storing information in arrays, 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 techniques will also be implemented and will be compared.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Presentation, Exercise, Group Discussion	Observation, Lab report, Viva
CLO2	Exercise, Group Discussion	Observation, Lab Test, Quiz
CLO3	Exercise, Group Discussion	Observation, Lab Test

Book References

1. Schaum's Outline of Theory and Problems of Data Structures by Seymour Lipschutz, Latest Edition.

2. Data Structure Fundamentals by Md. Rafiqul Islam, M. A. Mottalib, 3rd Edition

19.3.4 Digital Logic Design

Course Code: CSE0611215 **Course Title:** Digital Logic Design

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course introduces a different numbering system, Boolean function, K-map and minimization techniques. This course also introduces different combinational and sequential circuits. Students will learn to design decoder, encoder, multiplexers, memory elements etc.

Course Learning Outcomes

CLO1	**Describe** different numbering system, conversion among them and Boolean algebraic relations.
CLO2	**Analyze** the function of different types of combinational and sequential logic circuits.
CLO3	**Design** different combinational and sequential logic circuits.

Course Content

Digital logic: Boolean algebra, De Morgan's Theorems, logic gates and their truth tables, canonical forms, combinational logic circuits, minimization techniques;

Arithmetic and data handling logic circuits, decoders and encoders, multiplexers and demultiplexers;

Combinational circuit design; Flip-flops, race around problems; Counters: asynchronous counters, synchronous counters and their applications;

PLA design; Synchronous and asynchronous logic design; State diagram, Mealy and Moore machines; State minimizations and assignments; Pulse mode logic; Fundamental mode design.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz

Book References

1. Digital Logic and Computer Design by M. Morris Mano,2nd Edition

19.3.5 Digital Logic Design Lab

Course Code: CSE0611216 **Course Title**: Digital Logic Design Lab

Credits: 1.0 **Credits Hour:** 2 hours per week

Rationale of the Course

This course aims to provide students with knowledge of problem solving with digital logic circuits & systems. The basic building blocks of combinational and sequential circuits are introduced to enable students to develop circuit solutions to problems and to understand the design and operation of hardware models of digital systems.

Course Learning Outcomes

CLO1	**Demonstrate** the functionality of combinational circuits using lab equipment
CLO2	**Analyze** a given problem and apply the acquired knowledge to design both combinational and sequential circuits.
CLO3	**Examine** the relationship between abstract logic characterizations and practical implementations while designing a system.

Course Content

Logic gates and their truth tables, canonical forms, combinational logic circuits, minimization techniques, Arithmetic and data handling logic circuits, Adder, Subtractor, Comparator, decoders and encoders, multiplexers and demultiplexers, Flip-flops, race around problems, Asynchronous and synchronous counters and their applications, Registers and basic memory unit, Synchronous and asynchronous logic design, State diagram and State minimizations.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3			√							√		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Exercise, group discussion	Observation, lab report, Quiz, viva
CLO2	Exercise, group discussion	Lab test, Lab report, viva
CLO3	Exercise, group discussion	Lab test, Lab report, Viva

Book References

1. Digital Logic and Computer Design by M. Morris Mano,2nd Edition

19.4.4 Database Management System

Course Code: CSE0612215 **Course Title:** Database Management System

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course aims are to describe the fundamental elements of relational database management systems, explain the basic concepts of the relational data model, entity-relationship model, relational database design, relational algebra, and SQL, demonstrate the use of a rudimentary understanding of programmatic interfaces to a database

Course Learning Outcomes

CLO1	**Explain** the fundamental elements of relational database management systems.
CLO2	**Formulate** the queries required to solve the issues in the database.
CLO3	**Design** a database system that would facilitate inferring the knowledge.

Course Content

Concepts of database systems; Models: Entity-Relationship model, Relational model; Relational algebra; SQL; Integrity constraint; Relational database design; File organization and retrieval, file indexing; Transaction manager; Concurrency controller; Recovery manager; Security system; Database administration; Advanced database management systems: distributed, multimedia, object-oriented, object-relational; Some applications using SQL.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											

CLO2		√										
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment,
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test

Book References:

1. Database System Concept by Silbertz, Korth and Sudarshan, 7th Edition

2. Fundamentals of Relational Database Management Systems by S. Sumathi and S. Esakkirajan, 1st Edition

19.4.5 Database Management Systems Lab

Course Code: CSE0612216 **Course Title**: Database Management Systems Lab

Credits: 1.5 **Credits Hour:** 3 hours per week

Rationale of the Course

This course is designed to understand Database Management Systems computer application software that provides a way to manage data. The requirement of modern days is to have an automated system that manages, modifies and updates data accurately. This is achieved by a DBMS in a robust, correct and non-redundant way. DBMS lab aims at practicing and achieving this aim by using various software's such as SQL, ORACLE, and MS – Access etc. All these require a thorough practice of various DDL, DCL and DML queries.

Course Learning Outcomes

CLO1	**Construct** database concepts and structures and query language.
CLO2	**Design** the model of Relational Database using Entity Relationship (ER) model and explain the fundamental elements of Database Management System.
CLO3	**Design** and **build** a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.
CLO4	**Evaluate** MSSQL/MySQL/Oracle features and MSSQL /MySQL/Oracle related products for maintaining the integrity and performance of enterprise databases.

Course Content

Implementation of DDL commands, Implementation of DML commands, different types of Joins - Inner Join, Outer Join and Natural Join. Implementation of Group by & Having Clause, Order by Clause and Indexing. Sub Queries and Views, different types of constraints, Database Backup & Recovery Commands, Creating Database.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√	√									
CLO3	√											
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Group Discussion	Performance, Quiz
CLO2	Exercise and Group Discussion	Performance, Lab Test, Lab Report
CLO3	Exercise and Group Discussion	Performance, Lab Test, Lab Report, Quiz
CLO4	Mini Project and Group Discussion	Presentation, viva

Book References:

1. Database System Concept by Silbertz, Korth and Sudarshan, 7th Edition

2. Fundamentals of Relational Database Management Systems by S. Sumathi and S. Esakkirajan,

1st Edition

19.3.8 Coordinate Geometry, Linear Algebra, and Vector Analysis

Course Code: MAT0542213

Credits: 3.0

Course Title: Coordinate Geometry, Linear Algebra and Vector Analysis

Credits Hour: 3 hours per week

Rationale of the Course

This course determines different properties of straight lines, circles and conics with identification of curves in two dimension and directional cosines and directional ratios of straight lines manually with geometric interpretations, and different properties of conics and straight lines in three dimensions. It includes standard operations on vectors in two-dimensional and three-dimensional space and derivatives and integrals of vector functions.

Course Learning Outcomes

CLO1	**Understand** the transformations of axes in two-dimensional co-ordinate geometry and rectangular co-ordinates and plane in solid geometry.
CLO2	**Analyze** different properties of straight lines and conics.
CLO3	**Compute** vector differentiation, integration, gradient of scalar functions and divergence and curl of vector functions and their application to Green's, Stokes and Gauss theorems.

Course Content

Co-ordinate Geometry: 2-Dimentional co-ordinate geometry: change of axes transformation of co-ordinates, simplification of equations of curves. 3-Dimentional co-ordinate geometry: system of co-ordinates, distance between two points, section formula, projection, direction cosines, equations of planes and lines.

Vector Algebra: Scalars and vectors, equality of vectors; Addition and subtraction of vectors; Multiplication of vectors by scalars; Scalar and vector product of two vectors and their geometrical interpretation; Triple products and multiple products. Linear dependence and independence of vectors.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References

1. Vector Analysis by Murray Spiegel, Seymour Lipschutz and Dennis Spellman, 2nd Edition
2. A Text Book on Co-ordinate Geometry with Vector Analysis by Rahman & Bhattacharjee, 8th Edition

19.3.9 Probability & Statistics

Course Code: MATH0542213 **Course Title:** Probability & Statistics

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course introduces the fundamental concepts, principles and techniques of Statistics & Probability. Through this course, students will acquire basic knowledge of statistical data analysis as well as ability to predict patterns, characteristics and solve statistical data dependent problems.

Course Learning Outcomes

CLO1	**Summarize** the basic concept of statistical and probabilistic methods.
CLO2	**Organize** statistical data and how to draw inference and make conclusions.
CLO3	**Analyze** the methods of collection and presentation of data, the basic concepts of frequency distribution, central tendency, dispersion, estimations.
CLO4	**Present** the information in a scientific way to produce or write a sensible report.

Course Content:

Element of Statistics: Nature and scope of statistics, nature and representation of statistical data, attributes and variables, discrete and continuous variables, methods of data collection.

Presentation of Data and Exploratory Data Analysis Tools: Stem and Leaf plots, Frequency Tables, Histograms, Skewness and Modes, Percentiles and Quartiles, Estimating Percentiles from Histograms, Extremes and Median, Hinges, Outliers and 5 Number Summaries, Box-and-Whisker plots, Use of R or MATLAB for exploratory data analysis.

Measures of Location: Characteristics of an ideal measure; arithmetic mean; geometric mean; harmonic mean; median; mode; quartiles; deciles; percentiles.

Measure of Dispersion: Characteristics of an ideal measure; absolute and relative measures; range; standard deviation; mean deviation; quartile deviation; coefficient of dispersion; coefficient of variation; skewness and kurtosis.

Multivariate Data: Scatterplots and Scatterplot Matrices, Describing Scatterplots: Linearity and Nonlinearity, Homoscedasticity and Heteroscedasticity, Outliers,

Elements of Probability: Meaning and definition of probability; a priori probability and a posteriori probability; basic terminology of probability; random variables; probability function; expectation of sum and products.

Discrete and Continuous Probability Distribution: Distribution Function, Expectation, Variance, Moments and Moment Generating Functions, Transformation of Variable

Regression and Correlation: Relationship between variables, fitting of regression lines, simple correlation, multiple correlation and regression.

Test of Significance: Tests of mean; variance; correlation coefficient; and regression coefficient.

Probability Distribution: Concept of stochastic process; binomial, Poisson, Normal, and Exponential distributions; Discrete time Markov chain and continuous time Markov chain; birth-death process in queuing; Queuing models: M/M/1, M/M/C, M/G/1, M/G/1, M/D/1, G/M/1, solution network queues; closed queuing models and approximate models.

Limit Theorems: Markov's and Chebyshev's Inequality, Central Limit Theorem, Laws of Large Numbers.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1		√										
CLO2			√									
CLO3				√								
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

a) Probability and Statistics for Engineers and Scientists by Sheldon M. Ross, 6th Edition

❖ Semester 04

19.4.1 Data Structures and Algorithms II

Course Code: CSE0613221 **Course Title:** Data Structure and Algorithms II

Credits: 03 **Credits Hour:** 3 hours per week

Rationale of the Course

This course introduces the methodology of solving different types of problems using different Algorithms and also the way of analyzing the algorithms. Students will be able to apply the algorithms to the appropriate problem and understand the process of solving problems more efficiently**.** The course will demonstrate a familiarity with major algorithms and data structures.

Course Learning Outcomes

CLO1	**Analyze** the asymptotic performance of algorithms.
CLO2	**Design** efficient algorithms in common engineering design situations and employ to model engineering problems, when appropriate.
CLO3	**Apply** major algorithmic techniques for graph problems.
CLO4	**Examine** different algorithms to design, build, and test complex computational problems.

Course Content

This course introduces the concept of different methodology of Problem-Solving using Algorithms. Student will also be familiar to the analysis methods of the algorithms. The concepts that will be covered by the course : Techniques for analysis of algorithms; methods for the design of efficient algorithms: divide and conquer, greedy method, dynamic programming, back tracking, branch and bound; Basic search and traversal techniques; Topological sorting; Connected components, spanning trees, shortest paths; Graph algorithms; Flow algorithms; Approximation algorithms; Parallel algorithms; Algebraic simplification and transformations; Lower bound theory; NP-completeness, NP-hard and NP-complete problem, string matching algorithm; FFT and its application.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3		√										
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment,
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test

Book References:

b) Data Structures and Algorithms Made Easy by Narasimha Karumanchi, 5th Edition

19.4.2 Data Structures and Algorithms II Lab

Course Code: CSE0613222 **Course Title**: Data Structure and Algorithms II Lab

Credits: 1.5 **Credits Hour**: 3 hours per week

Rationale of the Course

The course is designed to develop skills to design and analyze different algorithms. This will help students develop techniques for analysis of algorithms and methods for the design of efficient algorithms. After completion students should be able to implement algorithmic solutions in programming languages.

Course Learning Outcomes

CLO1	**Explain** the major graph algorithms and their analyses. Employ graphs to model engineering problems, when appropriate.
CLO2	**Analyze** worst-case running times of algorithms using asymptotic analysis.
CLO3	**Identify** the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it.

Course Content

Design and development of programming solutions to solve algorithmic problems on diverse topics. The content includes algorithms time and space complexity, master theorem for recursive problem, time analysis for recursive binary search, heap sort algorithm, all pair shortest algorithm, Dijkstra's algorithm, topological ordering, knapsack problem, minimum spanning tree concept and algorithms, solving backtracking, traveling salesman by branch and bound algorithms, coin change, longest common subsequence, longest increasing subsequence.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Exercise, Group Discussion	Observation, lab report, quiz
CLO2	Exercise, Group Discussion	Observation, lab report, viva
CLO3	Exercise	Observation, lab report, lab test

Book References:

1. The Algorithm Design Manual by Steven S. Skiena, 2nd Edition

2. Introduction to Algorithms by T.H. Cormen, C.E. Leicerson, R.L. Rivest, and C. Stein, 4th Edition

19.4.3 Data Communication

Course Code: CSE0612223 **Course Title:** Data Communication

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course aims are to develop an understanding of the fundamentals of modern network and Internet technologies, combine them with applications and practices related to a business environment and establish the international exchange of information related to communication systems.

Course Learning Outcomes

CLO1	**Explain** data communication systems and its components.
CLO2	**Characterize** digital, analog representations and line coding schemes.
CLO3	**Evaluate** performance, reliability, error detection and correction of data communication systems.

Course Content

Topics include data transmission, multiplexing, switching, protocols and architecture, internetworking and ISDN. This course teaches the design and implementation techniques essential for robust engineering networks. Topics include networking principles, Transmission Control Protocol/Internet Protocol, naming and addressing (Domain Name System), data encoding/decoding techniques, link layer protocols, routing protocols, transport layer services, congestion control, quality of service, network services, Software Defined Networks (SDNs), programmable routers and overlay networks, wireless and mobile networking, security in computer networks, multimedia networking, and network management.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program L earning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√		√						√		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment,
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test

Book References:

1. Introduction to data communication and networking by Behrouz Forouzan, 4th Edition

2. Data and Computer Communications by William Stallings, 10th Edition

19.5.5 Software Engineering and System Analysis

Course Code: CSE0613225 **Course Title:** Software Engineering and System Analysis

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

Introduction to Software, Types of Software products, Attributes of good software, Software Engineering, Software Process: Software process models, SDLC life cycle, Waterfall Model, Evolutionary Model, Prototype Model, RAID Model, Spiral Model, V-Shaped Model, Agile Model, Software Specification, Validation, and Evolution, Project Management Activities, Project Planning, and Scheduling, Object-Oriented Design, Reusable Software Technologies, Software Engineering Ethics, Design Pattern, Risk Management, Requirements: Functional and Non-Functional, User and System Requirements analysis and design, Design: Multiprocessor and Client-Server Architecture, Distributed Object Architecture, CORBA, Software Testing: Testing Levels, System Testing, Integration Testing, White-box Testing, Black-box Testing, Validation and Verification, Managing People and Group Working, The People Capacity Maturity Model (PCMM), Software Cost Estimation and Software Maintenance, A project development by the help of software engineering and system analysis.

Course Learning Outcomes

CLO1	**Explain** details of system and software development life cycle (SDLC).
CLO2	**Analyze** the user requirements, and design different kinds of system and architectural models for building software systems.
CLO3	**Develop** testing mechanisms for assuring software quality including the dependability and availability.
CLO4	**Develop** a secured and ethical system through the knowledge of system development ethics and security in engineering practice.

Course Content

An introduction to the practical problems of specifying, designing, building, testing, and delivering reliable software systems. Special topics include professionalism, project management, and the legal framework for software development. As a central part of the course, student teams carry out projects for real clients. Each project includes all aspects of software development from a feasibility study to final delivery.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√	√									
CLO3				√								
CLO4			√			√						

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Software Engineering: A Practitioner's Approach by Roger S. Pressman, 5th Edition

19.5.6 Software Engineering and System Analysis Lab

Course Code: CSE0613226 **Course Title:** Software Engineering and System Analysis Lab

Credits: 1.5 **Credits Hour:** 3 hours per week

Rationale of the Course

The sessional course provides a practical experience on developing innovative solutions for real life problems by applying software engineering fundamentals which involve understanding the applicability of different software process models for different context, performing analysis, designing system architecture as well as system models using unified modelling language, developing prototypes using prototyping tools and evaluating the prototype using test cases.

Course Learning Outcomes

CLO1	**Understand** and apply software development process.
CLO2	**Analyze** the user requirements and design the system models.
CLO3	**Use** software prototyping tool and **develop** system prototypes and test cases to evaluate the prototypes.
CLO4	**Develop** the communication skill by presenting topics on software engineering sessional.

Course Content

An introduction to the practical problems of specifying, designing, building, testing, and delivering reliable software systems. As a central part of the course, student teams carry out projects for real clients. Each project includes all aspects of software development from a feasibility study to final delivery.

Concepts of software engineering: different phases of software; **Software processes:** software process models, process activities; **Requirements engineering:** functional and non-functional requirements, software requirements document, requirement specification, requirement elicitation and analysis; **System modelling:** context model, interaction models,; **Prototyping tools:** orientation with modern prototyping tools; **Architectural design:** architectural views and patterns; **Design and implementation:** object oriented design, design patterns; **Software testing an prototype evaluation:** development testing, release testing, user testing.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Outcomes (POs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√	√									
CLO3			√									
CLO4										√		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Report/Documentation, presentation
CLO2	Lecture, Group Discussion, Assignment	Report/Documentation, presentation
CLO3	Lecture, Exercise, Assignment	Report/Documentation, presentation
CLO4	Lecture, Group Discussion	Project Assessment and Viva

Book References:

1. Software Engineering by Ian Sommerville,10th Edition

2. Systems Analysis and Design by Alan Dennis Barbara Wixom and Roberta M. Roth, 7th Edition

19.4.6 Numerical Methods and Analysis

Course Code: CSE054122 **Course Title:** Numerical Methods and Analysis

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course aims to provide students with knowledge of problem solving with algebraic and transcendental equations. Students will be able to solve differential equations, a linear system of equations, evaluate a derivative at a value and perform an error analysis for various numerical methods.

Course Learning Outcomes

CLO1	**Apply** numerical methods to find the solution of algebraic equations using different methods under different conditions.
CLO2	**Find** numerical solutions of nonlinear equations and ordinary differential equations.
CLO3	**Perform** integration and differentiation using different numerical methods.
CLO4	**Analyze, calculate** and **interpret** errors in numerical methods.

Course Content

Motivation and errors in numerical techniques. Solution of algebraic and transcendental equations: method of iteration, False Position method, Newton-Rhapson method;

Solution of simultaneous linear equations: Cramer's rule, Iteration method, Interpolation: diagonal and horizontal difference, differences of a polynomial, Newton's formula for forward and backward interpolation, Integration: general quadrature formula, Trapezoidal rule, Simpson's rule, Weddle's rule;

Solution of ordinary differential equations: Euler's method, Picard's method, Taylor's series method, Runge-Kutta method;

Least squares approximation of functions: linear and polynomial regression, fitting exponential and trigonometric functions.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1		√										
CLO2			√									
CLO3	√											
CLO4				√								

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Introductory Methods of Numerical Analysis by S.S. Sastry, 5th Edition

19.4.7 Complex Variables, Fourier Analysis and Laplace Transform

Course Code: MATH 0541221

Credits: 3.0

Course Title: Complex Variables, Fourier Analysis and Laplace Transform

Credits Hour: 3 hours per week

Rationale of the Course

This course develops the concepts of complex variables, identifying analytic functions and Harmonic functions. It includes the details of Laplace transform and inverse Laplace transform and Fourier series which is a way to write periodic functions as sums of sinusoids. After completion of this course students will be able to apply Laplace Transform and Fourier series for circuit analysis, electronics and signal processing etc.

Course Learning Outcomes

CLO1	**Explain** the basic theory of functions of a complex variable and complex differentiation.
CLO2	**Analyze** the complex function with reference to their analyticity, integration using various theorems.
CLO3	**Apply** the Laplace and Fourier transforms of functions to solve engineering problems.

Course Content

Complex Variable: Complex number system. General functions of a complex variable. Limits and continuity of a function of complex variables and related theorems. Complex differentiation and the Cauchy-Riemann equations. Infinite series. Convergence and uniform convergence. Line integral of a complex function. Cauchy's integral formula. Liouville's theorem. Taylor's and Laurent's theorem. Singular points. Residue. Cauchy's residue theorem.

Fourier Analysis: Real and complex form of Fourier series; Finite transform; Fourier Integral; Fourier transforms and their uses in solving boundary value problems of wave equations.

Laplace Transforms: Definition; Laplace transforms of some elementary functions; sufficient conditions for existence of Laplace transforms; Inverse Laplace transforms; Laplace transforms of derivatives. The unit step function; Periodic function; Some special theorems on Laplace transforms; Partial fraction; Solutions of differential equations by Laplace transforms; Evaluation of improper integrals.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12

CLO1	√											
CLO2		√										
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment,
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test

Book References:

1. Complex Variable by Murray R. Spiegel, Seymour Lipschutz, John J. Schiller and Dennis Spellman, 2nd Edition
2. Schaum's Outline of Fourier Analysis with Applications to Boundary Value Problems by Murray R. Spiegel, 1st Edition
3. Laplace Transforms Problems by Murray R. Spiegel, 1st Edition

❖ Semester 05

19.5.1 Artificial Intelligence

Course Code: CSE0613311 **Course Title:** Artificial Intelligence

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course introduces the basic concepts of Artificial Intelligence with illustrations of the current state of the art research and applications. To recognize the characteristics of AI that makes it useful to real-world problems. To identify the type of AI problem (search inference, decision making under uncertainty, game theory, etc.) To describe the strengths and limitations of various state-space search algorithms, and choose the appropriate algorithm.

Course Learning Outcomes

CLO1	**Discuss** and **distinguish** the notions of rational behavior and intelligent agents.
CLO2	**Develop** a general appreciation of the goals, subareas, achievements and difficulties of AI.
CLO3	**Analysis** methods of informed and uninformed search and ability to practically apply the corresponding techniques.
CLO4	**Investigate** major concepts and approaches in knowledge representation, planning, learning, robotics and other AI areas.

Course Content

Overview of AI, Knowledge representation, Review of Uninformed Search Strategies and game playing; Informed search Strategies: A*, Heuristic functions, Memory Bounded Search (IDA*, SMA*); Iterative improvement Search, Max-Min Algorithm, constraint satisfaction problems. Review of Propositional logic, first order Logic, Introduction to Planning, Partial Order Planning. Bayesian Rule and its use in probabilistic reasoning; Belief Networks and Decision Networks; Learning Decision Trees; Learning General Logical Descriptions-Hypothesis.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2			√									
CLO3		√										
CLO4				√								

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Artificial Intelligence: A Modern Approach by Stuart Jonathan Russell, Peter Norvig, 3rd Edition

2. Artificial Intelligence: A New synthesis by Nils J. Nilsson, 1st Edition

19.5.2 Artificial Intelligence Lab

Course Code: CSE0613312 **Course Title**: Artificial Intelligence Lab

Credits: 1.0 **Credits Hour**: 2 hours per week

Rationale of the Course

Artificial intelligence (AI) is a research field that studies how to realize the intelligent human behaviors on a computer. The ultimate goal of AI is to make a computer that can learn, plan, and solve problems autonomously. Although AI has been studied for more than half a century, we still cannot make a computer that is as intelligent as a human in all aspects. In this course, we will study the most fundamental knowledge for understanding AI. We will introduce some basic search algorithms for problem solving; knowledge representation and reasoning; game playing theories; Uncertainty; natural language processing and neural networks.

Course Learning Outcomes

CLO1	**Understand** the concepts of Artificial intelligence, Intelligent Agents And issues in the design of search programs.
CLO2	**Explain** the role of agents and how it is related to the environment and the way of evaluating it and how agents can act by establishing goals.
CLO3	**Analyze** and simulate various searching techniques, constraint satisfaction problems and example problems- game playing techniques.

Course Content

Basics of Python programming language, Introduction to relevant libraries such as NumPy, Pandas, and Matplotlib, Overview of machine learning concepts and types, Supervised learning, unsupervised learning, reinforcement learning, Introduction to popular machine learning algorithms (e.g., linear regression, decision trees, k-nearest neighbors), Handling missing data, Feature scaling and normalization, Implementing and experimenting with various supervised learning algorithms, Model evaluation and performance metrics, Clustering algorithms (e.g., k-means, hierarchical clustering), Max-Min Algorithm, A* Algorithms, Introduction of basic Image processing techniques, Object detection and image recognition, AI Ethics, Applying the learned concepts to a real-world project, Collaborative projects to encourage teamwork, Familiarity with popular AI tools and frameworks.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1			√									
CLO2		√										
CLO3					√							

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Exercise, Mini- project, Group Discussion	Observation, lab report, Quiz
CLO2	Exercise, Mini-project, Group Discussion	Observation, lab report, viva
CLO3	Exercise, Project	Observation, lab report, lab test

Book References:

1. Artificial Intelligence: A Modern Approach by Stuart Jonathan Russell, Peter Norvig, 3rd Edition

2. Artificial Intelligence: A New synthesis by Nils J. Nilsson, 1st Edition

19.5.3 Computer Networks

Course Code: CSE0612313 **Course Title:** Computer Networks

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

The aim of this course is to introduce computer networks, organization and implementation. To obtain a theoretical understanding of data communication and computer networks. To realize and understand the organization and management of LAN, MAN, WAN. To clarify network terminology.

Course Learning Outcomes

CLO1	**Explain** different types of networks, proper placement of different layers of OSI model, and factors influencing network development.
CLO2	**Design** network routing for IP networks using different routing protocols.
CLO3	**Analyze** the network related problems.
CLO4	**Explain** various aspects of computer network and network topology.

Course Content

Protocol hierarchies; Data link control: HLDC; DLL on Internet; DLL of ATM; LAN Protocols: Standards IEEE 802. *; Hubs, Bridges, and Switches, FDDI, Fast Ethernet; Gigabit Ethernet; Routing algorithm; Congestion control; Internetworking, WAN; Fragmentation; Firewalls; IPV4, IPV6, ARP, RARP, Mobile IP, Network layer of ATM; Transport protocols; Transmission control protocol: connection management, transmission policy, congestion control, timer management; UDP; AAL of ATM; Domain Name System: Name servers; Email and its privacy; SNMP; HTTP; World Wide Web

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2			√									
CLO3		√										
CLO4										√		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Computer Networking: A Top-Down Approach Featuring the Internet by James F. Kurose and Keith W. Ross, 3rd Edition, Addison-Wesley, 2005.

2. Data Communications and Networking by Behrouz A. Forouzan, 3rd Edition

19.5.4 Computer Networks Lab

Course Code: CSE0612314 **Course Title**: Computer Networks Lab

Credits: 1.0 **Credits Hour: 2** hours per week

Rationale of the Course

This course is intended to provide in-depth knowledge of computer networks, various protocols used in communications, Managing and configuring Cisco Switches and Routers, and various WAN technologies.

Course Learning Outcomes

CLO1	**Demonstrate** a broad knowledge of the area of computer networking and its terminology.

CLO2	**Design**, implement and test the operation of a basic computer network.
CLO3	**Demonstrate** an understanding of the operation of a range of networking protocols and devices.
CLO4	**Design** a network for a small organization.

Course Content

Introduction of the simulator, networking devices, and cabling. Different topology configuration with multiple networks using basic routing commands. Introduction of Routing protocols and configure static routing. Design, Configuration, and Implementation of Dynamic Routing (RIP, EIGRP, OSPF), DHCP, VLAN, NAT.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√	√									
CLO3	√											
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Group Discussion	Observation, Quiz
CLO2	Exercise and Group Discussion	Observation, Lab Test, Lab Report
CLO3	Exercise and Group Discussion	Observation, Lab Test, Lab Report, Quiz
CLO4	Mini Project and Group Discussion	Presentation, viva

Book References:

1. Computer Networking: A Top-Down Approach Featuring the Internet by James F. Kurose and Keith W. Ross, 3rd Edition, Addison-Wesley, 2005.

2. Data Communications and Networking by Behrouz A. Forouzan, 3rd Edition

19.6.10 Software Project Design and Development Lab

Course Code: CSE0613316 **Course Title:** Software Project Design and Development Lab

Credits: 1.5 **Credits Hour:** 3 hours per week

Rationale of the Course

This course covers the techniques of software design and development: project management, structured programming, verification and validation, security and privacy, and project documentation; students are required to apply these techniques to large software projects.

Course Learning Outcomes

CLO1	**Explain** formal management for software projects.
CLO2	**Apply** a number of modern software development methods.
CLO3	**Demonstrate** the technology tools usage for environment setup and software development
CLO4	**Implement** Quality assurance practices for software projects.
CLO5	**Combine** and integrate appropriate modern software development methods for a variety of software projects.

Course Content

Introduction to SE, SDLC, Documentation, Environment setup, Requirement analysis, Object modeling, Project Implementation, Project Verification, validation, Project Security and Privacy, Model-View-Controller (MVC), Software Testing.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√	√				√						
CLO2	√											
CLO3					√							
CLO4											√	
CLO5									√		√	√

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Presentation, Viva
CLO2	Lecture, Group Discussion	Presentation, Assignment
CLO3	Lecture, Practical Work, Assignment	Lab Test, Project idea submission
CLO4	Lecture, Practical Work, Assignment	Lab Test, Project Work, Quiz
CLO5	Lecture, Practical Work, Assignment	Project Work Evaluation, Final Presentation, Viva

Books Reference:

1. Software Engineering by Ian Sommerville,10th Edition

2. Systems Analysis and Design by Alan Dennis Barbara Wixom and Roberta M. Roth, 7th Edition

19.5.7 Computer Architecture

Course Code: CSE0611317 **Course Title:** Computer Architecture

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

The course provides a thorough understanding of computer architectural designs. To expose flow of data and instruction streams in CPU, Memory and I/O devices. To introduce the latest system designs with pros and cons. To emphasis on different memory devices with analysis of cost, size and speed

Course Learning Outcomes

CLO1	**Explain** the basic computer architecture, organizational principles of memory components, modern multi-core, multi-thread processors and common architectural designs.
CLO2	**Evaluate** the performance improvement for instruction level parallelism.
CLO3	**Evaluate** comparative performances of different architectural and organizational computing systems.

Course Content

Study of architectural concepts in computer systems, computer arithmetic and arithmetic logic unit designs, memory hierarchies - register, cache, SRAM, DRAM, ROMs and dynamic address translation.

Discussion topics may include: instruction set design; processor microarchitecture, pipelining, system performance; superscalar, supercomputers, grid computing; multithreaded architectures; symmetric multiprocessors; and parallel computers.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3				√								
CLO4												√

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Computer Organization and Architecture by William Stallings, 8th Edition

19.5.8 Theory of Computation

Course Code: CSE0611319 **Course Title:** Theory of Computation

Credits: 2.0 **Credits Hour:** 2 hours per week

Rationale of the Course

The course introduces the basic concepts of the mathematical foundations of computation including automata theory. To introduce the concepts of the theory of formal languages and grammars; the notions of the algorithm, decidability, complexity, and computability. To understand and conduct mathematical proofs for computation and algorithms. To demonstrate an understanding of key notions, such as algorithm, computability, decidability, and complexity through problem-solving.

Course Learning Outcomes

CLO1	**Introduce** mathematical foundations of computation, such as the theory of formal languages and grammars, notions of the algorithm, complexity, computability.
CLO2	Ability to **understand** and conduct mathematical proofs for computation and algorithms.
CLO3	**Define** and **describe** formal models of computations, such as finite automata, context free grammar, pushdown automata, and Turing machines.
CLO4	**Demonstrate** the conversion between finite automata, regular grammars, regular expression representations of regular languages, context free grammar and pushdown automata.

Course Content

Basic notions: string, prefix, suffix, substring, concatenation; Cardinality;

Distinction between uncountable and countable infinite. Different proof techniques: Proof by construction, proof by contradiction, pigeon hole principle. Language theory;

Finite automata: deterministic finite automata, nondeterministic finite automata, equivalence and conversion of deterministic and nondeterministic finite automata, pushdown automata;

Context-free languages; Context-free grammars;

Turing Machines: basic machines, configuration, computing with Turing machines, combining Turing machines; Undesirability.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3			√									
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Introduction to the Theory of Computation by Michael Sipser, 3rd Edition
2. Introduction to Automata Theory, Languages and Computation by John Hopcroft, 3rd Edition

❖ Semester 06

19.6.1 Compiler

Course Code: CSE0613321 **Course Title:** Compiler

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course introduces the principles of compiler design and implementation. To identify the similarities and differences among various parsing techniques and grammar transformation techniques. To optimize the machine code generated by the compiler to make it faster and more efficient. To perceive the basic skills needed to design and implement a compiler of a given language.

Course Learning Outcomes

CLO1	**Understand** and **apply** automata theory and knowledge on formal languages.
CLO2	**Identify** and **select** suitable parsing strategies for a compiler for various cases. Knowledge in alternative methods (top-down or bottom-up, etc).
CLO3	**Select** and use modern techniques and tools needed to design and implement compilers.

Course Content

Introduction to compiling; Basic issues; Design and implementation of compilers for high-level programming languages; Phases of a typical compiler, Lexical analysis; Syntax analysis; Syntax-directed translation; Scanning, Parsing, Semantic analysis: type-checking; Run-time environments; Intermediate code generation; Code generation; Code optimization; Compiler development tools.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Compilers: Principles, Techniques and Tools by AlfredV. Aho, Ravi Sethi, Jeffrey D. Ullman, 2nd Edition

19.6.2 Compiler Lab

Course Code: CSE0613322 **Course Title:** Compiler Lab

Credits: 1.0 **Credits Hour:** 2 hours per week

Rationale of the Course

The course is intended to teach the students the basic techniques that underlie the practice of Compiler Construction. The course will introduce the theory and tools that can be standard employed in order to perform syntax-directed translation of a high-level programming language into an executable code. These techniques can also be employed in wider areas of application, whenever we need a syntax-directed analysis of symbolic expressions and languages and their translation into a lower-level description. They have multiple applications for man-machine interaction, including verification and program analysis.

Course Learning Outcomes

CLO1	Understand and define the role of lexical analyzer, use of regular expression and transition diagrams.
CLO2	Apply different compiler writing tools to implement the different Phases.
CLO3	Analyze the data flow and control flow.
CLO4	Compare various code optimization techniques.

Course Content

A language subset will be defined and used during the lab course. The programming exercises here consist of implementing the basic components of a compiler. The constructs in this subset are found in most programming languages. This module introduces topics include compiler design, lexical analysis, parsing, symbol tables, declaration and storage management, code generation, and optimization techniques.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√		√									
CLO2		√	√									
CLO3	√		√									
CLO4		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group Discussion	Examination, Class Test

CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Compilers: Principles, Techniques and Tools by AlfredV. Aho, Ravi Sethi, Jeffrey D. Ullman, 2nd Edition

19.6.3 Microprocessors, Microcontrollers and Assembly Language

Course Code: CSE0611323

Credits: 3.0

Course Title: Microprocessors, Microcontrollers and Assembly Language

Credits Hour: 3 hours per week

Rationale of the Course

This course introduces techniques for writing programs that can be run on 8086 microprocessor-based systems. To design systems using memory chips and peripheral chips for 16-bit 8086 microprocessors. To understand and devise techniques for faster execution of instructions, improve the speed of operations and enhance the performance of the microprocessor. To understand multi-core processors, RISC and CISC processors. To write assembly language programs.

Course Learning Outcomes

CLO1	**Explain** microprocessor and microcontroller's internal architecture and their operation.
CLO2	**Analyze** how the high-level language structure is converted to low level languages and how a processor executes a program line by line.
CLO3	**Design** programs to interface microprocessors to external devices and 8051 microcontroller-based systems.
CLO4	**Apply** knowledge and programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and solve assembly language programs.

Course Content

Assembly Language: System Architecture for Assembly language; Assembly programming basics; Assembly Addressing modes; Assembly instruction types and their formats: Arithmetic, Logical, Transfer control and conditional processing, Stacks, branches, String processing, subroutine and parameter passing, macros, Input/output; Interrupts; Procedures, file system and file I/O handling.

Microprocessors and Microcontrollers: Introduction to Microprocessor and Microcontroller. Architectural overview of Microprocessor and its operation, Common instruction types, addressing

modes. Intel 8086 Microprocessor: Internal architecture, register structure, programming model, addressing modes, instruction set; I/O Pin diagram and Control signals; I/O port organization and accessing; Cache Memory, TLB Structure; Memory Management in Intel 80X86 Family; segmentation and Real Mode Memory Management. Intel 80186, 80386 and 80486 segments register formats, Paged memory operation. Linear to physical address translation; Arithmetic co-processor; Interrupts and Exception in Intel 80X86 families of processors, type of Interrupts, Interrupts in real mode and protected mode, Interrupt descriptor tables, Interrupts Priorities; Input and Output: IO address spaces, Port organization, Memory mapped IO, Hand-shaking IO instruction, Keyboard-Display interface Timer handler, Microcontrollers: Architecture of 8051, memory organization, special function register, I/O ports, Special function registers.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√				√							
CLO2		√										
CLO3			√	√								
CLO4				√								

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. The intel microprocessors by Barry B. Brey, 8th Edition

19.6.4 Microprocessors, Microcontrollers and Assembly Language Lab

Course Code: CSE0611324

Credits: 1.0

Course Title: Microprocessors, Microcontrollers and Assembly Language Lab

Credits Hour: 2 hours per week

Rationale of the Course

This course introduces basics of assembly language programming, microprocessor architecture and discusses different interfaces and design of systems based on microprocessors and microcontrollers, and develops a Project of an embedded system based on a single-chip microcontroller or microprocessor.

Course Learning Outcomes

CLO1	**Explain** how low-level languages are implemented and how a processor executes a program line by line.
CLO2	**Design** basic assembly programs.
CLO3	**Analyze** how a basic microcontroller works with its associated components.
CLO4	**Demonstrate** low level programming of microcontrollers.

Course Content

Basics of Assembly language, flow control instructions, logic-shift-rotate-multiplication & division instructions, stack & procedure, arrays & addressing modes, String instructions & file operations, Circuit design in Arduino and simulation.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CLO1	√			√								
CLO2		√	√									
CLO3	√				√							
CLO4	√		√						√			

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Exercise	Observation, lab report, Quiz, viva
CLO2	Exercise, Group Discussion	Observation, lab report, Quiz, viva
CLO3	Exercise	Observation, lab report, Quiz, Viva
CLO4	Exercise, Mini Project202, Group Discussion	Presentation, Viva

Book References:

1. The intel microprocessors by Barry B. Brey, 8th Edition

2. The Intel microprocessors: 8086/8088, 80186/80188,80286,80386,80486, Pentium, Pentium Pro, and Pentium II processors: architecture, programming, and interfacing By Barry B. Brey, 8th Edition

3. Microprocessor Architecture, Programming, and Applications with the 8085 Ramesh Gaonkar, 6th Edition

19.6.5 Cyber Security

Course Code: CSE0612325 **Course Title:** Cyber Security

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course introduces the concept of cyber security, its interdisciplinary nature, and its relation to nations, businesses, society, and people. Participating students would gain knowledge of various cyber security terminologies, technologies, protocols, threat analysis, security principles, security mechanisms, policies, forensics, incidence response, and methods/practices to secure systems.

Course Learning Outcomes

CLO1	**Develop** a good understanding of the fundamental knowledge of the cyber-security domain and related issues.
CLO2	**Identify** what a vulnerability is and how to address the most common vulnerabilities.
CLO3	**Understand** basic and fundamental risk management principles as it relates to Cyber Security.
CLO4	**Apply** knowledge of current trends in ICT security, particularly those that relate to security protocols and policy, cryptography, malware, and digital forensics.

Course Content

Introduction to Cyber Security, Usability, Thinking like a Hacker, CIA Triad, Security Terminologies, Security Protocols;

Security Policies and Management: Multilevel and multilateral Policies, Security Mechanisms, Security Design Principles, Threat Analysis, and Risk Assessment;

Securing a System: Cryptography, Basic Techniques, Digital Signatures, Cryptanalysis;

Software Security: Low-level attacks, Code Review and Testing, Defenses, Fall-Break, Student Project Idea Discussion;

Network Security: Vulnerabilities, Attacks, Defenses, Internet and Smartphone Security: Anonymous vs Secure Browsing, Information Economics, Economics of Security, Physical Protection, Biometrics;

Banking Security: Cyber Forensics, Cyber Warfare, Surveillance, and Privacy, Incident Response and Mitigation, Business Continuity, Legal issues, and Ethics.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3	√											
CLO4	√											

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Exercise, Group Discussion	Examination, Class Test

Book References:

1. The Art of Deception by Kevin Mitnick and William L. Simon, 1st Edition

19.6.6 Cyber Security Lab

Course Code: CSE0612326 **Course Title:** Cyber Security Lab

Credits: 1.0 **Credits Hour: 2** hours per week

Rationale of the Course

This lab course is based on the cyber security theory course. This sessional course is designed to assist students in better understanding how to protect computer operating systems, networks, and data against cyber-attacks by utilizing various mechanisms, protocols, and technologies.

Course Learning Outcomes

CLO1	Understand the various important concepts of cyber security like cryptography, network and web applications, data privacy, and many more.
CLO2	Develop a good understanding of the basic and fundamental risk management principles as it relates to Cyber Security.
CLO3	Use and implement various security mechanisms, protocols, and policies to protect computer operating systems, networks, and data against cyber-attacks.

Course Content

Basic cryptography, Random number generators, Authentication and authorization, Access control, PKI, Buffer overflows, Format string attacks, Code injection, Return-to-libc attacks, ASLR, Heap-spraying, ROP, and use-after-free attacks, Defenses against memory corruption exploits, SQL injection, XSS, and CSRF attacks, Malware, Sandboxing, DoS attacks, Firewalls, Network intrusion detection, Honeypots, OS security, Null-pointer dereferences, Code integrity.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group Discussion	Presentation, quiz, Viva
CLO2	Lecture, Group Discussion	Presentation, Assignment, Quiz, Viva
CLO3	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz, Viva

Book References:

1. The Art of Deception by Kevin Mitnick and William L. Simon, 1st Edition

19.6.7 Computer Graphics & Multimedia

Course Code: CSE0611327 **Course Title:** Computer Graphics & Multimedia

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

The aim of this course is to learn the basic principles of 2-dimensional and 3-dimensional computer graphics. To study the elementary mathematics techniques that allow us to position objects in two- and three-dimensional space. To implement the algorithms and techniques necessary to produce the different mathematics of projections.

Course Learning Outcomes

CLO1	**Explain** the basic concepts and scope of computer graphics.
CLO2	**Apply** the mathematical principles of the ideas of computer graphics on different geometric objects.
CLO3	**Design** various computer graphics algorithms and techniques in graphical models.
CLO4	**Explain** the structures and technologies used in multimedia systems.

Course Content

Introduction to computer graphics and its applications; Principles of raster image generation; Light and Color models; Example of a graphics API; Graphics primitives; Graphics hardware; Graphics pipeline; Coordinate convention; Scan conversion; Clipping; Modeling transformations; Viewing transformations; Projection transformations; Polygons and polygon meshes; Curves and surfaces; Hidden lines and surface removal; Introduction to rendering including shading models, textures, ray tracing, and radiosity; Introduction to computer animation and kinematics; Fractals; Graphics programming using OpenGL 4.0 and above.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3			√									
CLO4					√							

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Books Reference:

1. COMPUTER GRAPHICS by Zhigang Xiang and Roy A. Plastock, 2nd edition

2. Computer Graphics by Hearn and Baker, 2nd Edition

19.6.8 Computer Graphics & Multimedia Lab

Course Code: CSE0611328 **Course Title:** Computer Graphics & Multimedia Lab

Credits: 1.5 **Credits Hour: 3** hours per week

Rationale of the Course

The course introduces the basic concepts of computer graphics. It provides the necessary theoretical background and demonstrates the application of computer science to graphics. The course further allows students to develop programming skills in computer graphics through programming assignments.

Course Learning Outcomes

At the end of this course student will:

CLO1	**Explain**, **illustrate** and **design** various kinds of viewing and Projections.
CLO2	**Learn** the representation and transformation of graphical images and pictures.
CLO3	**Develop** a practically based understanding of form and functional design contexts using computer graphics.

Course Content

Introduction to OpenGL, OpenGL Setup in Codeblocks; Write a Program to draw lines, triangles, quads and polygons; Implementation of 2D Transformation: Translation and Scaling; Implementation of 2D Transformation: Rotation; Project Idea Submission; Implementation of 3D Transformation: Translation and Scaling; Implementation of 3D Transformation: Rotation; Implementation of row, pitch, yo; Implementation of lighting effects; Implementation of texture Mapping; Implementation of line generation using slope's method, DDA and Bresenhem's algorithms; Implementation of circle generation using Mid-point method and Bresenhem's algorithm; Implementation of Polygon Clipping using Sutherland-Hodgeman algorithm; Solving miscellaneous problems; Project Submission;

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√		√								
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Presentation, Viva
CLO2	Lecture, Mini Project	Presentation, Assignment, Quiz
CLO3	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz, Viva

Books Reference:

1. COMPUTER GRAPHICS by Zhigang Xiang and Roy A. Plastock, 2nd edition

2. Computer Graphics by Hearn and Baker, 2nd Edition

❖ Semester 07

19.6.9 Simulation & Modeling Lab

Course Code: CSE0611416 **Course Title:** Simulation & Modeling Lab

Credits: 1.0 **Credits Hour:** 2 hours per week

Rationale of the Course

This course motivates to design various models to solve real-world problems using mathematics, computer programming language, computation power etc. and analyzes the behavior of a system for different types of datasets to provide a reasonable decision regarding the performance of a system in a cost and time effective manner.

Course Learning Outcomes

CLO1	**Define** basic terms in modeling and simulation.
CLO2	**Classify** various simulation models and introduce practical examples for each category.
CLO3	**Construct** a model for a given set of data and examine its validity.
CLO4	**Analyze** output data produced by a model and test validity of the model.

Course Content

Introduction to MATLAB, Random Number Generation, Hypothesis Testing, Chi-square goodness-of-fit test, Kolmogorov-Smirnov test, Test for Standard Normal Distribution, Testing Random Number Generators; Single server queuing system, Two-server queuing system, Inventory management system, Monte-Carlo simulation, Pure Pursuit problem, Probability Distribution fitting;

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√		√								
CLO3			√									
CLO4				√								

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group Discussion	Presentation, Viva
CLO2	Lecture, Group Discussion	Presentation, Assignment, Quiz, Viva
CLO3	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz, Viva
CLO4	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz, Viva

Books Reference:

1. Modeling and Simulation by Hartmut Bossel and Routledge Boo, 1st Edition

19.7.1 Operating Systems

Course Code: CSE0611411 **Course Title:** Operating Systems

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course learn**s** the fundamentals of Operating Systems. It will also help to learn the mechanisms of OS to handle processes and threads and their communication. The students will **learn** the mechanisms involved in memory management in contemporary OS.

Course Learning Outcomes

CLO1	**Understand** the concepts of Operating system, Processes, Kernel, Threads, Memory Management. File Organization, Input-Output management.
CLO2	**Utilize** and **implement** algorithms for scheduling process, thread, disk for better utilization of external memory
CLO3	**Analyze** various device and resource management techniques and the concept of handling deadlock situations.

Course Content

User Level Specification of OS; Fundamental Concepts of OS; Program and Processes; Management and Control of Processes; Process states; Details of Threads; CPU Scheduling; Concepts and Implementation of Virtual Memory, Physical and Logical address; Memory Management; Deadlock handling; File Organization; File System Interface and Virtual File Systems; Implementation of File Systems; I/O Software: Interrupt Service Routines and Device Drivers, access control.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcome (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CO 1	√											
CO 2			√									
CO 3		√		√								

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Class test, Assignment, Quiz

Books Reference:

1. Operating System Concepts by Abraham Silberschatz, 9th Edition

19.7.2 Operating System Lab

Course Code: CSE0611412 **Course Title:** Operating System Lab

Credits: 1.0 **Credits Hour:** 2 hours per week

Rationale of the Course

The aim of this lab course is to implement the concepts acquired during the operating system course. The programming exercises here consist of various CPU Scheduling Algorithms, Deadlock handling and Memory Management techniques.

Course Learning Outcomes

CLO1	**Understand** Linux commands.
CLO2	**Understand & Implement** different CPU scheduling algorithms to solve problems.
CLO3	**Analyze** appropriate memory allocation techniques.

Course Content

Introduction to Linux Operating System, Linux commands, shell scripting, programming with shell scripting; Scheduling algorithms: Different scheduling algorithms implementation and performance analysis; Deadlock: Introduction to Deadlock, Deadlock detection and Deadlock avoidance algorithms;

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12

CLO1	√											
CLO2			√									
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Practical work, Group Discussion	Presentation, Viva
CLO2	Lecture, Practical Work	Presentation, Assignment, Quiz, viva
CLO3	Lecture, Practical Work	Lab Test, Assignment, Quiz, Viva

Books Reference:

1. Operating System Concepts by Abraham Silberschatz, 9th Edition

19.7.3 Scientific Research & Methodologies Lab

Course Code: CSE0613414 **Course Title:** Scientific Research & Methodologies Lab

Credits: 1.0 **Credits Hour:** 2 hours per week

Rationale of the Course

Scientific Research & Methodology is a hands-on course designed to impart education in the foundational methods and techniques of academic research in Science and Engineering context.

UG students would examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection, ethical issues in research, time management, report writing, and presentation. Once equipped with this knowledge, participants would be well-placed to conduct disciplined research under supervision in an area of their choosing. In addition to their application in an academic setting, many of the methodologies discussed in this course would be similar to those deployed in professional research environments

Course Learning Outcomes

CLO1	**Understand** some basic concepts of research and its methodologies.
CLO2	**Select** and **define** appropriate research problems and parameters.
CLO3	**Relate** and **conduct** research (advanced project) in a formal and scientific approach.
CLO4	**Construct** a research report and thesis.

Course Content

Introduction to Research Methodologies, Foundations of Research, Problem Identification & Formulation, Research Design, Data Analysis, Research Misconduct and Ethics, Use of Tools / Techniques for Research;

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1		√										
CLO2			√									
CLO3							√				√	
CLO4												√

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Lab Test, Presentation
CLO2	Lecture, Group Discussion	Lab Test, Assignment
CLO3	Lecture, Practical Work, Assignment	Lab Test, Presentation, Quiz
CLO4	Lecture, Practical Work, Assignment	Research Report, Presentation, Viva

Books Reference:

1. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches by John W. Creswell, 3rd Edition

19.7.5 Thesis / Capstone Project

Course Code: CSE0613400 **Course Title:** Thesis / Capstone Project

Credits: 4.5 **Duration:** 1 Year (7th and 8th Semester)

Rationale of the Course

A detailed analysis and design of a Computer Science and Engineering project. This Capstone project provides students with an opportunity to interact real life problems to define, design, build and deploy real-world systems. The department provides a two-semester (final year) capstone experience Mandatory for all students for undergraduate program of Department of CSE. Students work individually or in a small group to contemplate on how their earned knowledge can be useful to solve real life problems or transmute into products which have business of humanitarian credibility. In the process of solving these problems students gain confidence and depth of knowledge in relevant subject matter and it subtly improve their leadership and management skills as well. Monitoring and assessing the students' progress and the final project report gives valuable insights about the possible modification and improvement of the delivery of courses.

The main objectives of this course is to apply technical knowledge and skills for further research and design of computer system at professional engineering scale, to work successfully in industry and/or have successful career in government or academia, contribute to the development of the IT profession, conform to ethical values and environmentally friendly policies, to depict effective leadership in multicultural work environment of the competitive world and to develop deeper understanding of Computer Science and Engineering design and analysis.

These experiences integrate all of the technical knowledge and skills from their courses as well as provide valuable experience in team-building, project management, oral and written communications, and problem solving.

The aim of this course is to apply technical knowledge and skills for further research and design of computer systems at professional engineering scale.

Course Learning Outcomes

CLO1	**Identify** a real-life problem that can be translated to an engineering and/or computing solution through design, development and validation.
CLO2	**Identify** outcomes and functional requirements of the proposed solution considering software and/or hardware specification and standards.
CLO3	**Identify** sub-components of a complex problem, prepare timeline and appropriate budget using the project management skill.
CLO4	**Analyze, design, build,** and **evaluate** engineering/computing system/subsystem with given specifications and requirements.
CLO5	**Use** modern analysis and design tools in the process of designing and validating of a system and subsystem.
CLO6	**Assess** professional, ethical, environmental and social impacts and responsibilities of the design projects.
CLO7	**Identify** and **validate** the impact of environmental considerations and the sustainability of a system/subsystem of a complete project.
CLO8	**Function** effectively in a multi-disciplinary team.
CLO9	**Present** design project results through written technical documents and oral presentations.

Course Content

Previous course knowledge, Literature review, Self-learning, Interdisciplinary cooperation.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√										√	
CLO2		√	√									
CLO3											√	
CLO4			√	√								
CLO5			√	√	√							
CLO6						√	√	√				
CLO7											√	
CLO8									√			
CLO9										√		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Presentation and Report
CLO2	Lecture, Group Discussion	Presentation and Report
CLO3	Lecture, Group Discussion	Presentation and Report
CLO4	Lecture, Group Discussion	Presentation and Report, Viva
CLO5	Lecture, Group Discussion	Presentation and Report
CLO6	Lecture, Group Discussion	Presentation and Report
CLO7	Lecture, Group Discussion	Presentation and Report
CLO8	Lecture, Group Discussion	Presentation and Report
CLO9	Lecture, Group Discussion	Presentation and Report, Viva

❖ Semester 08

19.7.4 Industrial Attachment

Course Code: CSE0613416 **Course Title:** Industrial Attachment

Credits: 1.0

Rationale of the Course

This course has been designed for the students to have real life experiences to help them prepare for their career.

Course Learning Outcomes

CLO1	**Develop** work responsibility and ethics in the working environment.
CLO2	**Communicate** effectively within the working environment.
CLO3	**Apply** theoretical and academic knowledge for solving the industrial problem.
CLO4	**Prepare** the report and presentation of training.

Course Content

As per industrial plan;

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1						√		√	√			
CLO2										√		
CLO3												√
CLO4					√							

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Presentation and Report
CLO2	Lecture, Group Discussion	Presentation and Report
CLO3	Lecture, Group Discussion	Presentation and Report
CLO4	Lecture, Group Discussion	Presentation and Report, Viva

Activities

Time	Task
Seventh Semester	
Week 1	Submit Project Proposal
Weeks 1 – 9	Initial research and background study.
Weeks 10 - 12	Preliminary data analysis and get started on the prototype.
Weeks 13 - 15	Develop data validation rules and data cleansing routines, prepare a primarily working prototype.
Eighth Semester	
Weeks 16 - 18	Develop the Prototype based on previous feedback from advisor and organizational supervisor.
Weeks 19 - 24	Complete Prototypes.
Week 25	Submit First Draft Report for Approval; Schedule oral presentation
Weeks 26 - 28	Finish Final Project Report
Week 29	Oral presentation

❖ Elective Courses: Elective I (Any One Course)

Advanced Problem-Solving Strategies Lab

Course Code: CSE0613204 **Course Title**: Advanced Problem-Solving Strategies Lab

Credits: 1.0 **Credits Hour**: 2 hours per week

Rationale of the Course

This course introduces computer programming and problem solving in a competitive environment. Topics include number theory, graph theory, dynamic programming, advanced data structure, problem-solving methods, algorithm design, and logic control structures. After completion students should be able to implement algorithmic solutions in programming languages.

Course Learning Outcomes

CLO1	**Acquire** adequate knowledge on the need of programming languages and advanced problem-solving techniques.
CLO2	**Develop** programs to implement the algorithms for solving the complex competitive programming problems.
CLO3	**Analyze** complex problems, to construct solutions (algorithms) and to solve those problems.

Course Content

Design and development of programming solutions to solve competitive programming problems on diverse topics. The content includes problem solving strategies such Divisors, Greatest Common Divisor, Least Common Multiple, Prime Number, Bezout's Identity, Sieve of Eratosthenes, Segmented Sieve, Euler Phi Function, Divisor Function, Sum of Divisors, Big Mod, Breadth First Search, Depth First Search, Shortest Path Faster Algorithm, Dijkstra's Algorithm, Floyd-Warshall Algorithm, (Disjoint Set Union, Minimum Spanning Trees, Lowest Common Ancestor, Bit Masking, 0-1 Knapsack, Coin Change, Longest Common Subsequence, Longest Increasing Subsequence, Longest Common Increasing Subsequence, Range Minimum Query, Segment Tree and Trie.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Exercise, Group Discussion	Observation, lab report, quiz
CLO2	Exercise, Group Discussion	Observation, lab report, viva
CLO3	Exercise	Observation, lab report, lab test

Book References

1. Problem-Solving Strategies by Arthur Engel, Latest Edition

Internet Programming Lab

Course Code: CSE0613208 **Course Title:** Internet Programming Lab

Credits: 01 **Credits Hour:** 2 hours per week

Rationale of the Course

This course covers theoretical and practical methods and techniques for programming on the Internet with a focus on the web server side. It covers a wide range of Web and Internet standards, architectural patterns, application frameworks, and programming languages that are used to deliver modern web sites. It will help the students to gain the skills and understanding to extrapolate to the "next" technology in a rapidly changing landscape.

Course Learning Outcomes

CLO1	**Understand** how web technologies interact, from the browser to the backend servers.
CLO2	**Implement** dynamic content web pages using two- and three-tier architectures
CLO3	**Gain** practical experience in a selected set of Web technologies
CLO4	**Learn** to use the technologies that keep pace with the rapidly changing landscape of web application development.

Course Content

Basic concepts of website, web browser, web application, rich internet application, web server, database server, architectural patterns, application frameworks, client-side programming, server-side programming; Session management, Encryption and other security topics; JavaScript and the DOM, JavaScript libraries/frameworks; MVC pattern, Web application frameworks; JSON, Ajax

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2			√									
CLO3	√											
CLO4					√							

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Presentation, Exercise, Group Discussion	Observation, Lab report, Viva
CLO2	Exercise, Mini Project	Observation, Lab Test
CLO3	Exercise, Assignment	Assignment, Quiz, Viva
CLO4	Exercise, Group Discussion, Mini Project	Observation, Lab Test

Book References

1. Programming PHP by Kevin Tatroe, Peter MacIntyre and Rasmus Lerdorf, 3rd Edition.

❖ Elective Courses: Elective II (Any One Course)

Linux Programming Lab

Course Code: CSE0611304 **Course Title**: Linux Programming Lab

Credits: 01 **Credits Hour**: 2 hours per week

Rationale of the Course

The Linux programming laboratory course covers major methods of Inter Process Communication (IPC), which is the basis of all client / server applications under Linux, Linux Utilities, working with the Bourne again shell (bash), files, process and signals. After completion of this course, students will be able to work with extensive programming exercises in shell scripts. It also emphasizes various concepts in multithreaded programming and socket programming.

Course Learning Outcomes

CLO1	**Solve** problems systematically using a structured logic approach.
CLO2	**Analyze** problems using a structured approach and construct a Linux program correctly based on that.
CLO3	**Develop** complete lab programs for simple to moderate problems individually.

Course Content

Study of purpose command list obtained from (man, who, cat, cd, ps, ls, mv,mkdir, rmdir, rm, echo, more, date, time, kill, pwd). Gather knowledge on the basic and advanced concepts of Shell Scripting. Implementation of shell programming on multiple problem-solving tasks.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1			√									
CLO2		√										
CLO3					√							

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Exercise, Lab Tasks, Group Discussion	Observation, lab report, Quiz
CLO2	Exercise, Lab Tasks, Group Discussion	Observation, lab report, viva
CLO3	Exercise, Lab Tasks	Observation, lab report, lab test

Book References

1. Linux Pocket Guide: Essential Commands by Daniel J. Barrett ,3rd Edition

❖ Elective Courses: Elective III (Any One Course)

Technical Writings and Presentation Lab

Course Code: CSE0619492 **Course Title:** Technical Writings and Presentation Lab

Credits: 1.0 **Credits Hour:** 2 hours per week

Rationale of the Course

The main objective of this course is to develop effective writing and presentation skills in students. After learning effective data gathering, interpreting and presentation skills, students will be able to write clear, persuasive and accessible documents for intended audiences. Furthermore, this course aims to develop textual, linguistic and presentation competencies in students appropriate for their professional careers.

Course Learning Outcomes

CLO1	**Write** clearly and fluently to produce effective technical documents.
CLO2	**Demonstrate** an appropriate communication style to different types of audiences both orally and written as per demand of their professional careers.
CLO3	**Communicate** in an ethically responsible manner.

Course Content

Introducing technical writing, Reasons for technical writing, Importance of technical writing.

The writing processes (Pre-writing, Writing, Re-writing), Objectives in technical writing, Audience recognition and involvement; Professional Letter writing.; The document design using illustrations; Oral Communication; Technical descriptions; Performing technical studies. Formal report writing. Patents; Informal report writing. Email messages. The Summary writing. Reviewing and editing techniques; Research paper writing. Thesis writing; Presentations.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Outcomes (POs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3	√											

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Presentation, Exercise, Group Discussion	Observation, Quiz, Viva
CLO2	Exercise, Group Discussion, Mini Project	Observation, Lab Test
CLO3	Exercise, Group Discussion, Mini Project	Observation, Final Lab Test, Presentation

Book References:

1. Technical Writing Process by Kieran Morgan, 2nd Edition

❖ Elective Courses: Elective IV (Any One Course with Lab)

Internet of Things

Course Code: CSE0612401 **Course Title:** Internet of Things

Credits: 03 **Credits Hour:** 3 hours per week

Rationale of the Course

This course provides advanced data collection, connectivity, and analysis of information collected by computers everywhere—taking the concepts of Machine-to-Machine communication farther than ever before. This course gives a foundation in the Internet of Things, including the components, tools, and analysis by teaching the concepts behind the IoT and a look at real-world solutions.

Course Learning Outcomes

CLO1	**Explain** the architecture, operation, and business benefits of an IoT solution
CLO2	**Explore** the relationship between IoT, cloud computing, and big data
CLO3	**Identify** how IoT differs from traditional data collection systems

Course Content

Introduction to the Internet of Things, Machine to Machine / User-less Communication, Common Use Cases Components of an IoT, Traditional Data Storage, Analog and Digital I/O Basics

Sensors and Data Collection Points, Embedded Platforms / Microcontrollers, Software Development

Device Security: Physical and Logical, Connectivity Options, Connecting Sensors to the Cloud

Scaling Number of Sensors.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz

Book References

1. The Internet of Things: Key Applications and Protocols by Olivier Hersent, 2nd Edition
2. IoT – Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT by Ketan Kaushik, 3rd Edition

Internet of Things Lab

Course Code: CSE0612402 **Course Title:** Internet of Things Lab

Credits: 1 **Credits Hour:** 2 hours per week

Rationale of the Course

This course provides advanced data collection, connectivity, and analysis of information collected by computers everywhere and taking the concepts of Machine-to-Machine communication farther than ever before. This course gives a foundation in the Internet of Things, including the components, tools, and analysis by teaching the concepts behind the IoT and a look at real-world solutions.

Course Learning Outcomes

CLO1	**Explain** the concept of Internet of Things
CLO2	**Implement** interfacing of various sensors with Arduino/Raspberry Pi.
CLO3	**Demonstrate** the ability to transmit data wirelessly between different devices
CLO4	**Show** an ability to upload/download sensor data on cloud and server.

Course Content

Introduction to the Internet of Things, Machine to Machine / User-less Communication, Common Use Cases Components of an IoT, Traditional Data Storage, real time, collects, integrates and analyzes data from millions of internet-connected devices that range from cameras, smartphones and wearables, to vehicles, medication pills, and industrial machines and develop innovative IoT-based solutions for industries and governments .Sensors and Data Collection Points, Embedded Platforms / Microcontrollers, Software Development. Device Security: Physical and Logical, Connectivity Options, Connecting Sensors to the Cloud Scaling Number of Sensors.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2			√									
CLO3		√										
CLO4				√								

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References

1. The Internet of Things: Key Applications and Protocols by Olivier Hersent, 2nd Edition

2. IoT – Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT by Ketan Kaushik, 3rd Edition

Foundation of Data Science

Course Code: CSE0612403 **Course Title:** Foundation of Data Science

Credits: 03 **Credits Hour:** 3 hours per week

Rationale of the Course

This course introduces the fundamental concepts, principles, and techniques of Data Science. It emphasizes the state-of-the-art data preprocessing techniques and models and algorithms essential to undertake data science-related problems. Also, this course exposes students to the latest developments of data science computing, and prepares them for further study of and research in machine learning, computer vision, and natural language processing.

Course Learning Outcomes

CLO1	**Identify** the need for data science and solve basic problems using Python built-in data types and their methods.
CLO2	**Design** an application with user-defined modules and packages using the OOP concept. Employ efficient storage and data operations using NumPy arrays.
CLO3	**Apply** powerful data manipulations using Pandas, do data preprocessing and visualization using Pandas and acquire knowledge on different machine learning models and algorithms.
CLO4	**Perform** experiments with machine learning, computer vision (CV), natural language processing (NLP), etc.

Course Content

Introduction to Data Science - Why Python? - Essential Python libraries - Python Introduction- Strings, List, Tuples, Dictionary, Set - type Conversion- Operators. Decision Making- Looping- Loop Control statement, user-defined functions - function arguments & its types.

User-defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods - Python Exception Handling. OOPs Concepts -Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance.

NumPy Basics: Arrays and Vectorized Computation- The NumPy array- Creating ndarrays- Data Types for ndarrays- Arithmetic with NumPy Arrays- Basic Indexing and Slicing - Boolean Indexing- Transposing Arrays and Swapping Axes.

Introduction to pandas Data Structures: Series, Data Frame, Essential Functionality: Dropping Entries, Indexing, Selection, and Filtering- Function Application and Mapping- Sorting and Ranking. Summarizing and Computing Descriptive Statistics- Unique Values, Value Counts, and Membership. Reading and Writing Data in Text Format.

Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- String Manipulation: Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.

Machine Learning: Supervised and Unsupervised learning, Linear regression, logistic regression, KNN, Naive Bayes, Decision tree, random forest.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											

CLO2	√											
CLO3		√										
CLO4	√											

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References

1. Foundations of Data Science by Avrim Blum, John Hopcroft, 1st Edition

Foundation of Data Science Lab

Course Code: CSE0612404 **Course Title:** Foundation of Data Science Lab

Credits: 01 **Credits Hour: 2** hours per week

Rationale of the Course

This course introduces the fundamental concepts, principles, techniques, and applications of Data Science. It emphasizes the state-of-the-art data preprocessing techniques and models and algorithms essential to undertake data science-related problems. Also, this course exposes students to the latest developments of data science computing, and prepares them for further study of and research in machine learning, computer vision, and natural language processing.

Course Learning Outcomes.

CLO1	**Identify** the need for data science and solve basic problems using Python built-in data types and their methods.
CLO2	**Design** an application with user-defined modules and packages using the OOP concept. Employ efficient storage and data operations using NumPy arrays.
CLO3	**Apply** powerful data manipulations using Pandas, do data preprocessing and visualization using Pandas and acquire knowledge on different machine learning models and algorithms.
CLO4	**Perform** experiments with machine learning.

Course Content

Introduction to data science and Python programming: Learn how to use Jupyter notebooks, basic data structures, operators, and control flow in Python.

Data manipulation and exploration with pandas: Learn how to read, write, filter, group, and aggregate data using pandas.

Data visualization with matplotlib and seaborn: Create, customize, and interpret various types of plots and charts. Basic plots like bar, scatter, lines, histogram using seaborn. Advanced plots like box, violin, swarm, and heatmap using seaborn.

Exploratory data analysis and descriptive statistics: Summarize, describe, and explore data using various techniques and tools. Calculate measures of central tendency, variability, and correlation.

Inferential statistics and hypothesis testing: Using statistical methods to make inferences and draw conclusions from data. Perform t-tests, ANOVA, chi-square tests, and regression analysis.

Machine learning basics and supervised learning: Implementing common machine learning algorithms such as linear regression, logistic regression, k-nearest neighbors, decision trees, and random forests using scikit-learn.

Unsupervised learning and clustering: unsupervised learning using scikit-learn. Principal component analysis, k-means clustering, hierarchical clustering, and DBSCAN.
Natural language processing and text analysis: Processing and analyzing text data with nltk and spaCy. Perform tokenization, stemming, lemmatization, part-of-speech tagging, named entity recognition.

Web scraping and APIs: Scraping data from web pages using BeautifulSoup. APIs to access data from various sources such as Twitter, Google Maps, Wikipedia, etc.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										
CLO4	√											

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Presentation, Exercise, Group Discussion	Observation, Quiz, Viva
CLO2	Exercise, Group Discussion, Mini Project	Observation, Lab Test

CLO3	Exercise, Group Discussion, Mini Project	Observation, Lab Test, Presentation
CLO4	Exercise, Group Discussion, Mini Project	Observation, Final Lab Test, Presentation

Book References

1. Foundations of Data Science by Avrim Blum, John Hopcroft, 1st Edition

Mobile Application Development Lab

Course Code: CSE0613406 **Course Title**: Mobile Application Development Lab

Credits: 01 **Credit Hours:** 2 hours per week

Rationale of the Course

This course introduces the components and structure of mobile application development frameworks and understanding how to work with various mobile application development frameworks for Android. It also covers learning the basic and important design concepts and issues of development of mobile applications and understanding the capabilities and limitations of mobile devices. After completion, students should be able to implement the OOPC to develop a mobile application using widgets with event handling.

Course Learning Outcomes

CLO1	**Analyze** the knowledge to build, assess, and analyze the software and hardware aspects of it.
CLO2	**Develop** programs to implement the design of mobile applications.
CLO3	**Apply** professional, managerial, interdisciplinary skill set, and domain specific tools in development processes.

Course Content

Design and development of mobile applications using layout, various widgets, fragment, button, radio button, checkbox, firebase, SQ lite, event handling, authorization, Intent, GPS, different APIs etc.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1			√									
CLO2			√									
CLO3					√							

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Exercise, Mini Project, Group Discussion	Observation, lab report, Quiz
CLO2	Exercise, Mini Project, Group Discussion	Observation, lab report, viva
CLO3	Exercise, Mini Project	Observation, lab report, lab test

Book References:

Android App Development for Dummies by Barry Burd, 6th Edition

Geographical Information Systems & Applications

Course Code: CSE 0613407

Credits: 3.0

Course Title: Geographical Information Systems & Applications

Credits Hour: 3 hours per week

Rationale of the Course

This course introduces the fundamental theories and concepts of Geographic Information Systems (GIS). The course content will include data input, storage and editing, spatial data structures, analytical functions of a GIS, data output, management of GIS, and applications of GIS.

Course Learning Outcomes

CLO1	**Understand** basic GIS theory and principles
CLO2	**Understand** the importance of scale, projection, and coordinate systems in GIS
CLO3	**Analyze** the issues associated with the implementation, operationalization and management of GIS.

Course Content

An introduction to GIS: The purpose of GIS, Some fundamental observations. A first definition of GIS, Spatial data and geo-information, Applications of GIS, The real world and representations of it, Modelling, Maps, Databases, Spatial databases. Geographic information and Spatial data types: Geographic phenomenon, types of phenomena, Geographical fields, Objects and boundaries, Computer representations of geographic information, Organizing one's spatial data, The temporal dimension. Data processing systems: Hardware and software trends, Geographic information systems, Database management systems. Data entry and preparation: Spatial data input, Spatial referencing, Data preparation, Point data transformation, Advanced operations on continuous field rasters. Spatial data analysis: Classification of analytic GIS capabilities, Retrieval, classification
and measurement, Overlay functions, Neighborhood functions, Network analysis. Data visualization: GIS and maps, the visualization process, Visualization strategies: present or explore, The cartographic toolbox, how to map, Map cosmetics, Map output. Data quality and metadata: Basic concepts and definitions, Measures of location error on maps, Error propagation in spatial data processing, Metadata and data sharing.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz

Book References:

1. Geographical Information Systems: Principles, Techniques, Management and Applications by Paul A. Longley, Michael F. Goodchild and David J. Maguire, 2nd Edition

Geographical Information Systems & Applications Lab

Course Code: CSE 0613408

Credits: 1.0

Course Title: Geographical Information Systems & Applications Lab

Credits Hour: 2 weeks per week

Rationale of the Course

This course aims are to Introduce basic concepts in GIS, provide exposure to basic tools and techniques in GIS software and Introduce applications of GIS in relevant areas.

Course Learning Outcomes:

Upon completion of this course, a fully engaged student will be able to:

CLO1	**Know** the basic concepts in GIS
CLO2	**Work** with basic tools in GIS software
CLO3	**Apply** GIS tools and techniques in related applications

Course Content

Familiarization with GIS Software, Data Input, Geo Referencing and Projections Digitization of Map/Top sheet, Creation of Thematic Maps, Base Map Preparation, Data Conversion – Vector to Raster, Raster to Vector, Adding Attribute Data – Querying on Attribute Data, Vector Analysis, Raster Analysis, Map Composition, Developing Digital Elevation Model, Simple Applications of GIS.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Exercise, Mini Project, Group Discussion	Observation, lab report, Quiz
CLO2	Exercise, Mini Project, Group Discussion	Observation, lab report, viva
CLO3	Exercise, Mini Project	Observation, lab report, lab test

Book References:

1. Geographical Information Systems: Principles, Techniques, Management and Applications by Paul A. Longley, Michael F. Goodchild and David J. Maguire, 2nd Edition

❖ Specialization Courses: Intelligent Systems

Machine Learning

Course Code: CSE0611431 **Course Title:** Machine Learning

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course learns paradigms in different environmental settings and applies the appropriate learning algorithm to best suit the current need. This course will enhance the learning parameters to achieve maximum performance.

Course Learning Outcomes

CLO1	**Discuss** the different learning paradigms in different environmental settings.
CLO2	**Understand** the fundamental issues and challenges of machine learning: data, model selection, model complexity etc.
CLO3	**Appreciate** the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and unsupervised learning.
CLO4	**Select** and apply the appropriate learning algorithm to best suit the current need**.**
CLO5	**Enhance** the learning parameters to achieve maximum performance.

Course Content

Introduction to Machine Learning; Regression analysis: Logistic Regression, Linear Regression; Supervised and Unsupervised learning; Bayesian Learning; Decision Tree Learning; Rule based learning; Instance based learning; Neural Nets; Support Vector Machine; Genetic Algorithms; Reinforcement learning; Ensemble learning; Hidden Markov

Models; Maximum Likelihood Estimates, Parameter Estimation; Computational learning theory.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcome (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√											
CO2	√											
CO3	√	√										
CO4		√										
CO5		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Class Test, Quiz
CLO4	Lecture, Group Discussion	Examination, Assignment
CLO5	Lecture, Exercise, Assignment	Examination, Assignment, Quiz

Book References

1.Machine Learning in action by Peter Harington, 4th Edition

2. Data Mining Concepts and Techniques by Jiawei Han and Micheline Kamber, 2nd Edition

Machine Learning Lab

Course Code: CSE0611432 **Course Title**: Machine Learning Lab

Credits: 01 **Credits Hour**: 2 hours per week

Rationale of the Course

This course introduces machine learning; Data preparation, model building, and data mining techniques such as clustering, decision trees and neural networks; Induction of predictive models from data: classification, regression, and probability estimation; Application case studies; Data-mining software tools review and comparison.

Course Learning Outcomes

CLO1	**Possess** the basic knowledge of Weka and Python concerning data mining and machine learning.
CLO2	**Implement** different data mining and machine learning algorithms like classification, prediction, clustering and association rule mining to solve real-world problems using Python.
CLO3	**Compare** and **evaluate** different data mining and machine learning algorithms like classification, prediction, clustering and association rule mining using Python.

Course Content

Introduction to supervised and unsupervised machine learning algorithms. Discussion on feature/attribute selection. Discussion on Project and execution plan, classification-based algorithm and Cluster Analysis: partitional (K-means), hierarchical, density-based with Python

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1				√								
CLO2			√									
CLO3					√							

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Exercise, Mini Project, Group Discussion	Observation, lab report, Quiz
CLO2	Exercise, Mini Project, Group Discussion	Observation, lab report, viva
CLO3	Exercise, Mini Project	Observation, lab report, lab test

Book References

1.Machine Learning in action by Peter Harington, 4th Edition

2. Data Mining Concepts and Techniques by Jiawei Han and Micheline Kamber, 2nd Edition

Pattern Recognition

Course Code: CSE0611433 **Course Title:** Pattern Recognition

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course provides a comprehensive introduction to pattern recognition techniques leading to the ability to understand contemporary terminology, progress, issues, and trends. This course will help to specify sectors and context where the application of pattern recognition can provide a fruitful solution.

Course Learning Outcomes

CLO1	**Identify** areas where pattern recognition techniques can offer a solution.
CLO2	**Analyze** the strength and limitations of some techniques used in pattern recognition for classification, regression and density estimation problems.
CLO3	**Solve** problems in regression and classification.
CLO4	**Develop** communication skill by presenting topics on pattern recognition

Course Content

Introduction to pattern recognition: Statistical and Neural Pattern Recognition, Bayesian decision theory; Classifiers: Linear classifiers, Nonlinear classifiers; Estimation Techniques: Parametric estimation techniques; non-parametric estimation techniques; Methods and Models: Template matching, Dynamic programming methods, correlation methods, Hidden Markov model, Support vector machine, Syntactic pattern recognition, Clustering algorithms, Principal component analysis.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	√											
CO2		√										
CO3			√									
CO4										√		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Pattern Recognition by Konstantinos Koutroumbas and Sergios Theodoridis, 4th Edition

2. Mastering Financial Pattern Recognition: Finding and Back-Testing Candlestick Patterns with Python by Sofien Kaabar, 1st Edition

Pattern Recognition Lab

Course Code: CSE0611434 **Course Title:** Pattern Recognition Lab

Credits: 1.0 **Credits Hour:** 2 hours per week

Rationale of the Course

This course motivates to apply various algorithms and techniques - classification, regression, clustering, neural network, decision tree and other estimation techniques which helps to identify different types of patterns in data that can give required solutions and suggestions to real-life problems for various applications.

Course Learning Outcomes

CLO1	**Understand** pattern recognition problems and select suitable techniques that can offer a solution.
CLO2	**Implement** solutions to problems in classification and regression through group project work.
CLO3	**Develop** oral and written communication skills to deliver solutions on pattern recognition problems.

Course Content

Introduction to MATLAB, Python Script, Bayes Classifier, K-Nearest Neighbor Classification, Linear Classifiers, Perceptron Algorithm, Clustering Algorithms, Support Vector Machine, Neural Network, Decision Tree;

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1				√								
CLO2									√			
CLO3										√		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Presentation, Viva
CLO2	Lecture, Group Discussion, Practical work	Lab Test, Assignment, Quiz, Viva
CLO3	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz, Viva

Book References:

1. Pattern Recognition by Konstantinos Koutroumbas and Sergios Theodoridis, 4th Edition

2. Mastering Financial Pattern Recognition: Finding and Back-Testing Candlestick Patterns with Python by Sofien Kaabar, 1st Edition

Computer Vision

Course Code: CSE0611435 **Course Title:** Computer Vision

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course introduces the fundamental concepts, principles and techniques of Computer Vision. Through this course students will get an organized concept of digital image formation process and computer vision related tools and techniques.

Course Learning Outcomes

CLO1	**Explain** about image formation techniques.
CLO2	**Apply** methods like Image filtering, segmentation, clustering, edge detection etc. to solve problems.
CLO3	**Integrate** modern tools and libraries to a computer vision project.
CLO4	**Evaluate** the challenges of digital image processing and computer vision.

Course Content

Introduction: Human Vision, Computer Vision, and Robots Vision System, Sensing, Seeing, and perceiving, the role of Vision. **Image formation:** The physics of imaging. Representing, acquiring, and displaying images. Grayscale, color, noise, lens distortion, blurring, and filtering. Image processing, preprocessing and image correction. Binary image analysis, Enhancing features and correcting imperfections, image understanding, Fourier Transform. Computer Vision Paradigms: Pixels, lines, boundaries, regions, and object representations, "Low-level", "intermediate-level", and "high-level" vision. **Image Analysis:** Finding edges (low-level), Gradients, zero crossing detectors, line models. Finding and grouping lines (intermediate-level), Boundary tracing, line fitting, Hough transform, Finding and processing regions Finding "elementary regions" (low-level) Merging, splitting, and grouping regions (intermediate-level), Grouping and analyzing lines and regions (high-level). **Feature Extraction/Analysis:** Feature extraction, shape, histogram, color, spectral, texture, using CVIP tools, Feature analysis, feature vectors, distance /similarity measures, data preprocessing, Segmentation/ Morphological Filtering, texture. Stereo, and Motion: Optical Flow and FOE, motion Understanding. Pattern classification using computer vision Applications in medicine, industry, and surveillance.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Outcomes (POs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3					√							
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group Discussion	Examination, Class Test

CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Computer Vision: Algorithms and Applications by Richard Szeliski , 2nd Edition

2. Practical Machine Learning for Computer Vision: End-to-End Machine Learning for Images by Valliappa Lakshmanan, Martin Görner and Ryan Gillard, 1st Edition

Computer Vision Lab

Course Code: CSE0611436 **Course Title:** Computer Vision Lab

Credits: 1.0 **Credits Hour:** 2 hours per week

Rationale of the Course

The Computer Vision Sessional course is designed to facilitate better understanding of dealing with various computer vision related tools & Software. This course is also integrating with digital image processing and visionary signals for getting desired output.

Course Learning Outcomes

CLO1	**Develop** a good understanding of the fundamental issues and challenges computer vision related tools & software.
CLO2	**Design** and implement image processing methods like image recognition, classification, extraction, detection etc.
CLO3	**Integrate** modern tools and libraries to a computer vision project.

Course Content

Computer Vision basics: Visual perception, Light and Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Concept of pixels, Linear and Nonlinear operations and Camera Structure.

Image Transformations: Introduction to MATLAB for Computer Vision Related issues. First Fourier Transform (FFT), Discrete Cosine Transform (DCT), Karhunen and Loeve Transform (KLT), Wavelet transform and sub-band decomposition. Image enhancement in the frequency domain and image restoration techniques, image compression techniques, image compression standards: JPEG, MPEG, H.261, and H.263, Image Filter, Image Segmentation.

Image Classification & Detection: Basic Concepts of CUDA, OpenCV, Keras, Tensorflow, Viso Suite for dealing with image classification & detection issues.

Mapping Course Learning Outcomes (CLOs) with the PLOs

	Program Outcomes (POs)

Course Learning Outcomes (CLOs)	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2			√									
CLO3					√							

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Lab Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Lab Test

Book References:

1. Computer Vision: Algorithms and Applications by Richard Szeliski , 2nd Edition

2. Practical Machine Learning for Computer Vision: End-to-End Machine Learning for Images by Valliappa Lakshmanan, Martin Görner and Ryan Gillard, 1st Edition

Digital Image Processing

Course Code: CSE0611437 **Course Title:** Digital Image Processing

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

This course describes image formation and the role the human visual system plays in perception of gray and color image data and to explain the basic elements and applications of image processing. It will help to select and analyze image sampling and quantization requirements and implications. The students will learn to perform gray level transformations for Image enhancement.

Course Learning Outcomes

CLO1	**Understand** image formation and the role of the human visual system in perception of gray and color image data.
CLO2	**Evaluate** the basic objectives and applications of image processing.
CLO3	**Analyze** image sampling and quantization requirements and implications.
CLO4	**Develop** communication skills by presenting topics on operating systems.

Course Content

Digital image fundamentals: visual perception, Light and Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some basic relationships between 245 pixels, Linear and Nonlinear operations; image transforms: First Fourier Transform (FFT), Discrete Cosine Transform (DCT), Karhunen and Loeve Transform (KLT), Wavelet transform and sub-band decomposition; image enhancement in the frequency domain and image restoration techniques, image compression techniques, image compression standards: JPEG,MPEG, H.261, and H.263, Image Filter, Image Segmentation.

4. Mapping of Course CO and PO

Course Learning Outcomes (CLOs)	Program Learning Outcome (PLOs)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	√											
CO2		√										
CO3			√									
CO4										√		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment
CLO3	Lecture, Exercise, Assignment	Examination, Assignment
CLO4	Lecture, Group Discussion	Examination, Presentation

Book References:

1. Digital Image Processing, Prentice-Hall Publication by Rafeal C. Gonzalez and Richard E. Woods, 3rd Edition

Digital Image Processing Lab

Course Code: CSE0611438 **Course Title:** Digital Image Processing Lab

Credits: 1.0 **Credits Hour:** 2 hours per week

Rationale of the Course

This course introduces the basic concept and methodology of Digital image Processing like image acquisition, enhancement, color image processing, restoration, compression, morphological processing, segmentation and its use in current systems that handle visual information, including television, photographs, x-rays etc. and further study and research in this field.

Course Learning Outcomes

CLO1	**Familiarization** with image acquisition, enhancement and color image processing.
CLO2	**Perform** image enhancement in the spatial domain.
CLO3	**Apply** MATLAB functions for image conversion.

Course Content

MATLAB workspace, Command Window, Variable panel 2) Working with variables, vectors and function 3) Working with library functions. 4) Getting started with MATLAB plotting tools. Demonstrates the different image data class likes: Logic, Arbitrary Double, Scaled Double (0 – 1), Uint8, Uint16, or Grey-scale; Application of image shrinking and enlarging. It also demonstrates the implementation of effective image resolution.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion, Exercise	Lab Work, Assignment, Lab Assessment
CLO2	Lecture, Exercise, Group Discussion, Assignment	Lab Work, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Lab Work, Assignment, Quiz, Viva, Lab Test

Book References:

1. Digital Image Processing, Prentice-Hall Publication by Rafeal C. Gonzalez and Richard E. Woods, 3rd Edition

Information Retrieval

Course Code: CSE0612439 **Course Title:** Information Retrieval

Credits: 3.0 **Credits Hour:** 3 hours per week

Rationale of the Course

The main objective of this course is to present scientific support in the field of information search and retrieval. This course explores the fundamental relationship between information retrieval, hypermedia architectures, and semantic models, thus deploying and testing several important retrieval models such as vector space, Boolean and query expansion. It discusses implementation and evaluation issues of new algorithms like clustering, pattern searching, and stemming with advanced data/file structures, indirectly facilitating a platform to implement a comprehensive catalog of information search tools while designing an e-commerce web site.

Course Learning Outcomes

CLO1	**Describe** models like vector-space, probabilistic and language models to identify the similarity of query and document.
CLO2	**Implement** clustering algorithms like hierarchical agglomerative clustering and k-means algorithms.
CLO3	**Understand** relevance feedback in vector space model and probabilistic model.
CLO4	**Understand** natural language systems to build semantic networks for text.

Course Content

Introduction: Retrieval strategies: vector space model, Probabilistic retrieval strategies: Simple term weights, non-binary independence model, Language models.

Retrieval Utilities: Relevance feedback, clustering, N-grams, Regression analysis, Thesauri.

Retrieval utilities: Semantic networks, parsing Cross –Language: Information Retrieval: Introduction, Crossing the Language barrier.

Efficiency: Inverted Index, Query processing, Signature files, Duplicate document detection.

Integrating structured data and text. A historical progression, Information retrieval as relational application, Semi Structured search using a relational schema. Distributed Information Retrieval: A theoretical Model of Distributed retrieval, web search.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3	√											
CLO4	√											

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Introduction to Information Retrieval by Christopher D. Manning , Prabhakar Raghavan and Hinrich Schütze, 3rd Edition

Information Retrieval Lab

Course Code: CSE0612440 **Course Title:** Information Retrieval Lab

Credits: 1.0 **Credits Hour:** 2 hours per week

Rationale of the Course

The main objective of this course is to present scientific support in the field of information search and retrieval. This course explores the fundamental relationship between information retrieval, hypermedia architectures, and semantic models, thus deploying and testing several important retrieval models such as vector space, Boolean and query expansion. It discusses implementation and evaluation issues of new algorithms like clustering, pattern searching, and stemming with advanced data/file structures, indirectly facilitating a platform to implement a comprehensive catalog of information search tools while designing an e-commerce web site.

Course Learning Outcomes

CLO1	**Implement** clustering algorithms like hierarchical agglomerative clustering and k-means algorithms.
CLO2	**Illustrate** how N-grams are used for detection and correction of spelling errors.
CLO3	**Design** the method to build an inverted index.

Course Content

Learn to write code for text indexing and retrieval; Learn to evaluate information retrieval systems; Learn to analyze textual and semi-structured data sets; Learn to evaluate information retrieval systems; Learn about text similarity measure; Understanding about search engine; Text Classification.

Mapping Course Learning Outcomes (CLOs) with the PLOs:

Course Learning Outcomes (CLOs)	Program Learning Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3	√											

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy:

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Presentation, Exercise, Group Discussion	Observation, Quiz, Viva
CLO2	Exercise, Group Discussion, Mini Project	Observation, Lab Test
CLO3	Exercise, Group Discussion, Mini Project	Observation, Lab Test, Presentation

Book References:

1. Introduction to Information Retrieval by Christopher D. Manning , Prabhakar Raghavan and Hinrich Schütze, 3rd Edition

Theory of Fuzzy Systems

Course Code: CSE0611453 **Course Title:** Theory of Fuzzy Systems

Credits: 03 **Credit hour:** 3 hours per week

Rationale of the Course

This course introduces the fundamental concepts and principles of Crips and Fuzzy set theory. It emphasizes the state-of-the-art models and algorithms essential to undertake the uncertainty and reasoning. Also, this course exposes students to analyze statistical data and compare fuzzy logic methods and statistical methods and prepare them for further study of and research in fuzzy set theory.

Course Learning Outcomes

CLO1	**Understand** Crips and Fuzzy set theory.
CLO2	**Recognize** fuzzy logic membership function and fuzzy inference systems.
CLO3	**Analyze** statistical data by using fuzzy logic methods and compare with statistical method.
CLO4	**Evaluate** fuzzy statistics applications.

Course Content

Introduction to Fuzzy sets , Crisp vs Fuzzy Types of Fuzzy sets, Membership functions , Alpha cuts, Operation on fuzzy sets, t-norm, complements t-conorm, combination of operations continued, Introduction to Fuzzy arithmetic Interval arithmetic, using alpha cuts MIN and MAX fuzzy numbers, Fuzzy arithmetic using Alpha cuts continued Decomposition principle, Extension principle Fuzzy arithmetic using Extension Principle Fuzzy Equations, Relations, Introduction to fuzzy relations Projections, Equivalence relation, transitive closure, compatibility relation, Introduction to propositional Logic, Boolean Algebra Multi valued logic ,Fuzzy Logic, Linguistic hedges, Fuzzy propositions (conditional and unconditional),Inference from conditional and qualified and quantified fuzzy propositions, Fuzzy Quantifiers, Introduction to possibility theory ,Possibility vs probability Belief and Plausibility, Dempster's rule.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Outcomes (POs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											

CLO3		√										
CLO4		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Exercise	Examination, Class Test

Book References:

1. An Introduction to Fuzzy Set Theory and Fuzzy Logic, Chander Mohan, Second Edition

Theory of Fuzzy Systems Lab

Course Code: CSE0611454 **Course Title:** Theory of Fuzzy Systems Lab

Credits: 01 **Credit hour:** 2 hours per week

Rationale of the Course

This course is designed to implement different fuzzy logic methods and statistical methods. It emphasizes the state-of-the-art models and algorithms essential to undertake the uncertainty and reasoning. Also, this course exposes students to analyze statistical data for research purpose.

Course Learning Outcomes

CLO1	**Understand** components of Soft Computing and differentiate between hard and soft computing.
CLO2	**Analyze** and appreciate the applications which can use fuzzy logic and fuzzy set theory.
CLO3	**Implement** fuzzy logic methods and compare with statistical method.

Course Content

Introduction to Fuzzy sets , Crisp vs Fuzzy Types of Fuzzy sets, Membership functions , Alpha cuts, Operation on fuzzy sets, t-norm, complements t-conorm, Introduction to Fuzzy arithmetic using alpha cuts MIN and MAX fuzzy numbers, Fuzzy arithmetic using Alpha cuts continued Decomposition principle and Extension Principle Fuzzy Equations, Relations, Introduction to fuzzy relations Projections, Equivalence relation, transitive closure, compatibility relation, Introduction to

propositional Logic, Boolean algebra and Fuzzy Logic, Linguistic hedges, Fuzzy propositions (conditional and unconditional),Inference from conditional and qualified and quantified fuzzy propositions, Fuzzy Quantifiers, Possibility-Probability Belief and Plausibility, Dempster's rule.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Assignment, Quiz
CLO2	Lecture, Group Discussion, Practical work	Examination, Assignment, Quiz
CLO3	Lecture, Group Discussion, Practical work	Examination, Assignment, Quiz

Data Mining & Warehouse

Course Code: CSE0611455 **Course Title:** Data Mining & Warehouse

Credits: 03 **Credits Hour:** 3 hours per week

Rationale of the Course

This course introduces methods and theory for developing data warehouses and analyzing data using data mining. Data quality and methods and techniques for preprocessing of data. Modeling and design of data warehouses. Algorithms for classification, clustering and association rule analysis. Practical use of software for data analysis.

Course Learning Outcomes

CLO1	**Discuss** the functionality of the various data mining and data warehousing component.
CLO2	**Explain** various data analysis techniques.
CLO3	**Describe** and **analyze** different data mining and data warehouse methodologies.

Course Content

Introduction of data mining-Definition, goals and application, Types of DM systems, DM architecture Issues in DM, KDD process.

Data Pre-processing-Attributes in DM, Basic statistical descriptions of data, Data cleaning, Data integration and transformation, Data reduction.

Association Rule Mining-Association rule mining, Mining of single dimensional Boolean association rules, Multilevel association rules and multidimensional association rules, Correlation analysis.

Classification-Basic issues regarding classification and predication, Classification by Bayesian classification, decision Tree, KNN and back propagation.

Clustering: Cluster analysis, Basic issues, Clustering using partitioning methods, Hierarchical methods, Density based methods, Algorithms for outlier analysis.

Advance Mining: Introduction to spatial mining, Text mining and web mining with related algorithms.

Introduction to data warehousing-Data warehousing components, building a data warehouse, Difference between database system and data warehouse, Data warehouse architecture-3 Tier architecture, multi-dimensional data model, Data cubes- Stars, Snowflakes, Fact constellations, online analytical processing, Typical OLAP operations.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Outcomes (POs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz

Book References

1. Data mining: Concepts and techniques by Han, J., Kamber, M., & Pei, J.Waltham: Morgan Kaufmann, 3rd Edition

2.Introduction to Data Mining and Applications by S. Sumathi, S.N. Sivanandam, 4th Edition

Data Mining & Warehouse Lab

Course Code: CSE0611456 **Course Title:** Data Mining & Warehouse Lab

Credits: 01 **Credits Hour:** 2 hours per week

Rationale of the Course

This course introduces the impart of knowledge on how to implement classical models and algorithms in data warehousing and data mining and to characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering. At the end to compare and contrast different conceptions of data mining.

Course Learning Outcomes

CLO1	**Evaluate** the different models of OLAP and data preprocessing.
CLO2	**List various** algorithms used in information analysis of Data Mining Techniques.
CLO3	**Demonstrate** the knowledge retrieved through solving problems.

Course Content

Listing applications for mining, file format for data mining, conversion of various data files, training the given dataset for an application, testing the given dataset for an application, generating accurate models, data pre-processing – data filters Feature selection, web mining, text mining, design of fact & dimension tables, generating graphs for star schema.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2					√							

CLO3									√			

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	**Lecture, Group Discussion, Exercise, Assignment**	**Lab Performance/Reporting**
CLO2	**Lecture, Group Discussion, Exercise, Assignment**	**Lab Performance/Reporting, Quiz, Viva**
CLO3	**Lecture, Group Discussion, Exercise, Assignment**	**Lab Performance/Reporting, Quiz, Viva**

Book References

1. Data mining: Concepts and techniques by Han, J., Kamber, M., & Pei, J.Waltham: Morgan Kaufmann, 3rd Edition

2.Introduction to Data Mining and Applications by S. Sumathi, S.N. Sivanandam, 4th Edition

Big Data Analytics

Course Code: CSE0612457 **Course Title:** Big Data Analytics

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course presents an introduction to big data, big data analysis and its application to modern systems. The course then deep-dive the big data platform and its use cases, an overview of Apache Hadoop, provide HDFS concepts and interfacing with HDFS, understanding Map Reduce jobs, provide hands on Hadoop ecosystem, apply analytics on structured and unstructured data, exposure to data analytics with R will be studied.

Course Learning Outcomes

CLO1	**Identify** Big Data and its Business Implications.
CLO2	**List** the components of Hadoop and Hadoop Eco-System.
CLO3	**Access** and Process Data on Distributed File System
CLO4	**Develop** Big Data Solutions using Hadoop Eco System.
CLO5	**Analyze** Infosphere, Big Insights, Big Data Recommendations.

Course Content

Introduction to Big Data and Hadoop: Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analyzing Data with Unix tools, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Info Sphere, Big Insights and Big Sheets.

HDFS (Hadoop Distributed File System): The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

Map Reduce: Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Hadoop Eco System: Pig- Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive- Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase- HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL- Introduction.

Data Analytics with R: Machine Learning - Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

Mapping the CLOs with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3			√		√							
CLO4		√	√		√							
CLO5				√	√							

Mapping the CLOs with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture delivery, group discussion	Exam, assignment, quiz
CLO2	Lecture delivery, presentation	Exam, class test, quiz
CLO3	Lecture delivery, case study, exercise	Exam, class test, quiz
CLO4	Lecture delivery, presentation, exercise	Assignment, viva
CLO5	Lecture delivery, presentation, group discussion	Assignment, viva

Book References:

1. Big Data: Principles and best practices of scalable real-time data systems by Nathan Marz and James Warren

Big Data Analytics Lab

Course Code: CSE0612458 **Course Title:** Big Data Analytics Lab

Credits: 01 **Credit Hours:** 2 hours per week

Rationale of the Course

This course is to familiarize the students with most important information technologies used in manipulating, storing, and analyzing big data. The basic tools for statistical analysis, R and Python, and several machine learning algorithms will be examined. The emphasis of the course will be on mastering Spark 2.0 which emerged as the most important big data processing framework. Spark ML (Machine Learning) API and Spark Streaming will be examined which allows analysis of data in flight.

Course Learning Outcomes

CLO1	**Examine** the tools of basic statistics, R and Python for the big data problems.
CLO2	**Analyze** the Big Data with Spark 2.0.
CLO3	**Analyze** the Big Data with Tensor Flow, VoltDB, Data Flow Engines and other memory databases.
CLO4	**Assess** the Quality of Big Data Analysis using Tensor Flow.

Course Content

Basic Statistics and R: We will cover basic statistical concepts with a brief review of R, a language very much used by statisticians. This course will use Python much more that R but we want to acknowledge the importance of this language;

Introduction to Spark 2.0: Spark 2.0 has surpassed Hadoop as the primary mainstream framework for massive data volume processing on huge computer clusters. We will first learn how to construct our computations such that they can process large amounts of data in batch mode. We will go through how to build up Spark clusters;

Basic Neural Network and Tensor Flow: Deep Learning and neural networks are emerging as the most precise tools for many large-scale classification and pattern recognition problems. Tensor Flow will be used on both GPU and CPU devices;

Tensor Flow, VoltDB, Data Flow Engines, and other memory databases are used to analyze streaming data. We must comprehend the comparative benefits of various systems for processing fast-moving data;

Mapping Course Learning Outcomes (CLOs) with the PLOs

	Program Learning Outcomes (PLOs)

Course Learning Outcomes (CLOs)	1	2	3	4	5	6	7	8	9	10	11	12
CLO1					√							
CLO2	√	√										
CLO3											√	
CLO4								√				

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Big Data: Principles and best practices of scalable real-time data systems by Nathan Marz and James Warren

Bioinformatics & Computational Biology

Course Code: CSE0611459 **Course Title:** Bioinformatics & Computational Biology

Credits: 03 **Credits Hour:** 3 hours per week

Rationale of the Course

This course familiarizes with vast amounts of biomedical and genomic data and the use of computational power to analyze those data. It will impart a solid understanding of the field of bioinformatics sequence analysis, phylogenetics, protein structure prediction, different topics of molecular biology and their application in medical science. This study will help to familiarize with the application of machine learning in computational biology, security and privacy for genomic data etc.

Course Learning Outcomes

CLO1	**Utilize** biomedical and genomic data as well as the use of computational power to analyze those data.

CLO2	**Percept** methods in sequence bioinformatics such as sequence alignment, phylogenetic analysis and pattern recognition.
CLO3	**Analyze** and compile results of bioinformatic analyses, such as protein structure prediction, molecular biology etc.
CLO4	**Solve** given biological problems by using appropriate bioinformatic methods and databases.

Course Content

Introduction to Bioinformatics: The central dogma of biology: DNA, RNA, Sequence alignment: Genomic sequences, Scoring matrices. Pairwise alignment. Online databases: BLAST, Advanced BLAST, Molecular phylogeny: Sequence alignment with dot matrix, Alignment visualization, Optimal alignment using dynamic programming method, Analyzing and sequencing nucleic acids, Structure and hierarchy of proteins: Principles of protein structure, protein secondary structure prediction, Protein tertiary structure prediction, Introduction to phylogenetics: drawing tree diagrams, tree building methods, Constructing phylogenetics tree: Stepwise clustering, Fitch Margoliash method, Maximum parsimony and maximum likelihood method, Ancestral studies using phylogeny, DNA replication: transcription, translation, Multiple sequence alignment, DNA digital data storage: DNA-based Archival Storage System. Human variation and disease: Sequence variation, phenologs, comparative genomics, and Personalized medicine.

Mapping of Course CO and PO

Course Learning Outcomes (CLOs)	**Program Learning Outcome (PLO)**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1				√								
CO2	√											
CO3		√										
CO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz

CLO4	Lecture, Group Discussion	Examination, Class Test

Book References

1. Essential Bioinformatics by Jin Xiong, 1st Edition

Bioinformatics & Computational Biology Lab

Course Code: CSE0611460 **Course Title:** Bioinformatics & Computational Biology Lab

Credits: 01 **Credits Hour:** 2hours per week

Rationale of the Course

This course is designed first of all for biology, agronomy, premed, and statistics students. However, computer science, mathematics, physics and chemistry majors may also find it beneficial. It is designed to benefit computational and experimental biologists as well as biostatisticians to understand the principles of analyzing biological data, building models and testing hypotheses using computer science paradigms. This Course does not depend on any graduate course.

Course Learning Outcomes

CLO1	**Understand** the principles and some methods of genomics, gene expression and proteomics that aid precision medicine, modern plant and animal breeding.
CLO2	**Identify** a biological problem, gather relevant datasets, design and implement new algorithms, apply the methods, and interpret the results.
CLO3	**Compare** several algorithms which solve the same biological problem in terms of their performance and the quality of their outputs on synthetic and real data sets.
CLO4	**Make** sense out of hundreds of differentially expressed genes using Gene Ontology, pathways, gene set enrichment analysis.

Course Content

Genomes: Biological sequence analysis, hidden Markov models, gene finding, comparative genomics, RNA structure, sequence alignment, hashing
Networks: Gene expression, clustering / classification, EM / Gibbs sampling, motifs, Bayesian networks, microRNAs, regulatory genomics, epigenomics
Evolution: Gene / species trees, phylogenomic, coalescent, personal genomics, population genomics, human ancestry, recent selection, disease mapping

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12

CLO1		√										
CLO2		√		√								
CLO3			√	√								
CLO4				√	√	√	√					

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Lab Performance, Viva
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Lab Performance, Viva

Book References

1. Essential Bioinformatics by Jin Xiong, 1st Edition

❖ Specialization Courses: Software Engineering

Software Project Management

Course Code: CSE0613443 **Course Title:** Software Project Management

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course includes software project planning, cost estimation and scheduling, project management tools, factors influencing productivity and success. It also includes productivity metrics, analysis of options and risks, software process standards and process implementation, software contracts and intellectual property and approaches to maintenance and long-term software development.

Course Learning Outcomes

CLO1	**Describe** the basic concepts of software project management and project planning.
CLO2	**Apply** project management techniques to real-world project.
CLO3	**Apply** different techniques in monitoring and control of project and people.

CLO4	**Understand** and **evaluate** project management standard, tools, managing contracts and software quality.

Course Content

Software Management & Economics: The Waterfall Model, Conventional Software Management Performance; Evolution of Software Economics - Software economics, Pragmatic software cost estimation, reducing software product size, Improving software processes.

The old and the new way of project management: Improving team effectiveness, improving automation through software environment, achieving required quality; Peer inspections – A pragmatic view, the principles of conventional software engineering, Principles of modern software management, Transitioning to an iterative process.

Software management process framework: Life cycle phases, the artifact sets, Management artifacts, Engineering artifacts, Pragmatic artifacts; Model Based Software Architectures - A management perspective and A technical perspective.

Project organization and planning: Work breakdown structures, Planning guidelines, the cost and schedule estimating process, the iteration planning process, Pragmatic planning, Line-of-Business organizations, Project organizations, Evolution of organizations; Process automation - Automation building blocks, The project environment.

Project control and Process instrumentation: The Seven-Core metrics, Management indicators, Quality indicators, Life-Cycle expectations, Pragmatic software metrics, Metrics automation, Modern project profiles, Next generation software economics, Modern process transitions.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Outcomes (POs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3		√										
CLO4				√			√					

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Class Test
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test
CLO4	Lecture, Group Discussion	Assignment, Project, Presentation

Book References:

1. Software Engineering A Practitioner's Approach, Roger S. Pressman
2. Software Engineering, Ian Sommerville, 10th Edition

Software Project Management Lab

Course Code: CSE0613444 **Course Title:** Software Project Management Lab

Credits: 01 **Credit hour:** 2 hours per week

Rationale of the Course

This course is aimed at introducing the primary important concepts of project management related to managing software development projects. They will also get familiar with the different activities involved in Software Project Management. Further, they will also come to know how to successfully plan and implement a software project management activity, and to complete a specific project in time with the available budget.

Course Learning Outcomes

CLO1	**Identify** the different project contexts and suggest an appropriate management strategy.
CLO2	**Practice** the role of professional ethics unsuccessful software development.
CLO3	**Identify** and **describe** the key phases of project management.
CLO4	**Determine** an appropriate project management approach through an evaluation of the business context and scope of the project.

Course Content

Software Management & Economics: The Waterfall Model, Conventional Software Management Performance;

The old and the new way of project management: Improving team effectiveness, improving automation through software environment, achieving required quality;

Software management process framework: Life cycle phases, The artifact sets, Management artifacts, Engineering artifacts, Pragmatic artifacts;

Project organization and planning: Work breakdown structures, Planning guidelines, the cost and schedule estimating process, The iteration planning process, Pragmatic planning, Line-of-Business organizations, Project organizations, Evolution of organizations;

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											

CLO2		√		√								
CLO3	√			√								
CLO4				√		√	√					

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion, Assignment	Examination, Lab Report, Lab Performance
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Lab Performance
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Lab Performance
CLO4	Lecture, Group Discussion, Projects	Assignment, Project, Presentation

Book References:

1. Software Testing: Principles and Practices (1st Edition) by Srinivasan Desikan, Gopalaswamy Ramesh

Software Testing & Quality Assurance

Course Code: CSE0613445 **Course Title:** Software Testing & Quality Assurance

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course is for those who want to work as software testers. This course covers software testing in detail. Students will be able to write a software quality plan· Define software quality metrics, prepare software quality checklists, develop an overall process improvement, writing test cases and plans, Testing methods such as verification, validation, tools, and testing metrics, Debugging techniques and best practices, Benefits of test automation, Introduction to TDD and BDD concepts as well as GIT and GitHub software.

Course Learning Outcomes

CLO1	**Explain** the fundamental concepts of software testing.
CLO2	**Identify** the fundamental differences between quality assurance and testing.
CLO3	**Design** independent paths and the test cases for a software.
CLO4	**Improve** the system's stability and smoothness.

Course Content

Software Testing Principles, Software Development Life Cycle, Software Testing Life Cycle, Types of Software Testing, Levels of Testing, SDLC models(Waterfall model, Spiral Model, Hybrid Model, Prototype Model), Manual Testing, Automation Testing, White Box Testing, Black Box Testing, Grey Box Testing, White Box Techniques, Functional Testing, Non-Functional Testing, Unit Testing, Integration Testing, System Testing, Acceptance testing (alpha,beta), Types of Non-functional (Performance Testing, Usability Testing, Compatibility Testing), Test case development(Testing Documentation, Test Scenario, Test Case), Testing Techniques (Error Guessing, Boundary Value analysis), Test Management (Test Plan, Test case review process, Requirement Traceability Matrix), Defect Tracking (Bug in Software Testing, Bug Life cycle), Other types of Testing (Regression Testing, Smoke Testing, Sanity Testing, Static Testing, Dynamic Testing, Load Testing, Stress Testing).

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3		√										
CLO4				√			√					

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Class Test
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test
CLO4	Lecture, Group Discussion	Assignment, Project, Presentation

Book References:

1. Software Testing: Principles and Practices (1st Edition) by Srinivasan Desikan, Gopalaswamy Ramesh

Software Testing & Quality Assurance Lab

Course Code: CSE0613446 **Course Title:** Software Testing & Quality Assurance lab

Credits: 01 **Credit hour:** 2 hours per week

Rationale of the Course

The course will prepare students to independently conduct research in software testing and quality assurance, and to apply that knowledge in their future. Also, the course aims to study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods.

Prerequisite: CSE0613315: Software Engineering and System Analysis

Course Learning Outcomes

CLO1	**Understand** the concept and need of software testing.
CLO2	**Understand** the need and usage of software tools required for manual and automated testing in the current industry scenario.
CLO3	**Create** a test plan and apply the core concepts.

Course Content

Understand software testing processes and their application, Relationship between software development testing and product life cycle.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion, Assignment	Examination, Lab Report, Lab Performance
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Lab Performance
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Lab Performance

Book References:

1. Software Testing: Principles and Practices (1st Edition) by Srinivasan Desikan, Gopalaswamy Ramesh.

Software Security and Maintenance

Course Code: CSE0613447 **Course Title:** Software Security and Maintenance

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

The course will prepare students to update their current knowledge and to learn new technologies and theoretical facts. It gives an overview of security issues for software, and provides programming methods for the development of secure applications.

Course Learning Outcomes

CLO1	**Introduce** secure software development issues from the design stage, through to implementation, testing and deployment.
CLO2	**Discuss** the core concepts of software security and the foundational principles that drive construction of resilient software.
CLO3	**Apply** software maintenance fundamentals, including terminology; the nature of and need for maintenance; maintenance costs; evolution and categories of maintenance.
CLO4	**Apply** rigorous techniques to achieve security and privacy.

Course Content

Introduction to Software Maintenance, Forms of Maintenance, Reverse Engineering and Re-engineering, Maintenance Models, Maintenance Personnel, Software evolution, Bug prediction and bug detection, Code duplication, Code reuse, API usage patterns, Highly configurable systems and software product lines, Software merging, Code recommender systems, Challenge of producing and maintaining complex software-intensive system; predictability and improved cost; teamwork in software development; quality assurance; process Centric software engineering practices; software engineering process framework developed by Software Engineering Institute (SEI); capability of each process area; framework to meet challenges; characteristics of software products and processes, its quantification, analysis, prediction, control, and guidelines to achieve both business and technical goals, Software Aging. Legacy Systems: Their issues and challenges. Introduction to Software Evolution, Maintenance and Reengineering. Reverse Engineering: Program Analysis, Architecture Recovery, Software Complexity and Maintenance Metrics, Program Visualization. Forward Engineering: Refactoring, Code Transformation, Web-enabling. Software Reengineering Strategies and Management.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3		√										
CLO4				√			√					

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Class Test
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test
CLO4	Lecture, Group Discussion	Assignment, Project, Presentation

Book References:

1. Software Security: Building Security In (1st Edition) by Gary McGraw

Software Security and Maintenance Lab

Course Code: CSE0613448 **Course Title:** Software Security and Maintenance lab

Credits: 01 **Credit Hour**: 2 hours per week

Rationale of the Course

This course is designed for software professionals that have the expertise to incorporate security practices– Confidentiality, integrity and authentication into each phase of the software development life cycle (SDLC), from software design and implementation to testing and deployment.

Course Learning Outcomes

CLO1	**Utilize** the best practices maintenance process.
CLO2	**Explain** the fundamental concepts of software security and its maintenance.
CLO3	**Exercise** best practices techniques for maintenance.

Course Content

This course addresses problems and solutions for long-term software maintenance and evolution, and for large-scale, long-lived software systems.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion, Assignment	Examination, Lab Report, Lab Performance

CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Lab Performance
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Lab Performance
CLO4	Lecture, Group Discussion, Projects	Assignment, Project, Presentation

Book References:

1. Software Security: Building Security In (1st Edition) by Gary McGraw

Enterprise Resource Planning & Content Management System

Course Code: CSE0612449

Credits: 03

Course Title: Enterprise Resource Planning & Content Management System

Credit Hour: 3 hours per week

Rationale of the Course

The aims of this course are to gain understanding of various Enterprise Systems modules and how they are able to be applied in a business context. The course will present the evolution, components and architecture of Enterprise Systems and help to understand the benefits and drawbacks of implementing Enterprise Systems and how they can assist organizations to improve their overall efficiency. This course will introduce enterprise systems and show how organizations use enterprise systems to run their operations more efficiently and effectively. Students will learn about the critical success factors and implementation strategies that lead to enterprise system success, and about the informational, knowledge, and decision-making opportunities afforded by enterprise systems. The course will examine typical Enterprise Systems modules: materials management (MM), supply chain management (SCM), customer relationship management (CRM), financials, projects and human resource management (HRM). Enterprise systems use a single database to integrate business transactions along and between processes, leading to benefits such as efficient and error-free workflows plus accounting, management reporting and improved decision-making. The course will incorporate a laboratory component using SAP software.

Course Learning Outcomes

CLO1	**Understand** the steps and activities in the ERP life cycle.
CLO2	**Identify** and **describe** typical functionality in an ERP system.
CLO3	**Understand** concepts of reengineering and how they relate to ERP system implementations.
CLO4	**Understand** the technical aspects of ERP systems.

Course Content

Introduction to CRM core competencies; organizational challenges; CRM implementation trends and common CRM implementation planning strategies; define selling-chain management's core competencies; SM business drivers and aspects of SM infrastructure; Business drivers for implementing ERP, core aspects of ERP infra-structure; common ERP applications in industry and common ERP implementation planning strategies; SCM core competencies; planning and execution processes; supply chain fusion; management issues and common SCM implementation planning strategies; E-Procurement business drivers; operating resource procurement; Common E-Procurement business problems; buy-side and sell-side applications and common E-Procurement implementation planning strategies; Core knowledge management application classes; business drivers for KM; Core KM architectural characteristics and common KM implementation planning strategies.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3		√										
CLO4				√			√					

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Class Test
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test
CLO4	Lecture, Group Discussion	Assignment, Project, Presentation

Book References:

1. Modern ERP: Select, Implement & Use Today's Advanced Business Systems (3rd Edition) by Marianne Bradford.

Enterprise Resource Planning & Content Management System Lab

Course Code: CSE0612450

Credits: 01

Course Title: Enterprise Resource Planning & Content Management System Lab

Credit Hours: 2 hours per week

Rationale of the Course

The course will prepare students to comprehend the technical aspects of ERP systems; to understand concepts of reengineering and how they relate to ERP system implementations; to be able to map business processes using process mapping techniques; To understand the steps and activities in the ERP life cycle; To be able to identify and describe typical functionality in an ERP system; To obtain practical hands-on experience with none of the COTS ERP Software e.g. SAP, Oracle. This course will also help to refine communication skills and group work skills, and assist the students in the development of research skills.

Course Learning Outcomes

CLO1	**Explain** the system, basic Management Information Systems and information system levels.
CLO2	**Describe** the selection, acquisition and implementation of enterprise systems.
CLO3	**Demonstrate** a good understanding of basic issues in Enterprise Systems
CLO4	**Demonstrate** an ability to work independently and in a group.

Course Content

Introduction to ERP & ERP Technology; Integrated business solutions; ERP markets and latest development; ERP and Business Process Reengineering; Systems integration; Major Vendors and System vendor selection; ERP Implementation planning and deployment; Enterprise system architectures; ERP Life Cycle: Planning and Package Selection; ERP Life Cycle: Implementation, Operation and Maintenance; Relational database; Sales, CRM and KM; Finance and Accounting; Human Capital Management, Self Service and Outsourcing;

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Outcomes (POs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										
CLO4		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion, Assignment	Examination, Lab Report, Lab Performance
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Lab Performance
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Lab Performance
CLO4	Lecture, Group Discussion, Projects	Assignment, Project, Presentation

Book References:

1. Modern ERP: Select, Implement & Use Today's Advanced Business Systems (3rd Edition) by Marianne Bradford.

Software Measurement and Metrics

Course Code: CSE0612451 **Course Title:** Software Measurement and Metrics

Credits: 03 **Credit Hour**: 3 hours per week

Rationale of the Course

This software metrics course aims to equip students with essential skills and knowledge for developing applications on mobile and wireless computing platforms, primarily focusing on Android. Students will learn programming techniques, design patterns, and the utilization of tools and frameworks necessary for developing standalone applications and mobile portals for enterprise and e-commerce systems. The course emphasizes the entire software development lifecycle, from inception to implementation and testing, with considerations for user characteristics, device capabilities, networking infrastructure, and deployment environments. By understanding these aspects, students can create software that meets stakeholder requirements while adapting to the dynamic landscape of mobile computing.

Course Learning Outcomes

CLO1	Understand various fundamentals of measurement and software metrics
CLO2	Apply frame work and analysis techniques for software measurement.
CLO3	Apply internal and external attributes of software product for effort estimation
CLO4	Apply reliability models for predicting software quality

Course Content

Fundamentals of Measurement: Measurement: what is it and why do it?: Measurement in Software Engineering, Scope of Software Metrics, **The Basics of measurement**: The representational theory of measurement, Measurement and models, Measurement scales and scale types, meaningfulness in measurement ,**A Goal-Based Framework For Software Measurement:** Classifying software measures, Determining what to Measure, Applying the framework, Software measurement validation, Performing Software Measurement validation **Empirical investigation**: Principles of Empirical Studies, Planning Experiments, Planning case studies as quasi-experiments ,Relevant and Meaningful Studies **Software Metrics Data Collection:** Defining good data ,Data collection for incident reports, How to collect data, Reliability of data collection Procedures **Analyzing software measurement data:** Statistical distributions and hypothesis testing, Classical data analysis techniques, Examples of simple analysis techniques, **Measuring internal product attributes: Size** Properties of Software Size, Code size, Design size, Requirements analysis and Specification size, Functional size measures and estimators, Applications of size measures **Measuring internal product attributes: Structure:** Aspects of Structural Measures, Control flow structure of program units, Design-level Attributes, Object-oriented Structural attributes and measures ,**Measuring External Product Attributes:** Modelling software quality, Measuring aspects of quality, Usability Measures, Maintainability measures, Security Measures **Software Reliability: Measurement and Prediction:** Basics of reliability theory, The software reliability problem, Parametric reliability growth models, Predictive accuracy

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	✔											
CLO2		✔										
CLO3			✔									
CLO4				✔								

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Class Test
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test
CLO4	Lecture, Exercise, Assignment	Examination, Class Test

Book References

1. Software Metrics A Rigorous and Practical Approach, Norman Fenton, James Bieman, Third Edition

Software Measurement and Metrics Lab

Course Code: CSE0612452 **Course Title:** Software Measurement and Metrics Lab

Credits: 01 **Credit hour:** 2 hours per week

Rationale of the Course

Software Measurement and Metrics Lab lies in the critical role that measurement and metrics play in software development processes. By understanding and applying relevant metrics, developers can identify areas for improvement and take proactive steps to enhance the quality of their software products. Through the analysis of process metrics, teams can identify bottlenecks, streamline workflows, and optimize resource allocation to improve overall productivity. By establishing baseline metrics and setting measurable objectives, organizations can systematically monitor progress, track performance against predefined targets, and iteratively refine their processes to achieve higher levels of efficiency and quality.

Course Learning Outcomes

CLO1	Understand various measurement techniques and metrics to software projects.
CLO2	Develop practical skills in using software measurement tools and software quality assessment frameworks.
CLO3	Apply measurement and metrics concepts to real-world software development scenarios.

Course Content

Introduction to Software Measurement and Metrics, Measurement Theory and Fundamentals , Software Metrics Frameworks and Models (e.g., ISO/IEC 9126, CMMI), Collecting and Analyzing Software Metrics Data, Understanding and measuring software size: LOC, FP, etc., Measuring software complexity: Cyclomatic Complexity, Halstead Metrics, Metrics for code quality: Coupling, Cohesion, Maintainability Index, Key performance indicators (KPIs), Process improvement methodologies: Lean, Six Sigma, Agile metrics, Implementing metrics-driven decision-making processes.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	✓											
CLO2		✓										
CLO3			✓									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lab sessions and Group discussions	Lab performance, Lab exam
CLO2	Individual and group assignments	Lab exam and Quiz
CLO3	Final project report and presentation	Viva, Lab exam, presentation

Book References

1. Software Metrics A Rigorous and PracticalApproach, Norman Fenton, James Bieman , Third Edition, 2014
2. Software metrics, Norman E, Fenton and Shari Lawrence Pfleeger,International Thomson Computer Press, 1997
3. Metric and models in software quality engineering, Stephen H.Kan, Second edition, 2002, Addison Wesley Professional.

Software Architecture and Design

Course Code: CSE0612453 **Course Title:** Software Architecture and Design

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course provides a comprehensive understanding of software architecture and design principles. Students will learn to conceptualize, plan, and create robust software systems that meet specified requirements. The course covers key architectural styles, design patterns, and best practices for developing scalable, maintainable, and efficient software solutions.

Course Learning Outcomes

CLO1	Understand Software Architecture Fundamentals
CLO2	Demonstrate proficiency in using common design patterns to solve recurring design problems.
CLO3	Analyze trade-offs when making design decisions.
CLO4	Comprehend and apply SOLID principles and other design principles to create modular and maintainable software

Course Content

Introduction to Software Architecture: Definition and importance, Role in the software development life cycle; **Architectural Styles:** Monolithic architecture, Client-server architecture, Microservices architecture, Event-driven architecture; **Design Patterns:** Creational, structural, and behavioral patterns, Singleton, Factory, Observer, MVC, etc. Modeling and Documentation; **UML diagrams:** Architecture documentation standards, Evaluation and Decision Making; **Trade-off analysis:** Technology and framework selection criteria; **Security in Design:** Threat modelingm Best practices for secure software design, Scalability and Performance Optimization; **Horizontal and vertical scaling:** Performance tuning and optimization strategies, Design Principles; **SOLID principles:** Separation of concerns, encapsulation, and cohesion.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	✔											
CLO2		✔										
CLO3			✔									
CLO4				✔								

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Class Test
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test
CLO4	Lecture, Exercise, Assignment	Examination, Class Test

Book References

1. "Software Architecture in Practice" by Len Bass, Paul Clements, Rick Kazman, 3rd Edition

2. "Clean Architecture: A Craftsman's Guide to Software Structure and Design" by Robert C. Martin, 1st Edition

Software Architecture and Design Lab

Course Code: CSE0612454 **Course Title:** Software Architecture and Design

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course provides a comprehensive understanding of software architecture and design principles. Students will learn to conceptualize, plan, and create robust software systems that meet specified requirements. The course covers key architectural styles, design patterns, and best practices for developing scalable, maintainable, and efficient software solutions.

Course Learning Outcomes

CLO1	Understand Software Architecture Fundamentals
CLO2	Demonstrate proficiency in using common design patterns to solve recurring design problems.
CLO3	Analyze trade-offs when making design decisions.
CLO4	Comprehend and apply SOLID principles and other design principles to create modular and maintainable software

Course Content

Introduction to Software Architecture, Overview of software architecture principles, Importance of good design, Common architectural patterns (e.g., client-server, MVC, microservices), Analyze and discuss real-world software architectures, Identify and critique the architecture of well-known applications, Design Principles and Patterns, SOLID principles, Design patterns (e.g., Creational, Structural, Behavioral), Anti-patterns and code smells, Apply SOLID principles to refactor code, Implement design patterns in small projects, Identify and correct anti-patterns in code snippets, System Modeling and Documentation, UML diagrams (Class diagrams, Sequence diagrams, etc.), Architecture documentation standards, Design decision documentation, Create UML diagrams for a given system, Document design decisions and trade-offs, Review and critique architecture documentation, Software Design Tools and Environments, Use of design tools (e.g., Visual Paradigm, Lucidchart), Version control in design (e.g., Git), Collaborative design practices, Practice using design tools to create diagrams, Collaborative design exercises using version control, Group projects to design and document a system collaboratively, Case Studies and Real-World Applications, Analyzing real-world software architectures, Case studies of successful and failed projects, Challenges and lessons learned from industry projects, Analyze and present case studies, Evaluate the architecture of a well-known software system, Discuss challenges and possible improvements.

Final Project, Project Assignment, Design and implement a comprehensive software system, Include documentation, UML diagrams, and rationale for design decisions, Present and defend the architecture choices made

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	✔											
CLO2		✔										
CLO3			✔									
CLO4				✔								

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Class Test
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Class Test
CLO4	Lecture, Exercise, Assignment	Examination, Class Test

Book References

1. "Software Architecture in Practice" by Len Bass, Paul Clements, Rick Kazman, 3rd Edition

2. "Clean Architecture: A Craftsman's Guide to Software Structure and Design" by Robert C. Martin, 1st Edition

Innovation Management and Entrepreneurship

Course Code: CSE0612495 **Course Title:** Innovation Management and Entrepreneurship

Credits: 03 **Credit Hours:** 3 hours per week

Rationale of the Course

The course introduces the students with the role of technology to assist software companies especially small startups to innovate their products, processes, and business models. This course provides the necessary guidelines of which tools to use and under what situations. Covering topics such as risk management, prioritization approaches, and digitally-enabled innovation processes, this premier reference source is an ideal resource for entrepreneurs, software developers, software managers, business leaders, engineers, students and faculty of higher education, researchers, and academicians.

Course Learning Outcomes

CLO1	**Develop** knowledge in technology and innovation based on a synthesis of current theories
CLO2	**Evaluate** theories of ethics and risk management in computers and emerging technologies.
CLO3	**Formulate** strategies for managing technology and innovation in global organizations.

Course Content

Business model innovation, Software startups, Hardware product design, Internet of Things, digitally enabled innovation process, Technology development zones, Digital Marketing.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2								√				
CLO3											√	

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	**Lecture, Group Discussion, Assignment**	**Examination, Assignment**
CLO2	**Lecture, Group Discussion, Assignment.**	**Examination, Assignment**

CLO3	**Lecture, Group Discussion, Assignment**	**Examination, Assignment**

Book References:
1. Innovation Management and New Product Development (6th Edition) by Paul Trott.

Innovation Management and Entrepreneurship Lab

Course Code: CSE0612496

Credits: 01

Course Title: Innovation management and Entrepreneurship Lab

Credit Hour: 2 hours per week

Rationale of the Course

The course introduces the students with the role of technology to assist software companies especially small start-ups to innovate their products, processes, and business models. This course provides the necessary guidelines of which tools to use and under what situations. The students will have hands on experience on managing business-oriented IT projects and IT bases start-ups.

Course Learning Outcomes

CLO1	**Gain** knowledge in innovation and technology-based business model
CLO2	**Analyze** real life problems and find solution to those.
CLO3	**Develop** projects related to digital marketing, software and hardware development or small startups.

Course Content

Business model innovation, Software startups, Hardware product design, Internet of Things, digitally enabled innovation process, Technology development zones, Digital Marketing.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3											√	

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	**Lecture, Group Discussion.**	**Lab Quiz, Viva**

CLO2	**Lecture, Mini Project, Group Discussion.**	**Presentation, Quiz**
CLO3	**Mini Project, Group Discussion**	**Presentation**

Book References:
1. Innovation Management and New Product Development (6th Edition) by Paul Trott.

❖ Specialization Courses: Networks & Security

Telecommunication System Engineering

Course Code: CSE0612463 **Course Title:** Telecommunication System Engineering

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course perceives knowledge regarding different components and techniques of the telecommunication system. It will help to develop knowledge on design and management of various telecommunication systems and develop skill on identification of telecommunication problems solving the respective problems. Students will acquire the knowledge and expertise in the field of telecommunication hardware.

Course Learning Outcomes

CLO1	**Demonstrate** theoretical and technical knowledge of telecommunications systems associated with LANs, MANs, and WANs.
CLO2	**Learn** to design, implement, and manage telecommunications systems using voice and data.
CLO3	**Analyze** telecommunications systems and networks in order to identify and solve these problems.
CLO4	**Acquire** the knowledge and expertise in the field of telecommunication hardware.

Course Content

Introduction: overview of telecommunication; history, evolution, convergence of telecommunication and data networks, National and International regulatory bodies; **Basic elements of Telecommunication**: Telephone apparatus, microphone, speaker, ringer, pulse and tone dialing mechanism, local and central batteries and advanced systems of power supplies; **Transmission media:** Characteristics and applications of twisted pairs, coaxial cables and optical fibers, Terrestrial and satellite microwave, radio waves, VSAT; **Telephone operating principles**: telephone equipment, description of the modern phone; **Telephone switching systems:** PSTN, PBX,

standards; **Basics of communication systems:** modulation, multiplexing; **Switching system:** circuit switching, packet switching; **Traffic analysis**: Traffic characterization, grades of service, network blocking probabilities, delay system and queuing, Integrated services digital network (ISDN), Digital subscriber loop (DSL); **Data communication equipment:** Tele-Traffic analysis; **Cellular telephony:** Frequency reuse, frequency management, channel alignment, handoff strategies, FDMA, TDMA, CDMA and GSM, Introduction to satellite communication, Optical fiber communication, Submarine cables, Digital Radio Microwave, etc.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcome (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√											
CO2			√									
CO3			√	√								
CO4					√							

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Telecommunication System Engineering, 4th Edition by Roger L. Freeman Telecommunication System Engineering (Wiley Series in Telecommunications and Signal Processing) 3rd Edition by Roger L. Freeman

Mobile & Wireless Networks

Course Code: CSE0612465 **Course Title:** Mobile & Wireless Networks

Credits: 03 **Credit Hour**: 3 hours per hour

Rationale of the Course

This course conveys the student a fundamental understanding of the key aspects and considerations of a wireless or mobile network. It teaches students topics including basic concepts of telecommunications, basic technology used in wireless communication, examples and types of systems and devices used for wireless networking, and security for wireless networks.

Course Learning Outcomes

CLO1	**Describe** the characteristics of modern wireless and cellular systems and networks.
CLO2	**Characterize** and **analyze** the radio propagation mechanisms of mobile and wireless environments.
CLO3	**Evaluate** the performances of digital modulation schemes towards effective transmission of user data in different multiple access scenarios.

Course Content

Introduction to wireless networking and mobile networking: Differentiate the term mobility from the term wireless and name some of the drivers that caused the evolution of wireless networks;

Explain what is meant by multiplexing and modulation and define examples of multiplexing techniques like SDMA, TDMA, FDMA, CDMA;

What are the reasons for choosing one multiplexing technique over another technique;

Network components that are part of wireless networking. Identify and illustrate the differences between the different types of wireless networks;

Brief review of 2nd and 3rd generation wireless: GSM, GPRS, CDMA; Cordless system;
Wireless local loop; Bluetooth: overview and baseband specifications;

Explain the considerations that must be known to correctly design a wireless network and define the characteristics of wireless networks that will be examined in accordance with the requirements for that network.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture, Group Discussion	Examination, Class Test

CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz, Class Test

Book References:

1. Telecommunication System Engineering, 4th Edition by Roger L. Freeman Telecommunication System Engineering (Wiley Series in Telecommunications and Signal Processing) 3rd Edition by Roger L. Freeman

Mobile & Wireless Networks Lab

Course Code: CSE0612466 **Course Title:** Mobile & Wireless Networks Lab

Credits: 01 **Credit Hour**: 2 hours per week

Rationale of the Course

The purpose of the course is to expose students to emerging networking protocols and technologies in the field of wireless mobile networks, with focus on Internet-of-Things (IoT) networking, mobile network measurement, mobility modeling and data analytics, connected vehicles, and mobile applications (apps).

Course Learning Outcomes

CLO1	**Acquire** hands-on experience of wireless and mobile networking technologies.
CLO2	**Experiment** with state-of-the-art networking technologies and tools that diagnoses and performs measurements on a mobile device or network.
CLO3	**Analyze** the protocol design and build simulations based on the design.

Course Content

Introduction to the unique challenges in wireless networking: Starting point is "regular" wired networks;

Understanding of wireless technologies at the physical, MAC, and higher layers: Focus is on wireless protocols;

Get experience in working with wireless networks: Implementing protocols, algorithms and Measurements of wireless networks;

Broad view of the state of the art and ongoing research in the wireless domain: hot topics and leading-edge research papers

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3		√	√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion, Exercise	Lab Work, Assignment, Lab Assessment
CLO2	Lecture, Exercise, Group Discussion, Assignment	Lab Work, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Lab Work, Assignment, Quiz, Viva, Lab Test

Book References:

1. Reference Book:1 Wireless Communications and Networks, Prentice Hall William Stallings

Computer Data & Network Security

Course Code: CSE 0612469 **Course Title:** Computer Data & Network Security

Credits: 03 **Credit Hours:** 3 hours per week

Rationale of the Course

This course understands the development of security, traditional encryption, security attacks and the fundamental security objectives. It will help the students to determine and analyze the security objectives, attacks, and models, so is able to recognize the security requirements in real-life cases.

Course Learning Outcomes

CLO1	**Understand** the development of security, traditional encryption, security attacks and the fundamental security objectives.
CLO2	**Evaluate** the security objectives, attacks, and models, so is able to recognize the security requirements in real-life cases
CLO3	**Analyze** the design and implementation issues of a real-life security solution.
CLO4	**Develop** communication skills by presenting topics on operating systems.

Course Content

Security : The Security Environment, Threats, Attackers; **Operating Systems Security** : Secure Systems, Trusted Computing Base; **Controlling Access to Resources**: Protection Domains, Access Control Lists, Capabilities; **Formal Models of Secure Systems:** Multilevel Security, Covert Channels; **Cryptography**: Overview, Symmetric cipher, Classical encryption technique, Block cipher and the data encryption standard (DES), Triple DES, Introduction to finite fields, Advanced Encryption Standard, Contemporary Symmetric Ciphers, confidentiality using symmetric encryption public, Key encryption and Hash functions, Public-key Cryptography, RSA algorithm, Key management, Diffie-Hellman key exchange, Other Public Key Cryptosystem, Message Authentication and Hash function, Hash Algorithm, Digital Signatures, Trusted Platform Modules; **Authentication**: Authentication using a physical object, Authentication using biometrics; **Exploiting Software:** Buffer Overflow Attacks , Format String Attacks, Dangling Pointers, Null Pointer Dereference Attacks, Integer Overflow Attacks, Command Injection Attacks, Time of Check to Time of Use Attacks; **Insider Attacks**: Logic Bombs, Back Doors, Login Spoofing ; **Malware:** Trojan Horses, Viruses, Worms, Spyware, Rootkits; **Defenses**: Firewalls, Antivirus and Anti-Antivirus Techniques, Code Signing, Jailing, Model-Based Intrusion Detection, Encapsulating Mobile Code, Java Security; **Network Security:** Network Security practice, Authentication application, Wireless Network Security, Electrical Mail security, IP security and Web security; **Research on Security and Case Study.**

Mapping of Course CO and PO

Course Outcome (CO) of the Course	**Program Outcome (PO)**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	√											
CO2		√										
CO3			√									
CO4										√		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment
CLO3	Lecture, Exercise, Assignment	Examination, Assignment
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Fundamentals of Network Security, 1st Edition by Eric Maiwald

Cloud Computing and Distributed System

Course Code: CSE0612471 **Course Title:** Cloud Computing and Distributed System\

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

The aim of this course is to examine techniques underlying the design and engineering of distributed systems and cloud computing systems.

Course Learning Outcomes

CLO1	**Provide** a comprehensive view on recent topics and trends in distributed systems and cloud computing.
CLO2	**Design** principles of distributed systems and cloud computing.
CLO3	**Examine** techniques underlying the design and engineering of distributed systems and cloud computing systems.

Course Content

Cloud architectures: SaaS, PaaS, IaaS. End-to-end system design. Networks and protocol stacks, Client-server computing. Sockets and remote procedure call, Distributed file systems and cache consistency. NFS, AFS. Storage in the Cloud: Google/ Hadoop file system, Web services and REST. Example: Amazon S3, The JAX-RS API. Persistent cloud services, Failure models and failure detectors., Asynchrony: publish-subscribe. Server-side events and REST. Web sockets. Vertex: Node.js for Java. Distributed snapshots. Distributed debugging. Time and ordering of events. Causal broadcasts. Batch cloud computing: map-reduce and Hadoop. Domain-specific languages for cloud data processing: Pig and Hive., Transactions. Serializability and recoverability, Long-lived transactions., Transactions. Atomic commitment protocols: 2PC and 3PC., Highly available services. Replicated services and quorum consensus. The CAP Theorem. NoSQL data stores. Table-based (Google Big Table), key-based (Amazon Dynamo), and Cassandra. The Hector API. Query processing with Map-reduce. Consensus and the Paxos algorithm. Applications in the cloud: Google Chubby, Yahoo Zookeeper. Peer-to-peer systems. Distributed hash tables. Applications in multiplayer game-playing.

Distributed Systems

Introduction: What is a distributed system. Examples of distributed systems. Goals (transparency, open operation, scalability, robustness), Distributed Systems Hardware: Multiprocessors. Homogeneous multi-computer systems. Heterogeneous multi-computer systems, Distributed Systems Software: Distributed operating systems. Network operating systems. Middleware, Communication: The Client-server model. Remote Procedure Call. Calling remote objects. Message -based communication. Stream-based communication, Causality: Relationship "happened - before", Distributed Algorithms: Leader Election, MSTs, Consensus, Mutual Exclusion, Replication, Cloud Computing: Map-Reduce, Amazon EC2.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Final Examination, Assignment, Quiz

Book References:

1. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things 1st Edition by Kai Hwang (Author), Jack Dongarra (Author), Geoffrey C. Fox (Author)

Cloud Computing and Distributed System Lab

Course Code: CSE0612472 **Course Title:** Cloud Computing and Distributed System Lab

Credits: 01 **Credit Hour**: 2 hours per week

Rationale of the Course

The goal of this course is to provide a comprehensive view on recent trends in distributed systems and cloud computing. It is an advanced technology that will utilize existing hardware to offer end users remote access to virtual machines. The benefits of this project will apply to the following general audiences: students, instructors and institutions.

The key goals of a distributed system include: Transparency: Achieving the image of a single system image without concealing the details of the location, access, migration, concurrency, failure, relocation, persistence and resources to the users. Openness: Making the network easier to configure and modify.

Course Learning Outcomes

CLO1	**Examine** various techniques underlying the design and engineering of distributed systems and cloud computing systems.
CLO2	**Understand** the basic models and architectures of distributed applications.
CLO3	**Enable** students to master the development skills for providing and constructing distributed services on the Web and cloud.
CLO4	**Understand** different parallel and distributed programming paradigms and algorithms, and gain practice in implementing and testing solutions using these.

Course Content

This course covers a broad range of topics related to parallel and distributed computing, including parallel and distributed architectures and systems, parallel and distributed programming paradigms, parallel algorithms, and scientific and other applications of parallel and distributed computing. In lecture/discussion sections, students examine both classic results as well as recent research in the field. The lab portion of the course includes programming projects using different programming paradigms, and students will have the opportunity to examine one course topic in depth through an open-ended project of their own choosing. Course topics may include: multi-core, SMP, MMP, client-server, clusters, clouds, grids, peer-to-peer systems, GPU computing, scheduling, scalability, resource discovery and allocation, fault tolerance, security, parallel I/0, sockets, threads, message passing, MPI, RPC, distributed shared memory, data parallel languages, MapReduce, parallel debugging, and applications of parallel and distributed computing.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2					√							
CLO3		√										
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Presentation, Quiz, Viva
CLO2	Lecture, Group Discussion	Presentation, Assignment, Quiz, Viva
CLO3	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz, Viva
CLO4	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz, Viva

Book References:

1. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things 1st Edition by Kai Hwang (Author), Jack Dongarra (Author), Geoffrey C. Fox (Author)

Cryptography

Course Code: CSE0612475 **Course Title:** Cryptography

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This is a course on computer security and cryptographic algorithms. The following components are covered in the course: Overview of computer security concepts, Computer security technology and principles, Software security and trusted systems, Management issues, Cryptographic algorithms, and Network security.

Course Learning Outcomes

CLO1	**Understand** the basics of Cryptography and Network Security.
CLO2	**Evaluate** the various cryptographic algorithms.
CLO3	**Use** cryptographic algorithms in network protocols and network applications.
CLO4	**Analyze** the techniques and algorithms for key management, key distribution, and user authentication.

Course Content

Introduction of Classical Encryption Techniques: Computer Security concepts, The OSI security architecture, A model for network security, Symmetric cipher model, Substitution cipher, and Transposition cipher.

DES & Number Theory: Block cipher principles, The Data Encryption Standard, The strength of DES, Differential and linear cryptanalysis, Modular arithmetic, Euclid's algorithm, Finite fields, Polynomial arithmetic.

AES & Block Cipher Operation: The Origins of AES, AES structure, AES Round function, AES key expansion, AES cipher, Avalanche Effect, multiple encryption and triple DES, Block cipher modes of operation, Stream ciphers, and RC4.

Key Management and Distribution: Symmetric key distribution using symmetric encryption and asymmetric encryption, Distribution of public key, public key infrastructure.

Public-Key Encryption: Introduction to number theory, Principles of public-key cryptosystems, Applications for public-key cryptosystems, Requirements for public-key cryptography, the RSA algorithm.

Key Management and Elliptic Curve Cryptography (ECC): Key management, Diffie-Hellman key exchange, Elgamal cryptographic system, Elliptic curve arithmetic, ECC-key exchange using ECC, Elliptic curve encryption/decryption.

MAC and Hash Function: Authentication requirement, Authentication functions, Message authentication code, Hash functions, Security of hash functions and MACs, MD5 message digest algorithm, Secure hash algorithm, RIPEMD-160, HMAC.

Hash Algorithm, Digital Signatures, and Authentication Protocols: Authentication protocols, Secure hash algorithm, HMAC, HMAC design objectives, Digital signature, Elgamal digital signature scheme, Schnorr digital signature scheme, Digital signature standard, Mutual authentication, One-way authentication, Digital signature standard.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12

CLO1	√											
CLO2	√											
CLO3		√										
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Reference Book:1.Cryptography and Network Security Principles and Practice, Prentice Hall, W. Stallings

Cryptography Lab

Course Code: CSE0612476 **Course Title:** Cryptography Lab

Credits: 01 **Credit Hour:** 2 hours per week

Rationale of the Course

This lab course is based on the cryptography theory course. The learning objective of this lab is to get familiar with the concepts of symmetric and asymmetric encryption and decryption algorithm implementation. After finishing the lab, students should be able to gain an experience in encryption algorithms, encryption modes, and padding.

Course Learning Outcomes

CLO1	**Apply** computational techniques and software principles to solve complex engineering problems.
CLO2	**Evaluate** the strengths and weaknesses of many popular cryptographic algorithms.
CLO3	**Develop** a good understanding of cryptographic algorithms in network protocols and network applications.
CLO4	**Implement** various algorithms of classical and public key encryption in a range of real-world applications.

Course Content

Introduction to Symmetric cipher, Classical encryption technique, Substitution cipher, and Transposition cipher, Block cipher, Data Encryption Standard (DES), Triple DES, Advanced Encryption Standard (AES).

Introduction to Public-key Cryptography, RSA Algorithm, Key Management, Diffie-Hellman key exchange, Public Key Cryptosystem, Message Authentication, and Hash function.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2					√							
CLO3		√										
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Presentation, Quiz, Viva
CLO2	Lecture, Group Discussion	Presentation, Assignment, Quiz, Viva
CLO3	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz, Viva
CLO4	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz, Viva

Book References:

1. Reference Book:1.Cryptography and Network Security Principles and Practice, Prentice Hall, W. Stallings

Digital Signal Processing

Course Code: CSE 0612477 **Course Title:** Digital Signal Processing

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course describes the key theoretical principles underpinning DSP in a design procedure through design examples and case studies and explains how to use a powerful general-purpose mathematical package such as MATLAB to design and simulate Digital Signal Processing systems. It will help to

select and analyze the architecture of a digital signal processor and some programming issues in fixed-point digital signal processors in real-time implementation. The students will learn to perform real-time signal processing algorithms using the latest fixed-point processor.

Course Learning Outcomes

CLO1	**Understand** the key theoretical principles underpinning DSP in a design procedure through these design examples and case study.
CLO2	**Evaluate** the basic architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.
CLO3	**Analyze** and **implement** signal processing algorithms.
CLO4	**Develop** communication skills by presenting topics on operating systems.

Course Content

Introduction to speech, image & data processing; Discrete time signals, sequences; Linear Constant Coefficient difference equation; Sampling continuous time signals; **Two dimensional sequences and systems**; Z-transform, Inverse Z-transform, H-transform; **Frequency domain representation**, discrete time systems and signals; **Fourier series and Fourier Transform**; Parseval's theorem; Equivalent noise definition of bandwidth; Convolution, Correlation and method of numerical integration; **Computation of the DFT:** Goertzel FFT, Chirp Z-transform algorithms. **Two-dimensional filter design**, Quantization effects in digital filters.

Mapping of Course CO and PO

Course Outcome (CO) of the Course	Program Outcome (PO)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	√											
CO2		√										
CO3			√									
CO4										√		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Reference Book: Digital Signal Processing, Prentice-hall Of India, J. G. Prokis

Digital Signal Processing Lab

Course Code: CSE 0612478 **Course Title:** Digital Signal Processing Lab

Credits: 01 **Credit Hour:** 2 hours per week

Rationale of the Course

The Digital Signal Processing Sessional course is designed to assist better understanding of dealing with signals and processing signals for getting desired output, removing noise associated with signals.

Course Learning Outcomes

CLO1	**Develop** a good understanding of the fundamental issues and challenges of DSP: data, model selection, model complexity, etc.
CLO2	**Evaluate** the strengths and weaknesses of many popular DSP approaches.
CLO3	**Appreciate** the underlying mathematical relationships within and across DSP algorithms.
CLO4	Design and implement various DSP algorithms in a range of real-world applications.

Course Content

Introduction to analog and digital signals, Discrete time signals Sequences, Linear Constant Coefficient difference equation, concept of analog to digital signal conversion; **Z-Transform (ZT):** Introduction to z-transform, Z-transform algorithms, Inverse Z-transform, H-transform; **Frequency domain Analysis:** Discrete time signals and systems, Fourier series, Discrete Fourier Transform (DFT), Inverse Discrete Fourier Transform (IDFT); Convolution, Correlation, Numerical integration; **Filter Design:** FIR filter, IIR filter, Quantization effects in digital filters, Windowing methods to design digital filters;

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1		√										
CLO2					√							
CLO3				√								
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy

CLO1	Lecture, Group Discussion	Presentation, Viva
CLO2	Lecture, Group Discussion	Presentation, Assignment, Quiz, Viva
CLO3	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz, Viva
CLO4	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz, Viva

Book References:

1. Reference Book: Digital Signal Processing, Prentice-hall Of India, J. G. Prokis

Network Operations and Management

Course Code: CSE0612479 **Course Title:** Network Operations and Management

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This subject is to understand and apply the principles of design, configuration, and operation of network and service management systems. Architecture and standards for network management will be presented. As a result, the student will be able to outline the principles of network management architecture and apply them to the design of network management systems based on standard architectures and apply the principles of network management basic administration.

Course Learning Outcomes

CLO1	**Analyze** the deployment of a network management center and outline the different network management functional areas, and related tasks.
CLO2	**Know** and **apply** existing network management models.
CLO3	**Know** and **apply** integrated network management concepts and network management framework.
CLO4	**Know** existing technologies and trends in the network management arena

Course Content

Network management planning: Network management definition, Network management objectives, Costs in network management, Network management project development flow, Resources in a network management project. **Network management functions**: Introduction, Configuration management, Failures management, Performance management, Performance indicators, Account management, Security management. **Integrated network management:** Monitoring phases, Heterogeneity problem, Integrated network management requirements, Standard network management models, TMN architecture. **Internet network management framework:** SNMP design, Standard evolution, SNMP architecture, SMI information model, Standard MIBs, SNMP operations, SNMP security. **Technologies and trends in network management:** Technologies in network management, Trends in network management.

Mapping Course Learning Outcomes (CLOs) with the PLOs

	Program Learning Outcomes (PLOs)

Course Learning Outcomes (CLOs)	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2	√											
CLO3		√										
CLO4	√											

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Network Operations and Network Management by Aftab A. Siddiqui, 4th Edition

Network Operations and Management Lab

Course Code: CSE0612480 **Course Title:** Network Operation and Management Lab

Credits: 01 **Credit Hour**: 2 hours per week

Rationale of the Course

This lab course is based on the network operation and management theory course. Students need to understand various components of network management i.e. fault management, performance management, configuration management, and security management. The aim is to learn the integration of the components into an enterprise management system and experience aspects of network management including the skills of using basic network management tools and applications.

Course Learning Outcomes

CLO1	**Develop** a good understanding of the deployment of a network management center and outline the different network management functional areas, and related tasks.
CLO2	**Analyze** the strengths and weaknesses of existing network management models.
CLO3	**Integrate** network management concepts and network management framework.
CLO4	**Apply** and use the appropriate technologies and tools for network management.

Course Content

Installing, Upgrading, and Migrating Server Workloads; Configuring Disks and Volumes; Creating, Managing, and Maintaining Images for Deployment; Managing Server Installations; Monitoring Server Installations; Installing and Configuring DNS Servers; Creating and Configuring DNS Zones and Records; Installing and Configuring DHCP; Managing and Maintaining DHCP; Implementing Network Policy Server (NPS); Implementing Distributed File System (DFS) and Branch Office Solutions; Installing and Configuring Domain Controllers; Creating and Managing Active Directory Users and Computers; Creating and Managing Active Directory Groups; Maintaining Active Directory; Creating and Managing Group Policy Objects (GPOs); Configuring Group Policy Processing; Configuring Group Policy Settings; Configuring Group Policy Preferences.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2		√										
CLO3		√										
CLO4					√							

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Presentation, Quiz, Viva
CLO2	Lecture, Group Discussion	Presentation, Assignment, Quiz, Viva
CLO3	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz, Viva
CLO4	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz, Viva

Book References:

1. Network Operations and Network Management by Aftab A. Siddiqui, 4th Edition

❖ Specialization Courses: Systems & Hardware

Real-time Control Systems

Course Code: CSE0611473 Course Title: Real-time Control Systems

Credits: 03 **Credit Hour**: 3 hours per week

Rationale of the Course

The aim of the course is that the student should learn how to design and implement computer-based control systems. The real-time course provides the students not only with the basic concepts of real-time programming, but also provides a vehicle for development of small class projects which address methods, tools, and the critical aspects of a modern software development life cycle. The experience with teaching the course may serve as a model for similar offerings in other computer science, computer engineering, and software engineering college programs.

Course Learning Outcomes

CLO1	**Analyze** Real-time scheduling and stimulability.
CLO2	**Examine** formal specification and verification of timing constraints and properties.
CLO3	**Construct** new techniques to advance the state-of-the-art real-time systems research

Course Content

Overview of computer control strategies; introduction to real-time systems; hardware and software requirements; implementation of digital control algorithms; design of real-time computer control systems; design analysis; considerations for fault detection and fault tolerance. The lab work and project require solid background in C programming.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1		√										
CLO2				√								
CLO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy

CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Class Test

Book References:

1. Real-Time Systems by Jane W.S. Liu (4th Edition)

Real-time Control Systems Lab

Course Code: CSE0611474 **Course Title:** Real-time Control Systems

Credits: 01 **Credit Hour**: 2 hours per week

Rationale of the Course

This course deals with practical techniques for the specification, design and implementation of real-time computer control systems. Real-time embedded systems are enabling technologies for many current and future generation applications and are increasingly becoming pervasive. This course aims to provide a good understanding of both fundamental concepts and advanced topics in real-time systems and networks. The real-time course provides the students not only with the basic concepts of real-time programming, but also provides a vehicle for development of small class projects which address methods, tools, and the critical aspects of a modern software development life cycle. The experience with teaching the course may serve as a model for similar offerings in other computer science, computer engineering, and software engineering college programs.

Course Learning Outcomes

CLO1	**Solve** real-world control problem by using engineering knowledge.
CLO2	**Adapt** real-time system concepts to understand and design real-time control systems
CLO3	**Illustrate** solutions for more complex real-time control problems
CLO4	**Design** and develop a real-time computer controller to control a DC motor.

Course Content

Overview of computer control strategies; introduction to real-time systems, Classification of real-time systems time constraints classification of computer programs.; hardware and software requirements; General-purpose computer specialized processors external interfaces A/D and D/A conversion data transfer techniques data communications techniques. Real-time operating systems computer languages for real-time applications. Concurrent Programming; implementation of digital control algorithms; design of real-time computer control systems; Scheduling of Real-Time Control Tasks design analysis; considerations for fault detection and fault tolerance. The lab work and project require solid background in C programming.

Laboratory Work: C - Review; Time and Clocks; POSIX Threads and Concurrent Programming; Resource Sharing and Coordination; Task Synchronization and Communication; Project Real-Time Digital PID Controller Design and Implementation.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2			√									
CLO3				√								
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Real-Time Systems by Jane W.S. Liu (4th Edition)

Robotics

Course Code: CSE0619481 **Course Title:** Robotics

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course explains the basics of robotic systems, robot design, development process and their vast applications. This course will help to specify and analyze the simulation, modeling and drawbacks of a robotic system for an interactive complex environment.

Course Learning Outcomes

CLO1	**Explain** with the concept development and key components of robotics technologies.
CLO2	**Solve** problems in spatial coordinate representation and spatial transformation, robot locomotion design, kinematics, motion control, localization and mapping, navigation and path planning.
CLO3	**Design** and **implement** a robotic project on a physical mobile robot platform, with tasks involving project specification, algorithm design, software programming, simulation and modeling, control and obstacle avoidance in a complex and interactive environment.

Course Content

Introduction to robotics: overview of robot mechanisms, dynamics, and intelligent controls, planar and spatial kinematics, and motion planning; mechanism design for manipulators and mobile robots, multi-rigid body dynamics, 3D graphic simulation; **Control design**: actuators, and sensors; wireless networking, task modeling; **Human-machine interface**: embedded software mechanical design, rigid body velocity, Jacobean, inverse kinematics, redundant and parallel robots, trajectory control, face control and haptics, **Micro and Nano-robotics**: mobile robots. Human-robot interaction, Multiagent, fault diagnosis.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Outcome (CO) of the Course	Program Outcome (PO)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	√											
CO2		√										
CO3			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Group Discussion, Assignment	Examination, Assignment, Class Test

Book References:

1. Introduction to Autonomous Mobile Robots by Roland Siegwart, Ilon Reiser, and Juhwan Park (3rd Edition)

Robotics Lab

Course Code: CSE 0619482 **Course Title:** Robotics Lab

Credit: 01 **Credit Hour: 2 hours per week**

Rationale of the Course

This course covers the theoretical and practical methods and techniques for formulating robot's motion using differential mathematical equations. It also focuses on the integration of different sensors in a robotic system and on the implementation of code needs to functionate the robotic system

Course Learning Outcomes

CLO1	**Learn** and **utilize** the mathematical representation of rigid body motions, including homogeneous transformations, to solve for position and orientation and velocities of objects.
CLO2	**Formulate** and solve forward and inverse kinematic equations and write programs to solve these equations and carry them out on physical robots.
CLO3	**Expound** the mathematical theory and physical implementation of common robot sensors including rotary encoders and cameras, as well as Write programs to read and process data from such sensors to send control commands to robots

Course Content

Historical development of robots; basic terminology and structure; robots in automated manufacturing; Rigid Motions and Homogeneous Transformation: Rotations and their composition; Euler angles; roll-pitch-yaw; homogeneous transformations; Forward and Inverse Kinematics; Motion planning, Vision-based control.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2			√									
CLO3					√							

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Presentation, Exercise, Group Discussion	Observation, Lab report, Viva
CLO2	Exercise, Assignment	Assignment, Quiz, Viva
CLO3	Exercise, Mini Project	Observation, Mini Project

Book References:

1. Introduction to Autonomous Mobile Robots by Roland Siegwart, Ilon Reiser, and Juhwan Park (3rd Edition)

Human Computer Interaction

Course Code: CSE0611483 **Course Title:** Human Computer Interaction

Credits: 03 **Credit Hour**: 3 hours per week

Rationale of the Course

The objective is to understand the definitions and foundations of the HCI domain. Then learn to design interfaces and interactive solutions using user-centered techniques and to apply evaluation methods, quality factors, and data analysis techniques. This course will explore research frontiers of HCI, including universal design, responsive design, and pervasive computing.

Course Learning Outcomes

CLO1	**Understand** and **apply** the fundamentals of HCI and Interaction design.
CLO2	**Analyze** the focused users and system requirements, and to design different kinds of UIs and Interaction systems for building intuitive usable software solutions.
CLO3	**Apply** (design) evaluation methods for assuring the enhanced usability including effectiveness, efficiency and satisfaction.
CLO4	**Develop** communication skills by presenting topics on HCI.

Course Content

Introduction to HCI and Interaction design: HCI, Interaction design, The process of design, User focus, Scenarios, Navigation design, Screen design and layout, Iteration and prototyping. HCI in the software process: The software life cycle, Usability engineering, Iterative design and prototyping, Design rationale. Design rules: Principles to support usability, Standards, Guidelines, Golden rules and heuristics, HCI patterns. Evaluation techniques: What is evaluation? What, why, and when to evaluate, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Evaluation paradigms and techniques, The D E C I D E framework to guide evaluation. Observing users: Participant observation, ethnography, Data collection, and analyzing, interpreting and presenting data, Qualitative analysis, Feeding the findings back into design. Asking users and experts: Interviews, Questionnaires, Inspections, walkthroughs. Universal design: Universal design principles, multi-modal interaction, designing for diversity. Task analysis: Differences between task analysis and other techniques, Task decomposition, Knowledge-based techniques, Entity-relationship-based techniques, Sources of information and data collection, Uses of task analysis. Modeling rich interaction: Status-event analysis, Rich contexts, Low intention and sensor-based interaction. Ubiquitous computing and augmented realities: Ubiquitous computing applications research, virtual and augmented reality, Information and data visualization. Hypertext, multimedia, and the world wide web: Understanding hypertext, Finding things, Web technology.

Mapping of Course CO and PO

Course Learning Outcomes (COs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	√											
CO2		√	√									
CO3				√								
CO4										√		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Human-Computer Interaction by Ben Shneiderman and Catherine Plaisant (5th Edition)

Human Computer Interaction Lab

Course Code: CSE 0611484 **Course Title:** Human Computer Interaction Lab

Credits: 1.0 **Credit Hour**: 2 credit per hour

Rationale of the Course

This course introduces students to the interdisciplinary field of Human-Computer Interaction (HCI). It covers principles and techniques in the design, development, and evaluation of interactive systems, and provides students with an introduction to UX Design and User-Centered Research. Additionally, some classes will focus on emergent areas within HCI, like Human-Robot Interaction, AR/VR, and Fabrication; At the end of this course, students will have gained an understanding of: the field of Human-Computer Interaction; how to approach the design of a system, component, or process from a user-centered perspective; methods to design and conduct user experiments. The semester-long group project will provide practical design experience to students, and opportunities to practice communication and collaboration. In addition, students will be able to demonstrate their ability to work in a team and to communicate scientific content to a peer audience.

Course Learning Outcomes

CLO1	**Analyze** and identify usability issues in User interfaces.
CLO2	**Design** user interfaces according to the standards.
CLO3	**Evaluate** user interfaces using Heuristic Evaluation and Thinking aloud Test.

CLO4	**Demonstrate** skills to collaborate in a team for justifying identified problems and to write interface related reports as per the standards.

Course Content

History of HCI; Design Thinking and User-Centered Research Methods; Usability Tests; Experimental Design and Analysis/Interpretation of Data; Designing for Diverse Needs; Emergent areas within HCI like Human-Robot Interaction;

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1		√										
CLO2			√									
CLO3			√									
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Human-Computer Interaction by Ben Shneiderman and Catherine Plaisant (5th Edition)

Embedded Systems

Course Code: CSE0611485 **Course Title:** Embedded Systems

Credits: 03 **Credit Hour:** 3 hours per week

Rationale of the Course

This course introduces the fundamental concepts of microcontroller-based embedded systems design, development and Implementation. It includes embedded system types, microcontroller architecture, programming, I/O interfacing, task scheduling, interrupt management and other related topics.

Course Learning Outcomes

CLO1	**Explain** the basic concepts of Embedded systems design.
CLO2	**Develop** an embedded system based on a single-chip microcontroller.
CLO3	**Investigate** microprocessor-based systems and interface them with I/O devices.
CLO4	**Design** embedded systems based on programmable logic controllers.

Course Content

Introduction to embedded systems. History of Microprocessor & I/O processor, microcontroller

Architecture. Microcontroller Operation, Microcontroller Programming, Instruction set.

Microcontroller Programming: Program developing, Timing and Subroutines, Input/output; Interrupts, Procedures, file system and file I/O handling.

Architectural overview of Microprocessor and its operation, Common instruction types, addressing modes, Cache Memory, TLB Structure; Memory Management in Intel 80X86 Family; Interfacing to External Devices.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√											
CLO2			√									
CLO3				√								
CLO4			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Embedded Systems: A Comprehensive Guide for Engineers and Programmers, 2nd Edition by Tammy Noergaard

Embedded Systems Lab

Course Code: CSE0611486 **Course Title:** Embedded Systems Lab

Credits: 01 **Credit Hour:** 2 hour per week

Rationale of the Course

This lab course provides a collection of experiments for supporting the lectures. The labs are designed to familiarize students with various aspects of hardware and software for microcontroller applications such as interfacing with various devices, programming I/O ports and interrupts and working with sensors.

Course Learning Outcomes

CLO1	**Examine** the I/O port operation using a simulator.
CLO2	**Demonstrate** an ability to interface a temperature sensor to the 8051
CLO3	**Develop** a program to transfer and receive data from/to a PC serially.
CLO4	**Examine** and **use** an 8051 assembler and simulator

Course Content

Introduction to embedded systems. various number system representation, Microcontroller Operation, Microcontroller Programming, Instruction set. Microcontroller Programming: Program developing, Microcontroller Programming: Timing and Subroutines, Input/output; Interrupts, Procedures, file system and file I/O handling. Programing of 8051 timer applications.

Mapping Course Learning Outcomes (CLOs) with the PLOs

	Program Outcomes (POs)

Course Learning Outcomes (CLOs)	1	2	3	4	5	6	7	8	9	10	11	12
CLO1				√								
CLO2											√	
CLO3			√									
CLO4				√								

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. Embedded Systems: A Comprehensive Guide for Engineers and Programmers, 2nd Edition by Tammy Noergaard

VLSI

Course Code: CSE0619487 **Course Title:** VLSI

Credits: 03 **Credit Hour**: 3 hours per week

Rationale of the Course

The course recognizes the different logical components as well as their interconnection and design various integrated electronic circuits to perform certain digital functions. From thi9s course the students will study and analyze different properties, behavior, and performance metrics of different integrated digital electronic circuits. It will help them to understand the various stages involved in designing a silicon chip, ranging from the initial system and logical considerations to designing each layer of silicon and finally, the overall fabrication process.

Course Learning Outcomes

CLO1	**Describe** mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnections
CLO2	**Understand** and analyze models of moderately sized CMOS circuits to implement specified digital functions.

CLO3	**Understand** and **apply** the basic theory of MOS devices and basic circuits, the overall process of designing MOS circuits, and the VLSI fabrication process on an industrial scale.
CLO4	**Design** MOS circuits to achieve various basic to moderately complex digital functions using VLSI design rules and geometric or stick diagrams.

Course Content

VLSI design methodology: Top-down Design Approach, Technology Trends and Design Automation Algorithms; Introduction to CMOS Inverters and Basic Gates; MOS devices and Basic Circuits (various inverters, pass gates and buffer circuits), CMOS Fabrication Process and Layout; CMOS Circuit Characteristics and Performance Estimation; Buffer Circuit Design; Introduction to BiCMOS Circuits; Complex CMOS Gates; CMOS layout design rules, CMOS Building Blocks - Adder, Comparator, Multiplier, Counter, and Shifter; Data Path and Memory structures. Design Methodology and Tools; Geometric and stick diagrams, PLA, FPGA, cell-based and full custom design methods, System-on chip design, Hardware modeling - Hardware Modeling Languages, Logic Networks, State Diagrams, Data-flow and Sequencing Graphs, Behavioral Optimization; Floor Planning and Architecture Design.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (COs)	Program Learning Outcomes (PLOs)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	√											
CO2	√	√		√								
CO3	√				√	√	√					
CO4		√	√							√	√	

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References:

1. CMOS VLSI Design: A Circuits and Systems Perspective, 4th Edition by Neil Weste and David Harris

VLSI Lab

Course Code: CSE0619488 **Course Title:** VLSI Lab

Credits: 01 **Credit Hour:** 2 hours per week

Rationale of the Course

This course is designed for a better understanding of VLSI and CMOS circuit design principles, logical and mathematical considerations, the overall design process and the silicon fabrication process using various modern tools, ICs, and simulators.

Course Learning Outcomes

CLO1	**Acquire** fundamental knowledge and understating of VLSI systems, their design principles, design considerations, and the overall design process using simulation and design software.
CLO2	**Analyze** a given digital function or a given circuit problem to implement and evaluate a VLSI system or CMOS circuit.
CLO3	**Design** and **implement** the solutions developed by the students for particular problems using ICs and simulator software.

Course Content

Introduction to PSpice, basic electrical circuits implement with PSpice, logic gates implementation and their I/O Graphs analysis with PSpice and DSCH;

Introduction to Micro wind, basic electrical circuits implement with Micro wind, logic gates implementation and their I/O Graphs analysis with PSpice, DSCH, and Micro wind.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√				√							
CLO2		√	√				√					
CLO3			√		√					√	√	

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Presentation, Viva
CLO2	Lecture, Group Discussion	Presentation, Assignment, Quiz, Viva
CLO3	Lecture, Practical Work, Assignment	Lab Test, Assignment, Quiz

Book References:

1. CMOS VLSI Design: A Circuits and Systems Perspective, 4th Edition by Neil Weste and David Harris

❖ General Education Courses

Bangladesh Studies: History and Culture

Course Code: GED0222121 **Course Title:** Bangladesh Studies: History and Culture

Credits: 02 **Credit Hour:** 2 hours per week

Rationale of the Course

This course will impart knowledge about the history of Bangladesh. The students will be able to discuss the glorious past of Bangladesh and different phases of the historical development and the diversity of Cultural traits. They will also learn about the emergence of Bangladesh as an independent country.

Course Learning Outcomes

CLO1	**Learn** about the history and glorious past of Bangladesh along with the creation of ancestors.
CLO2	**Estimate** the heroic movements of the people of Bangladesh.
CLO3	**Evaluate** the emergence of Bangladesh as an independent country.
CLO4	**Designate** the different phases of the historical development and the diversity of Cultural traits.
CLO5	**Appraise** the contribution of Bangabandhu Sheikh Mujibur Rahman and also Bengalis in the liberation war of Bangladesh.

Course Content

The aim of this course is to acquaint the students with the history of Bangladesh in order to instill in them the spirits of nationalism so as to enable them to become proud citizens of Bangladesh. Since history of Bangladesh, especially of the War of Independence was not taught in a proper way following the political change over of 1975 for almost twenty years, it is now time to make the young generation familiar with the history of the liberation struggle that the Bengal's waged against the Pakistanis who committed genocide by killing three million people and molesting three hundred thousand mothers and sisters. From this viewpoint, introducing a course of history on the emergence of Bangladesh for university students is more appropriate than ever before. Anyway, it is a three-credit course that will be taught as part of the General Educational Development Course (GED) at the University of Information Technology and Sciences (UITS).

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Learning Outcomes (PLOs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√				√							
CLO2		√	√				√					

CLO3			√		√					√	√	
CLO4			√									
CLO5			√									

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion	Examination, Class Test
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion, Assignment	Examination, Assignment, Class Test
CLO5	Lecture, Assignment	Examination

Book References

1. "Bangladesh: A Political History since Independence" by Ali Riaz

2. "History of Bangladesh, 1704-1971" by Sirajul Islam

❖ General Education Courses (Any Two)

Industrial and Operation Management

Course Code: GED0413321 **Course Title:** Industrial and Operation Management

Credits: 02 **Credit Hour**: 2 hours per week

Rationale of the Course

The course focuses on the basic concepts, issues, and techniques for efficient and effective operations through operations strategy, product and service design, process design and analysis, capacity planning, lean production systems, materials and inventory management, quality management and six sigma, project management, and supply chain management.

Course Learning Outcomes

CLO1	**Identify** and **explain** operations management concepts and techniques used to support management decision making in a range of contexts.
CLO2	**Evaluate** the main constituent parts of the supply chain of an organization and identify improvements.

CLO3	**Describe** decision making in the operations management function and its application to process, capacity, supply, and Quality and workforce management.

Course Content

Concepts of Operation Management, Operation Strategy. Operations Competitive Dimension Operation Management Process, Labor productivity, Labor productivity ratio, Operation Management & Decision Making, Scopes of Operation Management, Trends in Business Other important trends Industrial Revolution, Definition of Business Forecasting, Demand Management and Types of Forecasting, Elements of Business Forecasting, Features, Elements and Steps of Business Forecasting Quantitative and Qualitative methods of Forecasting, Cost and Benefits of Forecasting, Focus Forecasting collaborative planning, Product Design, Phrases of Product Design, Designing for Manufacturing, Quality function Development, Evolution of Quality Management, Insights of Quality Management, Quality Awards, Total Quality Management, Quality Tool, Inventory Management, Reasons for Inventory Management, Nature and Importance of Inventory Management, Requirements for effective Inventory Management, Zero inventories, Work in Process, Supply Chain Management, Function of supply chain Management, Need for Supply Chain Management, Benefits of Supply Chain Management, Technologies in Manufacturing, Benefits of Technology Investments, Determining the cost of Capital, Long term debt, Short term debt, quality, Warranty, Guarantee, Lead time, Statistical process control, Critical path, Network diagram.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	**Program Learning Outcomes (PLOs)**											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√		√	√				√				
CLO2	√		√		√	√	√					
CLO3	√	√										

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO1	Lecture	Quiz/Mid Term
CLO2	Guest Speaker (Industry expert)	Group Project/Presentation
CLO3	Lecture, Case study	Assignment, Term Final

Book References

1. "Introduction to Operations and Supply Chain Management" by Cecil B. Bozarth and Robert B. Handfield (4th Edition)

2. "Operations Management: An Integrated Approach" by R. Dan Reid and Nada R. Sanders (7th Edition)

Business Law

Course Code: GED0421323 **Course Title:** Business Law

Credits: 02 **Credit Hour:** 2 hours per week

Rationale of the Course

The course incorporates inheritance and transfer of property, relationship between person, industry, trade and commerce. Commercial law or mercantile law is to include the rules relating to industry, trade, and commerce.

Course Learning Outcomes

CLO1	**Identify**, **interpret** and **apply** rules and issues relating to the law.
CLO2	**Identify**, **interpret** and **apply** basic legal concepts in negligence, contract law.
CLO3	**Analyze** legal problems with an appreciation of the multiple issues impacting on business and non-business legal issues.

Course Content

Law of contract (The essential elements of contract, offer and acceptance, Intention to create legal relations, void and voidable contract. Agreement, capacity of parties, free consent), Law of relating to negotiable (definitions, acceptance, negotiations, right and liabilities of parties, bankers and customers), Company Law (Introduction, the memorandum and articles of association, The formation of a company, Capital share and shareholders, Meeting and resolutions, directors, Company management, accounts and audits, borrowing power, debentures, control over companies), Law of partnership (Nature of partnership, rights and liabilities of partners).

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcomes (CLOs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CLO1	√	√						√				
CLO2	√		√	√				√				
CLO3	√	√		√				√				

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, case study, videos, class discussion, Guest speaker (Industry expert), case analysis	Quiz, Group Project, Presentation
CLO2	Lecture, case study, videos, class discussion, Guest speaker (Industry expert), case analysis	Class Test, Presentation, Midterm
CLO3	Lecture, case study, videos, class discussion, Guest speaker (Industry expert), case analysis.	Quiz, Group Project, Class Test, Presentation, Brainstorming

Book References

1. "Business Law: A Hands-On Approach" by Neal Bevans (4th Edition)

2. "Business Law: Text and Cases" by Kenneth W. Clarkson, Roger LeRoy Miller, and Frank B. Cross (15th Edition)

Professional Ethics and Communication for Engineering

Course Code: GED0223421

Credits: 02

Course Title: Professional Ethics and Communication for Engineering

Credit Hour: 2 hours per week

Rationale of the Course

This course develops a firm ethical base. By completing this course, the students will gain the ability to continue professional development with an understanding of the legal issues and to critically assess the codes of professional conduct for computer professionals. It will help to identify and analyze practical legal problems commonly encountered in the computing industry.

Course Learning Outcomes

CLO1	**Understand** the theoretical aspects of ethics and moral philosophy in professional fields.
CLO2	**Identify** practical and legal problems commonly encountered by engineers in their professional industry.
CLO3	**Develop** foundation knowledge of ethics to be and apply them to solve engineering problems.
CLO4	**Develop** the communication skill by presenting topics on Engineering Ethics and Moral Philosophy.

Course Content

Engineering Ethics: **Introduction to Ethics**; Theories of Ethics; **Principles of Engineering Ethics**; Ethical expectation: Employers and employees, Inter-professional relationship, **Standards and codes**: Fundamental Canons, NSPE codes, IEEE codes of conduct, ACM codes; Institutionalization

of ethical conduct. Ethical Dilemmas, Choices (Whistle Blowing), **Computer Ethics**: Computer Crime and Cyber Security, Privacy and Confidentiality issue in CSE, Legal Framework in CSE-Copyright laws, ICT Act, Right to Information (RTI), Patents, and Royalty etc. Ethical Challenges for CSE Engineers with the advancement of Technology; **Case studies** related to ethical issues in ICT and other Engineering disciplines. Introduction to **Philosophy of Engineering**, metaphysics, epistemology, axiology, and logic.

Mapping Course Learning Outcomes (CLOs) with the PLOs

Course Learning Outcome (CLOs)	Program Learning Outcomes (PLOs)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	√											
CO2		√										
CO3								√				
CO4										√		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture, Group Discussion	Examination, Class Test
CLO2	Lecture, Group Discussion, Assignment	Examination, Assignment, Quiz
CLO3	Lecture, Exercise, Assignment	Examination, Assignment, Quiz
CLO4	Lecture, Group Discussion	Examination, Class Test

Book References

1. "Engineering Ethics: Concepts and Cases" by Charles E. Harris Jr., Michael S. Pritchard, and Michael J. Rabins (6th Edition)

2. "Professional Communication in Engineering" by John M. Powers and William J. Schaffer (2nd Edition)

3. "Professional Ethics in Engineering" by Mike W. Martin and Roland Schinzinger (4th Edition)

PART D

20.1 Grading/Evaluation

The overall performance of a student in a particular course is evaluated through a scheme of continuous assessment. For theory courses this continuous assessment is made through class attendances, quizzes, class tests, assignments, midterm examination, and a term final examination. The assessment in laboratory/sessional courses is made through practical work during the class lab report/lab performance, Quiz, lab exam and viva-voce. The distribution of marks for the performance evaluation is as follows:

i. Theory Courses

S/N	Section	Marks (%)
1	Attendance	10
2	Continuous Assessment (Class Tests/Assignment etc.)	20
3	Mid Term Examination	20
4	Term Final Examination	50
	Total Marks	**100**

ii. Laboratory Courses

S/N	Section	Marks (%)
1	Attendance	20
2	Lab Report/ Lab Performance	30
3	Quiz/ Final Examination	30
4	Viva Voce	20
	Total Marks	**100**

Class attendance is compulsory for every student. 10% of total marks in every course is allocated for attendance in classes including tutorials and labs. If a student does not attend a minimum of 70% of the total classes including tutorials and labs, s/he will not be allowed to take the final exam.

20.2 Grading Scale

Letter grading will be made to assess student's performance. The grade will be assigned on the overall evaluation of a student's performance on the basis of semester final examination, mid-term examination, case studies, tutorial tests, term papers, assignment and class attendance in aggregate and whatever is applicable for an individual program. The teachers responsible for the course will determine the grades/GPA. The final result will be prepared by cumulating the grade point average over the courses. The UGC approved common grading system is adopted for assigning a letter grade and grade point. This is given in the following table.

Numerical Grade	Letter Grade	Grade Point
80% and above	A + (A plus)	4.00
75% to less than 80%	A (A regular)	3.75
70% to less than 75%	A – (A minus)	3.50
65% to less than 70%	B + (B plus)	3.25
60% to less than 65%	B (B regular)	3.00
55% to less than 60%	B – (B minus)	2.75
50% to less than 55%	C + (C plus)	2.50
45% to less than 50%	C (C regular)	2.25
40% to less than 45%	D	2.00
Less than 40%	F	0.00

20.3 Grades

Each course has a certain number of credits, which describes its corresponding weights. A letter grade with a specified number of grade points is awarded for each course for which a student is registered. Marks earned by the students in Class Tests, Quizzes, Assignments, Participation, Attendance, Mid Term Exam, Term Final Exam, Projects, etc. are to be cumulated and the total is to be graded.

The performance of a student is measured by both the number of credits completed satisfactorily and the weighted average of the grade point earned. Grade 'A' will be considered as exceptional performance, Grade 'B' will be considered as very good performance, Grade 'C' will be considered as satisfactory performance and Grade 'D' will be considered as minimally acceptable performance, Grade 'F' will be considered as unacceptable performance, Grade 'I' will be considered as Incomplete and grade 'W' will be considered as withdrawn.

20.4 Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA)

The semester GPA is calculated by dividing the total weighted grade points obtained by the student (either pass or fail) by the total credits attempted by the student in a particular semester. Total weighted grade points of a course are calculated by multiplying the grade point value obtained by the student by the credit of that particular course. So, the formula for GPA calculation is:

$$GPA = \frac{\sum_{i=1}^{n}(Cr_i \times GP_i)}{\sum_{i=1}^{n} Cr_i}$$

Where,
n = Total number of Courses in a semester.
i = Serial of a course
Cr_i = Credit of Course *'i'*
GPi = Obtain Grade Point of Course *'i'*

For example, if a student takes five courses in a particular semester having credits of C1, C2, C3, C4, and C5 and his/ her obtained grade points in these courses are G1, G2, G3, G4, and G5, respectively then his/ her Semester GPA or GPA would be calculated as-

$$GPA = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4G_4 + C_5G_5}{C_1 + C_2 + C_3 + C_4 + C_5}$$

If any student has any 'F' grade he/she has to complete that particular course.

Cumulative Grade Point Average (CGPA) is the weighted average of the total grade points obtained in all the courses taken by a student. CGPA of a student is calculated by dividing the total weighted grade points by the total credits earned by the student. Details are given below:

If the earned credits (optional/ elective) exceed the "minimum degree requirements", then the additional credits will not be incorporated in calculating CGPA but will be documented into the "Transcript".

"Best Grade" (higher grade point) among all passing grades of a course will be considered in calculating CGPA

$$CGPA = \frac{\sum_{i=1}^{n}\left(Cr_i \times Best(GP_i)\right)}{\sum_{i=1}^{n} Cr_i}$$

Where,

n = Total number of Courses taken in the whole program

i = Serial of a course

Cr_i = Credit of Course *'i'*

GPi = Obtained Grade Points of Course *'i'*

Best (GPi) = Best "Grade Point" among all "Grade Points" of the Course *'i'*

The performance of a student will be evaluated in terms of semester grade point average (GPA) and cumulative grade point average (CGPA) which is the grade average for all the semesters. To be awarded a degree a student has to obtain a minimum Cumulative Grade Point Average (CGPA) of 2.25.

Students who will fail to maintain this minimum rate of progress will not be in good standing. This can happen when one or more of the following conditions exist: Semester GPA falls below 2.25 or Cumulative GPA falls below 2.25.

20.5 Course Withdrawal

A student can withdraw a course before a certain deadline. As per the policy, when a student withdraws a course within the final deadline to "Withdraw" with or without tuition fee adjustment as per the Academic Calendar, the student will be assigned a "W" grade. Moreover, if a student applies for dropping the entire semester within the deadline and the semester drop application is approved, the student will get "W" grades in all courses that he took in that semester. But if the semester is dropped after the deadline for withdrawal of courses the student will get "F" grades instead.

20.6 Supplementary

If a student registers for a course in a semester and get an "F" grade after being present or absent in the term final examination he will be able to sit for a supplementary examination within that semester. The supplementary examination will be taken within 15 days and the student has to pay 50% of the registration fee for that course. The course teacher will provide a new question different from the question provided before in the term final exam. A student can register for at most 2 supplementary examinations in a semester.

20.7 Retake

A student will be able to register any course from his/her curriculum as many times as he/she wishes if he/she gets an "F" grade on that course. From the 2nd registration it will be called as retake. For every registration the student will get a grade. During calculating CGPA the best grade of a course will be counted. For granting waiver based on semester result the originally obtained grades will be considered.

20.8 Grade Improvement

If a student obtains less than 60% mark (less than GPA 3.00 or Letter Grade B) in a course then he/she can make up deficiencies in GPA and credit requirements by re-registering and completing the course in another semester. During calculating CGPA the best grade of that course will be counted. A student can register for grade improvement not more than one time.

20.9 Dropout

A dropout is a student who does not enroll himself at any specific semester during the previous academic year (two consecutive semesters for a bi-semester-based system) without reporting in the prescribed format and does not enroll and also does not report for his inclusion within the first two weeks of the first academic semester of the current academic year then that particular student would be treated as a dropout student. Under this circumstance, his admission to that particular program and into UITS would be treated as canceled. However, if a student remains absent from the academic activities with proper reporting, then he/she should not be counted as a dropout student. In that case, he/she may apply for re-admission to the program with the prescribed re-admission fee, and once granted his/her name would strike off from the dropout list and then his name would be included in the study-break list of students. A single individual may be counted as a dropout more than once if he/she drops out of UITS in multiple academic years during his/her study period. As such, no student who drops out is counted more than once in a particular academic year. UITS may count drop out of a student if a student informs the institution in writing that he/she is leaning the University for any specific reasons. In that case, the University may conduct an exit interview in a prescribed format through a committee formed by the Vice-Chancellor to identify the reasons for the student dropout. If dropout is registered in written form, then there is no way of returning to the program later.

20.10 Admission Cancellation

The following will be the reasons for the cancellation of admission:

- If a student does not continue four semesters consecutively without the prior permission of the university authority.
- If a student does not pay his/her dues in due time.
- If a student violates the rules and regulations of the university.
- If the authority takes any disciplinary action against a student for some specific reasons.

20.11 Re-admission

If a student's admission is cancelled due to the above reason(s), he/she will have to get re-admission with the permission of the proper authority provided he/she wishes to continue his/her study at the university, but it is not a fundamental right. Re-admission procedures are as follows:

- Students should submit a re-admission application at least one month before the beginning of the semester he/she plans to enter for the permission of the university authority for re-admission.
- Before re-admission, he/she will have to pay his/her previous full dues.
- At the time of re-admission students will have to pay a fee as a re-admission fee. Re-admission forms will available at the admission office.
- Re-admission will be confirmed after the payment of all necessary fees and submission of the completed re-admission form to the admission office.

Note: University authority reserves the right to cancel the admission of a student for false statement without showing any cause.

20.12 Course Waiver Policy for Diploma Students

Students having diploma or equivalent in engineering or related background can enroll in a batch. The waiver policy will be applicable according to respective departmental waiver policy set by the departmental academic committee. Course waiver requires approval from the equivalence committee of each department concerned of UITS.

20.13 Course Registration

Any student who makes use of classroom or laboratory facilities or faculty time is required to register formally. Being admitted to the university, each student is assigned to a student batch coordinator. The student can register for courses he intends to take during a given term only by the advice and consent of his/her coordinator. A student must be enrolled in at least 12 credit hours. He may be allowed to enroll in up to a maximum of 24 credit hours if recommended by his/her Advisor. The department may approve a lesser number of credit hours to suit individual requirements. Such cases will only be applied to students needing less than 12 credits for graduation. Some courses involve pre-requisite courses. A student will be allowed to register in those courses subject to satisfaction of pre-requisite courses. Registration will be done at the beginning of each term. The registration program with dates and venue will be announced in advance. Late registration is permitted within the 6^{th} week of starting the classes on payment of late registration fee. Students having outstanding dues to university will not be permitted to register. If a student is unable to complete the semester final examination due to severe illness or serious accident, he/she may apply to the head of the department for total withdrawal of the semester within a week after the end of the semester final examination.

20.14 Special Courses

Those courses which include self study courses, will be from amongst the regular courses listed in the course catalogue, a special course can be run only in exceptional cases with the approval of the academic council. The special course may be offered to any student at any semester if it helps student for graduation. It will be offered only if the course is not running in that semester as a regular course.

20.15 Absence during Term

To attend the final exam, students need to avail at least 75% attendance. The student with 65%-74% attendance, he/she needs to pay 500 BDT for each course. If any student avail attendance below 65%, he/she will not be allowed for attending the final exam.