UNIVERSITY OF RAJSHAHI

Faculty of Engineering

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Course Curriculum
B.Sc. Engineering
Session: 2019–2020

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RULES AND REGULATIONS FOR THE UNDERGRADUATE PROGRAM

1. Duration of Course and Course Structure (Ref. Academic Ordinance Faculty of Engineering (AOFE) article no-4)

1.1 The B. Sc. Engg. Programs shall extend over a period of four academic years, each of a normal duration of one calendar year, divided into 2 Semesters; (details are given in Section 7 of the ordinance).

1.2 The curricula of the B. Sc. Engg. Degree in the different departments shall be proposed by the Committee of Courses and approved by the Syndicate on the recommendation of the Academic Council.

1.3 The Committee of Courses shall review the curricula at least once in every Academic Year and recommend changes and revision, if any, to the Faculty, and then the Faculty will recommend to the Academic Council.

1.4 Teaching of the courses is reckoned in terms of credits and the credits allotted to various courses will be determined by the Committee of Courses under the following guidelines;

Nature of course	Contact hour/credit (in a semester)
Theoretical Lecture	: 1 hour/week
Laboratory/Project	: 2 - 3 hours/week
Field work	: 2 weeks of field work

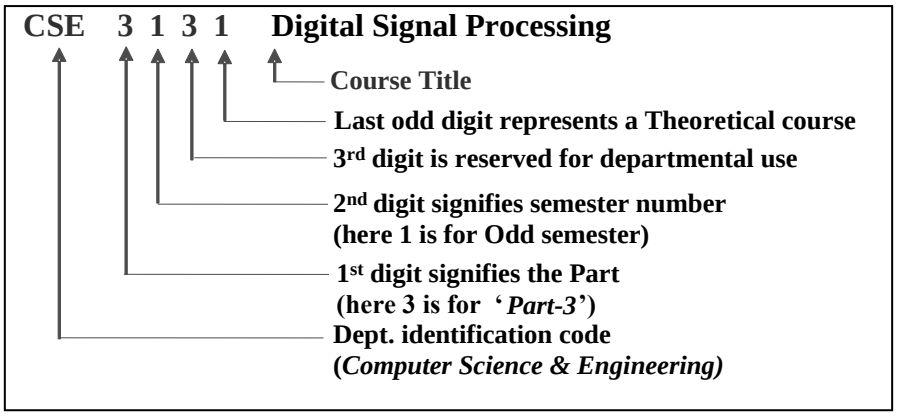
1.5 **Contact Hours/ week:** The total contact hours for the regular students including lecture, tutorial and laboratory shall be between 24 - 42 periods per week, each period being 40 to 60 minutes in duration.

1.6 **Course Adviser**: In each degree-awarding department, one of the teachers nominated by the Academic Committee shall act as Course Advisor for each academic year.

1.7 With the approval of Academic Committee, Course Advisor will prepare and announce the class routine, showing details of the lectures, course plan, class test, etc. at the start of each semester.

1.8 C**ourse Designation:** Each course is designated by a two to four letter word usually identifying the course offering department followed by a four-digit number with the following criteria without any space between letters and numerical.

(a) The first digit will correspond to the Part (year) in which the course is normally taken by the students, (b) The second digit will correspond the semester (1 for odd and 2 for even) in which the course is normally taken by the students, (c) The third digit will be reserved for departmental use for such things as to identify different areas within a department, (d) The last digit will be odd for theoretical, even for laboratory courses and ‘0’ for Board Viva voce and (e) The course designation system is illustrated by the following example.



2. Duration of Examination [Ref.: AOFE article no- 6]

Duration of Theoretical examination of different courses at the end of semester shall be as follows:

Courses less than or equal to 2 Credits	2 Hours
Courses greater than 2 credits but less than or equal to 4 Credits	3 Hours

3. Academic Calendar [Ref.: AOFE article no- 7]

3.1 The academic year shall be divided into two semesters each having duration of not less than 11 teaching weeks.

3.2 There shall be final examinations at the end of each semester conducted by the respective Examination Committee of the Departments.

3.3 **An academic schedule** for the academic year shall be announced for general notification before the start of the academic year, on the approval of the Academic Committee. The schedule may be prepared according to the following guidelines:

Semester- Odd (19 weeks)	**Number of weeks**
Teaching Preparatory Leave Examination Period Result Publication	11 (55 working days) 2 2 - 3 3 - 4 — **6**
	19
Inter Semester Recess	1
Semester- Even (19 weeks)	
Teaching Preparatory Leave Examination Period Result Publication	11 (55 working days) 2 2 - 3 3 - 4 — **6**
	19
Vacation (Summer, Ramadan, and Others)	13
Total:	**52**

4. Attendance [Ref. AOFE article no-13]

In order to be eligible to appear, as a regular candidate, at the semester final examinations, a student shall be required to have attended at least 70% of the total number of periods of lectures/tutorials/laboratory classes offered during the semester in every course. A student whose attendance falls short of 70% but not below 60% in any course may be allowed to appear at the final examinations as non-collegiate student and he/she shall not be eligible for the award of any scholarship or stipend. A student, appearing the examination under the benefit of this provision shall have to pay in addition to the fees, the requisite fee prescribed by the syndicate for the purpose. Student having less than 60% attendance in any course will not be allowed to appear in the final

examinations of the semester. An attendance report of the students will be prepared by the concerned course teacher and posted for information of the students. The basis of awarding marks for class participation and attendance is shown in the following Table.

Table-1 Distribution of Marks in Attendance

Attendance	Marks (%)	Remarks
90% and above	100	**Regular**
85% to less than 90%	90	
80% to less than 85%	80	
75% to less than 80%	70	
70% to less than 75%	60	
65% to less than 70%	50	**Non-collegiate**
60% to less than 65%	40	
less than 60%	0	

5. Class Test [Ref. AOFE article no- 16]

For theoretical courses of less than or equal to 2 credits there shall be at least three class tests and at least four class tests for greater than 2 credits in a semester. Previous class test marks will remain valid for the reported/ course improvement student if he/she is unable to appear at class test.

6. The Grading System [Ref. AOFE article no-14]

6.1 The letter grade system shall be used to assess the performance of the students as shown in the following Table:

Table-2 Grading System

Marks	Letter Grade (LG)	Grade Point (GP)
80% or above	A+	4.0
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.5
65 to less than 70%	B+	3.25
60% to less than 65%	B	3.0
55% to less than 60%	B-	2.75
50 to less than 55%	C+	2.5
45% to less than 50%	C	2.25
40 to less than 45%	D	2.0
less than 40%	F	0.0
Incomplete	I	0.0

Absence of a candidate in an examination of a course in which he/she ought to have been present will be considered as if the candidate obtained zero marks ('F' grade) in that course.

6.2 A **Grade Point Average (GPA)** shall be calculated for each semester as follows:

$$GPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i} \qquad \text{(i)}$$

where, n is the number of courses offered during the semester, C_i is the number of credits allotted to a particular course and G_i is the grade point earned for that course.

6.3 A **Yearly Grade Point Average (YGPA**) shall be calculated for each academic year as follows:

$$\text{YGPA} = \frac{\sum_{j=1}^{2} C_j G_j}{\sum_{j=1}^{2} C_j} \qquad \text{(ii)}$$

Where 2 is the number of semesters, C_j is the number of credits allotted to the jth semester and G_j is the GPA earned for that semester.

6.4 The **Cumulative Grade Point Average (CGPA)** gives the cumulative performance of the students from the first year up to the end of the year to which it refers, and will be calculated as follows:

$$\text{CGPA} = \frac{\sum_{k=1}^{m} C_k G_k}{\sum_{k=1}^{m} C_k} \qquad \text{(iii)}$$

where, m is the total number of years being considered, C_k is the total number of credits registered during the kth year and G_k is the YGPA earned in that particular year.

6.5 A Cumulative Grade Point Average (CGPA) shall be calculated at the end of each academic year and to be communicated to the students along with the YGPAs. The individual grades of courses obtained by them for the semesters of the academic year will, however, be communicated at the end of individual semester by the Chairman of the Examination Committee.

6.6 YGPA will be calculated up to 3rd digit after decimal following the truncation rule whereas CGPA will be recorded up to the second place of decimal following the rounding rule. For instance, YGPA=3.2125 will be recorded as 3.212 but CGPA=3.335 will be recorded as 3.34.

Illustration: Suppose a student obtained following grades in Part-I odd semester:

B.Sc. Engg. Part-I Odd Semester	Credit	Letter Grade	GP
EEE 1111	**3**	B+	**3.25**
EEE 1112	**1**	A	**3.75**
CSE 1151	**3**	A+	**4**
CSE 1152	**2**	A-	**3.5**
CE 1152	**1**	A+	**4**
PHY 1121	**3**	F	**0**
PHY 1122	**1**	C+	**2.50**
MATH 1131	**3**	B+	**3.25**
ENG 1111	**2**	A	**3.75**
ENG 1112	**1**	A+	**4**

Therefore, GPA in the odd semester is

$$= \frac{3\times3.25+1\times3.75+3\times4+2\times3.5+1\times4+3\times0+1\times2.50+3\times3.25+2\times3.75+1\times4}{3+1+3+2+1+3+1+3+2+1}$$

$$= \frac{60.25}{20} = 3.0125 \approx 3.012$$

(GPA will be truncated to the third digit)

And let's assume that his/her GPA in Part-I Even Semester is = 3.132 and the total credits allotted for that semester is 20.

Therefore, YGPA of Part-I examination is $= \frac{20\times3.012+20\times3.132}{20+20} = 3.072$

(YGPA will be truncated to the third digit)
Similarly assume that, the student's YGPA for the other 3 Parts are as follows-

Semester/year	Credit	YGPA
Part-II	40	3.475
Part-III	40	2.963
Part-IV	40	3.338

Then his/her CGPA of four academic years is

$$\frac{40\times 3.072+40\times 3.475+40\times 2.963+40\times 3.338}{160}=3.212\approx 3.21$$

(CGPA will be recorded upto 2nd digit following the rounding rule. If the third digit is less than 5, it will be immediately truncated, but if the third digit is greater than or equal to 5, the second digit will be added by 1 and only the first two digits after decimal will be kept for record)

6.7 Earned Credit

The courses in which a student has obtained minimum 'D' in 'Theoretical courses' and 'C' in 'Laboratory courses and Board Viva-voce' or higher grade will be counted as credits earned by the student. Any course in which a student has obtained 'F' grade will not be counted towards his/her earned credit. 'F' grade will not be counted for GPA calculation but will stay permanently on the Grade sheet and transcripts.

7. Conducting Examination and Rules for Promotion [Ref. AOFE article no-15]

7.1 The academic year shall be divided into two semesters each having duration of not less than 11 teaching weeks (details are given in Section 7 of the Ordinance).

7.2 There shall be final examinations conducted by the concerned Examination Committee of the Departments at the end of each semester.

7.3 The results shall be finalized at the end of the even semester of the academic year. A student entering in an odd semester shall automatically move on to the next semester, unless he/she was barred from appearing at the final examinations at the end of the semester. Individual course grades and GPA shall be announced within a date ordinarily not later than three weeks after the end of the semester final examinations.

7.4 **Minimum passing grade:** The minimum passing grade in a theoretical course will be D and the minimum passing grade in a laboratory/project/field work/in-plant training/workshop/similar Courses (henceforth referred to as laboratory course) and Viva voce will be C.

7.5 **Promotion to higher class:** In order to be promoted to higher class a student must obtain the following requirements:

i) Yearly Grade Point Average (YGPA) of 2.25 or higher
ii) Credit point loss (F or I Grade) in the theoretical courses not more than 10.
iii) Minimum C grade in the laboratory courses and viva-voce.

7.6 **Course Improvement:** A promoted student may appear for only theoretical course improvement in the immediate next academic year for maximum 10 credit points to clear his/her F grade or to improve the grades on the courses in which less than B grade (including those of F grade) was obtained in Part-1, Part-2 and Part-3 examinations. In such case, the student has to give his/her choice of course/courses for course improvement in writing. If the student fails to clear his/her F grades in the first attempt, he/she shall get another (last) chance in the immediate next year to clear the F grades. In every case a student has to carry his previous marks on CA. In the case of student's failure to improve his/her course grade at the course improvement examination, the previous grade shall remain valid.

7.7 **Course Exemption:** Students who fail to be promoted to the next higher class shall be exempted from taking the theoretical and laboratory courses where they obtained grades equal to B or above. These grades would be counted in calculating GPA in the next year's examination results.

7.8 **Merit Position:** The YGPA obtained by a student in the semester final examinations will be considered for determining the merit position for the award of scholarships, stipends etc.

8. Publication of Results [Ref. AOFE article no-17]

8.1 **Award of degree**: In order to qualify for the B.Sc. Engg. degree, a student must have to earn minimum 150 credits and a minimum CGPAof2.25 within a maximum of six academic years. The result will be published in accordance with merit.

8.2 **Honors**: Candidates for Bachelor degree in engineering will be awarded the degree with Honors if their earned credit is 160 and CGPA is 3.75 or higher.

8.3 **Result Improvement:** A candidate obtaining B.Sc. Engg. within 4 or 5 academic years shall be allowed to improve his/her result, of maximum of 10 credit points (courses less than 'B' grade) of the Part-IV theoretical courses in the immediate next regular examination after publication of his/her result. No improvement shall be allowed for laboratory examinations and Board Viva-voce. If a candidate fails to improve CGPA with the block of new GP in total, the previous results shall remain valid.

8.4 **Readmission and Course Exemption:** If a student fails to obtain the degree within 4 or 5 academic year, he/she will be readmitted in Part-4 and will appear for the exam according to the clause 15.6. Course exemption rules will also be valid according to clause 15.7.

8.5 **Dean's List:** As a recognition of excellent performance, the names of students obtaining a cumulative GPA of 3.75 or above in two regular semesters in each academic year may be published in the Dean's List in the faculty. Students who have received an 'F' grade in any course during any of the two regular semesters will not be considered for Dean's List in that year.

8.6 **Recording of Result:** The transcripts in English will show the course designation, course title, credit, letter grade, grade point of individual courses, YGPA of each year, and finally, CGPA.

9. Eligibility for Examination [Ref. AOFE article no-23]:

9.1 A candidate may not be admitted to any semester final examination unless he/she has

- 9.1.1 Submitted application in the prescribed form to the Registrar/Vice-Chancellor for appearing at the examination,
- 9.1.2 Paid the prescribed examination fees, and all outstanding University and Hall dues,
- 9.1.3 Fulfilled the conditions for attendance in class and
- 9.1.4 Been barred by any disciplinary rules.

9.2 On special circumstances the Vice-Chancellor may permit a student to appear at the examination.

9.3 A student whose attendance falls short of 70% but not below 60% in any course as mentioned above may be allowed to appear at the final examinations as a non-collegiate student.

B.Sc. in
Computer Science & Engineering

B.Sc. in Computer Science & Engineering

The Computer Science and Engineering program combines a rigorous education in computer science with added emphasis on the physical and architectural underpinnings of modern computer system design. With a background that spans computer science and computer engineering, our graduates are able to address computing systems across the hardware-software spectrum.

Vision

To become a prominent department of Computer Science & Engineering producing competent professionals with research and innovation skills, inculcating moral values and societal concerns.

Mission

M1. Provide learning ambience to generate innovative and problem solving skills with professionalism.

M2. Create facilities and expertise in advanced computer technology thereby promote research.

M3. Enhance Industry Institute Interaction program to get acquainted with corporate culture.

M4. Induce ethical values and spirit of social commitment.

The Program Educational Objectives:

The Computer Science and Engineering undergraduate program educational objectives are that our alumni/ae:

PEO1. Practice as computing professionals, conducting research and/or leading, designing, developing, or maintaining projects in various technical areas.

PEO2. Apply the ethical and social aspects of modern computing technology to the design, development, and usage of computing artifacts.

PEO3. Enhance their skills and embrace new computing technologies through self-directed professional development and post-graduate training or education.

Mapping between Mission and Program Educational Objectives

Mission	Program Educational Objectives:		
	PEO1	PEO2	PEO3
M1	√		√
M2	√		√
M3	√		√
M4		√	

Program Learning Outcomes (PLO):

The following Program Learning Outcomes (student Outcomes) describes the skills imparted by our B.Sc. in Computer Science & Engineering program:

PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals to the solution of complex problems of computer and information technology.

PO2 **Problem analysis**: Identify, formulate, research and analyze complex computer engineering problems

PO3 **design/development of solutions**: Design solutions for complex computer engineering problems and design system components or processes that meet the specified needs with technological concerns

PO4 **Investigation:** Conduct investigations of complex computer science and technology problems, considering experimental design, data analysis and interpretation.

PO5 **Modern tool usage:** Create, select and apply appropriate techniques, resources and modern computer engineering and ICT tools.

PO6 **The engineer and society**: Apply reasoning informed by contextual knowledge to develop the computer technologies for society benefits.

PO7 **Environment and sustainability**: Understand the impact of professional computer engineering solutions in societal and environmental contexts and demonstrate the knowledge for sustainable development.

PO8 **Ethics:** Apply ethical principles and commit to the professional ethics, responsibilities and the norms of the engineering practice

PO9 **Individual work and teamwork:** Function effectively as an individual and as a member or leader of diverse teams and in multidisciplinary settings.

PO10 **Communication:** Communicate effectively about complex computer science and engineering activities with the engineering community and with society at large in both oral and written.

PO11 **Project management and finance**: Demonstrate knowledge and understanding of computer engineering and management principles and apply these to one's work as a team member or a leader to manage projects in multidisciplinary environments.

PO12 **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.

Mapping between Program Educational Objectives (PEO) and Program Learning Outcomes (PO)

	Program Learning Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	√	√	√	√	√		√			√		
PEO2							√	√			√	
PEO3						√	√		√	√	√	√

Distribution of Courses:

The total credits have been set to **160 in eight semesters** for the program of B.Sc. in Computer Science and Engineering in order to achieve Program Educational Objectives as well as to ensure the Program Learning Outcomes. The following credit distribution has been designed from the above perspective and based on these credit distributions, different courses are offered in different semester as given below.

Summary of the subject-wise distributions of total credits

Course Type	Marks	% of Marks	Credits
Mathematics and Basic Sciences			
(a) Mathematics	375	9.375	15
(b) Statistics	100	2.5	4
(c) Physics	75	1.875	3
(d) Chemistry	75	1.875	3
Humanities			
(a) Economics	50	1.25	2
(b) Accounting	50	1.25	2
(c) English	50	1.25	2
(d) Law	50	1.25	2
Basic and Major Engineering			
(i) Basic Engineering with Lab	**150**	**3.75**	**6**
(ii) Major Engineering			
(a) Theoretical	2125	53.125	85
(b) Laboratory	850	21.25	34
(c) Board viva-voce	50	1.25	2
Total	**4000**	**100**	**160**

Summary of the year-wise distributions of total credits

Year	Semester	Credits distributions
First Year (Part 1)	Odd	21
	Even	19
Second Year (Part 2)	Odd	19
	Even	21
Third Year (Part 3)	Odd	21
	Even	19
Fourth Year (Part 4)	Odd	20
	Even	**20**

Courses offered in Part-I, Odd Semester

Code	Course Title	Marks	Credit
ENG1111	Technical and Communicative English	50	2
MATH 1121	Differential and Integral Calculus	75	3
CHEM1121	Chemistry	75	3
EEE1131	Basic Electronics	75	3
EEE1132	Basic Electronics Lab	25	1
CSE1111	Introduction to Computer Systems	75	3
CSE1112	Computer Maintenance and Engineering Drawing Lab	25	1
CSE1121	Structural Programming Language	75	3
CSE1122	Structural Programming Language Lab	50	2
	Total	525	21

Courses offered in Part-I, Even Semester

Code	Course Title	Marks	Credit
ECON1211	Engineering Economics	50	2
STAT1211	Statistics for Engineers	50	2
MATH1221	Co-ordinate Geometry, Vector analysis and Complex Variable	75	3
PHY 1211	Basic Electricity and Electrical Circuits	75	3
CSE1211	Introduction to Digital Electronics	75	3
CSE1212	Introduction to Digital Electronics Lab	25	1
CSE1221	Object Oriented Programming	75	3
CSE1222	Object Oriented Programming Lab	50	2
	Total	475	19

Courses offered in Part-II, Odd Semester

Code	Course Title	Marks	Credit
ACCO2111	Industrial Management and Accountancy	50	2
STAT2111	Theory of Statistics	50	2
MATH 2131	Differential Equations and Optimization	75	3
CSE2111	Digital System Design	75	3
CSE2112	Digital System Design Lab	25	1
CSE2121	Data Structure	75	3
CSE2122	Data Structure Lab	25	1
CSE2131	Discrete Mathematics	75	3
CSE2142	Writing Professional Code Lab	25	1
	Total	475	19

Courses offered in Part-II, Even Semester

Code	Course Title	Marks	Credit
LAW2211	Cyber and Intellectual Property Law	50	2
MATH2231	Numerical Methods	50	2
MATH2232	Numerical Methods Lab	25	1
MATH2241	Linear Algebra	75	3
CSE2211	Theory of Computation	75	3
CSE2221	Design and Analysis of Algorithms	75	3
CSE2222	Design and Analysis of Algorithms Lab	25	1
CSE2231	Computer Architecture and Organization	75	3
CSE2232	Computer Architecture and Organization Lab	25	1
CSE2242	Technical Writing and Presentation	25	1
CSE2252	Web Application Development Lab	25	1
	Total	525	21

Courses offered in Part-III, Odd Semester

Code	Course Title	Marks	Credit
CSE3111	Software Engineering	75	3
CSE3112	Software Engineering Lab	25	1
CSE3121	Database Management Systems	75	3
CSE3122	Database Management Systems Lab	25	1
CSE3131	Web Engineering	75	3
CSE3132	Web Engineering Lab	25	1
CSE3141	Compiler Design	75	3
CSE3142	Compiler Design Lab	25	1
CSE 3151	Engineering Ethics and Environment Protection	50	2
ICE3161	Communication Engineering	50	2
CSE3162	Mobile Application Development Lab	25	1
	Total	525	21

Courses offered in Part-III, Even Semester

Code	Course Title	Marks	Credit
CSE3211	Project Planning & Management	75	3
CSE3221	Digital Signal Processing	75	3
CSE3222	Digital Signal Processing Lab	25	1
CSE3231	Microprocessor and Assembly Language	75	3
CSE3232	Microprocessor and Assembly Language Lab	25	1
CSE3241	Operating Systems	75	3
CSE3242	Operating Systems Lab	25	1
CSE 3251	Computer Networks	75	3
CSE 3252	Computer Networks Lab	25	1
	Total	475	19

Courses offered in Part-IV, Odd Semester

Code	Course Title	Marks	Credit
CSE4111	Parallel Processing and Distributed System	75	3
CSE4112	Parallel Processing and Distributed System Lab	25	1
CSE4121	Object Oriented Design and Design Patterns	50	2
CSE4122	Object Oriented Design and Design Patterns Lab	25	1
CSE4131	Artificial Intelligence	75	3
CSE4132	Artificial Intelligence Lab	25	1
CSE4141	Microprocessor Interfacing and Microcontrollers	75	3
CSE4142	Microprocessor Interfacing and Microcontrollers Lab	25	1
Option I (T)	Theory: Should be selected from Table-I	75	3
Option I (L)	Lab course based on Option-I (T)	25	1
CSE4192	Thesis/ Project (Part I)	25	1
	Total	500	20

Table-I: Option I

Code	Course Title	Marks	Credit
CSE4151	Computational Geometry	75	3
CSE4152	Computational Geometry Lab	25	1
CSE4161	Digital Image Processing	75	3
CSE4162	Digital Image Processing Lab	25	1
CSE4171	Computer Simulation and Modeling	75	3
CSE4172	Computer Simulation and Modeling Lab	25	1
CSE4181	UI UX Engineering	75	3
CSE4182	UI UX Engineering Lab	25	1
CSE4191	Blockchain	75	3
CSE4192	Blockchain Lab	25	1

Courses offered in Part-IV, Even Semester

Code	Course Title	Marks	Credit
CSE4211	Machine Learning	75	3
CSE4212	Machine Learning Lab	25	1
CSE4221	Computer Graphics	75	3
CSE4222	Computer Graphics Lab	25	1
CSE4231	Cryptography and Network Security	75	3
CSE4232	Cryptography and Network Security Lab	25	1
Option II (T)	Theory: Should be selected from Table-II	75	3
Option II (L)	Lab course based on Option-II (T)	25	1
CSE4280	Board viva-voce	50	2
CSE4292	Thesis/ Project (Part II)	50	2
	Total	500	20

Table-II: Option II

Code	Course Title	Marks	Credit
CSE4241	Multimedia System	75	3
CSE4242	Multimedia System Lab	25	1
CSE4251	Distributed Database Management System	75	3
CSE4252	Distributed Database Management System Lab	25	1
CSE4261	Neural Networks and Deep Learning	75	3
CSE4262	Neural Networks and Deep Learning Lab	25	1
CSE4271	Big Data	75	3
CSE4272	Big Data Lab	25	1
CSE4281	Systems Biology	75	3
CSE4282	Systems Biology	25	1

Offered Courses Vs Program Learning Outcome mapping

Course ID	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P)12
ENG1111	Technical and Communicative English	√	√		√								√
MATH1121	Differential and Integral Calculus	√	√	√	√								
CHEM1121	Chemistry	√	√	√									
EEE1131	Basic Electronics	√		√		√							
EEE1132	Basic Electronics Lab			√	√	√							
CSE1111	Introduction to Computer Systems	√											
CSE1112	Computer Maintenance and Engineering Drawing Lab		√	√		√							
CSE1121	Structural Programming Language	√											
CSE1122	Structural Programming Language Lab	√				√							
ECON1211	Engineering Economics	√	√	√									
STAT1211	Statistics for Engineers	√	√	√									
MATH 1221	Co-ordinate Geometry, Vector analysis and Complex Variable	√											
PHY1211	Basic Electricity and Electrical Circuits	√	√										
CSE1211	Introduction to Digital Electronics	√											
CSE1212	Introduction to Digital Electronics Lab					√							
CSE1221	Object Oriented Programming	√				√							
CSE1222	Object Oriented Programming Lab			√		√							

Offered Courses Vs Program Learning Outcome mapping

Course ID	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P)12
ACCO2111	Industrial Management and Accountancy	√	√	√								√	
STAT2111	Theory of Statistics	√	√										
MATH 2131	Differential Equations and Optimization	√											
CSE2111	Digital System Design		√	√									
CSE2112	Digital System Design Lab					√							
CSE2121	Data Structure	√	√	√									
CSE2122	Data Structure Lab			√		√							
CSE2131	Discrete Mathematics	√											
CSE2142	Writing Professional Code Lab			√		√							
LAW2211	Cyber and Intellectual Property Law	√	√	√									
MATH2231	Numerical Methods		√										
MATH2232	Numerical Methods Lab	√		√									
MATH2241	Linear Algebra												
CSE2211	Theory of Computation	√	√										
CSE2221	Design and Analysis of Algorithms		√	√									
CSE2222	Design and Analysis of Algorithms Lab		√	√									
CSE2231	Computer Architecture and Organization	√	√			√							
CSE2232	Computer Architecture and Organization Lab			√		√							
CSE2242	Technical Writing and Presentation										√		
CSE2252	Web Application Development Lab			√		√							

Offered Courses Vs Program Learning Outcome mapping

Course ID	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P)12
CSE3111	Software Engineering	√								√			
CSE3112	Software Engineering Lab			√		√							
CSE3121	Database Management Systems	√	√										
CSE3122	Database Management Systems Lab					√							
CSE3131	Web Engineering	√	√		√								
CSE3132	Web Engineering Lab					√							√
CSE3141	Compiler Design	√		√		√							
CSE3142	Compiler Design Lab			√		√							
CSE 3151	Engineering Ethics and Environment Protection							√	√				
ICE3161	Communication Engineering	√											
CSE3162	Mobile Application Development Lab					√							
CSE3211	Project Planning & Management	√		√								√	
CSE3221	Digital Signal Processing	√	√	√									
CSE3222	Digital Signal Processing Lab			√		√							
CSE3231	Microprocessor and Assembly Language	√	√	√									
CSE3232	Microprocessor and Assembly Language Lab			√		√							
CSE3241	Operating Systems	√											
CSE3242	Operating Systems Lab	√	√	√									
CSE 3251	Computer Networks	√											
CSE 3252	Computer Networks Lab					√							

Offered Courses Vs Program Learning Outcome mapping

Course ID	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P)12
CSE4111	Parallel Processing and Distributed System	√		√									
CSE4112	Parallel Processing and Distributed System Lab			√		√							
CSE4121	Object Oriented Design and Design Patterns		√	√		√							
CSE4122	Object Oriented Design and Design Patterns Lab			√		√							
CSE4131	Artificial Intelligence	√	√										
CSE4132	Artificial Intelligence Lab		√		√	√							
CSE4141	Microprocessor Interfacing and Microcontrollers	√	√										
CSE4142	Microprocessor Interfacing and Microcontrollers Lab			√		√							
Option I (T)	Theory: Should be selected from Table-I												
Option I (L)	Lab course based on Option-I (T)												
CSE4192	Thesis/ Project (Part I)									√			
CSE4151	Computational Geometry	√											
CSE4152	Computational Geometry Lab	√	√										
CSE4161	Digital Image Processing	√	√										
CSE4162	Digital Image Processing Lab	√	√	√									
CSE 4171	Simulation and Modeling		√	√		√							
CSE 4172	Simulation and Modeling Lab					√							
CSE4181	UI UX Engineering			√									
CSE4182	UI UX Engineering Lab			√									
CSE4191	Blockchain	√		√									
CSE4192	Blockchain Lab			√									

Offered Courses Vs Program Learning Outcome mapping

Course ID	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P)12
CSE4211	Machine Learning		√	√									
CSE4212	Machine Learning Lab			√		√							
CSE4221	Computer Graphics	√	√	√									
CSE4222	Computer Graphics Lab			√		√							
CSE4231	Cryptography and Network Security	√			√		√						
CSE4232	Cryptography and Network Security Lab			√		√							
Option II (T)	Theory: Should be selected from Table-II												
Option II (L)	Lab course based on Option-II (T)												
CSE4280	Board viva-voce										√		
CSE4292	Thesis/ Project (Part II)									√			
CSE4241	Multimedia System	√	√		√								
CSE4242	Multimedia System Lab	√	√		√	√							
CSE4251	Distributed Database Management System	√											
CSE4252	Distributed Database Management System Lab	√	√										
CSE4261	Neural Networks and Deep Learning	√		√									
CSE4262	Neural Networks and Deep Learning Lab			√									
CSE4271	Big Data	√		√		√							
CSE4272	Big Data Lab	√		√		√							
CSE4281	Systems Biology			√									
CSE4282	Systems Biology			√									

Details of the
Offered Courses
of
B.Sc. in
Computer Science and Engineering

1st Year (Odd Semester)

ENG 1111: Technical and Communicative English
Credits: 2 **Contact Hours:** 26
Year: First Semester**:** Odd

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To be able to communicate through one of the most dominating *language* of the world, which is having its impact on every field of work, English.

Course Objective:
The course aims to give students a formal and methodical exposure to Academic and Technical writing and professional communication skills. It intends to teach students the tools for writing technical error free English. It also intends to grow effective and fast reading skill among the students. Students will also be taught to speak English with correct pronunciation and phonetics.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understand** and extract the essential information from a written or spoken text on a specific topic.	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO2	To **practice** a variety of social functions including greetings, introductions and farewells.	**Engineering knowledge** (PO1) **Problem analysis** (PO2)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO3	To **examine** and Integrate information from various texts on the same subject, in order to write or speak on the subject knowledgeably.	**Investigation** (PO4), **Life-long Learning** (P12)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Grammar: Grammatical principles, modals, phrases & idioms, prefixes & suffixes, sentence structures, WH & yes/ no questions, conditional sentences.

Vocabulary: Technical & scientific vocabulary, defining terms.

Spoken English: Introduction to phonetic symbols, dialogue, responding to particular situations, extempore speech.

Reading: Comprehension of technical & non-technical materials-skimming, scanning, inferring & responding to context.

Technical Writing: Paragraph & composition writing on scientific & other themes, report writing, research paper writing, library references.

Professional communication: Business letter, job application, memos, quotations, tender notice.

Text Book:

1. A. J. Thomson & A. V. Martinet : **A Practical English Grammar**, *Oxford University Press*
2. John M. Lannon : **Technical Writing**, *Scott Foresman& Co.*

Books Recommended:

1. A. Ashley : **Oxford Handbook of Commercial Correspondence**, *Oxford University Press*
2. John Swales : **Writing Scientific English**, *Cengage Learning Australia*
3. Robert J. Dixson : **Complete Course in English**, *Prentice Hall*

MATH1121: Differential and Integral Calculus
Credits: 3 **Contact Hours:** 39
Year: First **Semester:** Even

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation Familiarize students with introductory calculus.

Course Objective:
The main objective of this course is to provide necessary background of differential and integral calculus. Different mathematical problems in this course will help building a comprehensive skill for analyzing and solving real life engineering problems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understand** the concept of a function, limits and continuity and solve the limiting value problem.	**Engineering knowledge** (PO1) **Problem analysis** (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO2	To **apply** different method of solving ordinary and partial differentiation.	**Design/development of solutions** (PO3) **Investigation** (PO4)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO3	To **calculate** the integral of definite and indefinite forms.	**Problem analysis** (PO2), **Design/development of solutions** (PO3)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Series and Sequences : Sequence and infinite series, their convergence and divergence, The taylor series for e^x, sin□x, and cos□x, Power series, Radius of convergence.

Functions: Domain, Range, Inverse function and graphs of functions, Composition of function, Limits, Continuity and Differentiability.

Ordinary Differentiation: Differentiability, Differentiation, Successive differentiation and Leibnitz theorem. Expansions of functions: Rolle's theorem, Mean value theorem, Taylor's and Maclaurin's formulae. Partial Differentiation: Euler's theorem, Tangents and normal, Asymptotes.

Application of Derivative: Linear Approximations and Newton's Method, Maximum and Minimum Values, Increasing and Decreasing Functions, Concavity and the Second Derivative Test, Rates of Change in Economics and the Sciences.

Indefinite Integrals: Method of substitution, Integration by parts, Special trigonometric functions and rational fractions. Definite Integrals: Fundamental theorem, General properties, Evaluations of definite integrals and reduction formulas. Multiple Integrals: Double integrals Triple integrals Change of variables in multiple integration.

Application of the Definite Integral: Determination of lengths, Areas and Volumes, Area Between Curves, Arc Length and Surface Area.

Basic concepts of Vector Calculus.

Text Book:

1. Gilbert Strang : **Calculus**, *Wellesley-Cambridge Press*.
2. B. C. Das and B.N. Mukherjee : **Differential Calculus**, *U. N. Dhur & Sons*
3. B. C. Das and B.N. Mukherjee : **Integral Calculus**, *U. N. Dhur & Sons*

Books Recommended:

1. Howard Hinton : **Calculas- A New Horizon**, *John Wiley & Sons Inc.*
2. F. Ayres and Elliot Mendelson : **Calculas (Schaum's Outline Series)**, *McGraw-Hill*
3. Joseph Edwards : **Differential Calculas**, *Kessinger Publishing*
4. Md. Abdul Latif and S. Bhattacharjee **Differential Calculus**, *Chandaapure, Chittagong*

CHEM 1121: Chemistry
Credits: 3 **Contact Hours:** 39
Year: First **Semester:** Odd

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To know basics of physical and inorganic chemistry.

Course Objective:
As per standards, the engineering graduates need to study some basic science courses like physics, chemistry, mathematics in their undergraduate courses. The aim of this course is to review the basic knowledge of chemistry that they have learned in high school level as well as prepare them for a higher level of study. The physical and inorganic chemistry knowledge expected to help the CS graduates in understanding the environmental impacts created by their designed systems and the way to resolve the negative issues.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **explain** the different terminologies related with the physical and inorganic chemistry	**Engineering knowledge** (PO1) **Problem analysis** (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO2	To **explain** the internal chemical operations of devices related to computer systems like semiconductors, batteries.	**Problem analysis** (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO3	To **choose** the right elements for the right situation based on their chemical bonding	**Problem analysis** (PO2), **Design/development of solutions** (PO3)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Electrochemistry: Conductors, Electrolytes and Electrolysis; Faradays Laws of Electrolysis and their significance. Ohm's law and electrolytic conductances; Theories for electrolytic conductance (Arrhenius& Debye-Hükel). Ionic mobility, Kohlrausch's law, Tranference Number and its determination; Activities, activity coefficient and Debye-Hükel limiting law.Electrochemicalcells(Electrolytic and Galvanic/Voltaic):Electrode reaction and potentials. Reference electrodes; Reversible and concentration cells,Storage Batteries(or accumulators).

Atomic structure and Periodic Table: Modern concept of atomic structure and Periodic Table; related principles and Laws. Constitution and Periodic properties of elements (ionization potential, electronigativety, electron affinity, atomic and ionic radii). Grouping of elements, their properties and uses. Isotopes and radioactivity.
Electronic Theory of Valency and Chemical Bonding: Different types of bonds (ionic, covalent, co-ordinate, hydrogen and metallic) Classification of solids on the basis of bonding and their properties. Atomic orbitals and their hybridization; valency bond and Molecular orbital theories.

Chemistry of Transition Elements, Lanthanides and Actinides: Definitions, electronic configurations, preparations (nuclear transformations), general properties and uses.

Text Book:

1. R. D. Madan : **Modern Inorganic Chemistry,** *S. Chand Publishers*
2. M. M. Haque and M. A. Nawab : **Principles of Physical Chemistry**, *Nawab Publications*

Books Recommended:

1. Esmarch S. Gilreath : **Fundamental Concepts in Inorganic Chemistry**, *McGraw-Hill*
2. G. M. Barrow : **Physical Chemistry**, *McGraw-Hill*
3. W. J. Moore : **Physical Chemistry**, *Orient BlackswanPvt Ltd.*

4. Keith J. Laidler, John H. Meiser : **Physical Chemistry**, *Houghton Mifflin Company*.
5. S. Z. Haider : **Modern Inorganic Chemistry,** *Friends International.*
6. Audrey L. Companion : **Chemical Bonding**, *McGraw-Hill*
7. F. Albert Cotton, Geoffrey Wilkinson, Paul L. Gaus : **Basic Inorganic Chemistry**, *Wiley & Sons.*
8. Donald K. Sebera : **Electronic Structure and Chemical Bonding**, *Wiley & Sons.*

EEE 1131: Basic Electronics
Credits: 3 **Contact Hours:** 39
Year: First Semester: Odd

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop basics knowledge on Electrical circuits and Electronics

Course Objective:
The knowledge on electrical circuits and electronics are highly significant to develop expertise on computer hardware. From this perspective, the major objectives of this course are to build necessary background on electrical circuits and electronics required to be a computer engineer. The student will study circuit theory, properties of electronic devices and their operational principle, measuring devices etc.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **Interpret** characteristics of diodes and transistors and their applications in electronics circuits.	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **design and construct** the characteristics of OpAmp and its various applications.	**Design/development of solutions**(PO3)	Cognitive domain – level **	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☐ Presentation
CO3	**T**o **Operate** different types of instruement like multimeter, oscilloscope, function generator, trainer etc.	**Modern tools usage** (PO5)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Semiconductor Diodes: Semiconductor, n-and p-type semiconductors, p-n junction diode and their V-I characteristics, Zener diode, half-and full wave rectifiers, voltage regulation using Zener diodes.

Transistor: Transistor action, transistor biasing, DC characteristics of CE, CB and CC configurations. Transistor Amplifiers and Oscillators: CE, CB and CC amplifiers, current, voltage and power gains, frequency responses, feedback, positive and negative feedback, oscillators and masturbators, astable and monostable multivibrator.

Field effect transistor: FET, MPOSFET, Characteristics, basing and applications.

Operational Amplifier: Difference amplifier, CMRR, Ideal operational amplifier, Inverting amplifier, Non-inverting amplifier, General purpose IC operational amplifier, Integrator, Differentiator, Comparator and Converter.

Optoelectronic Devices: PN photodiode, Phototransistor, Solar cell, Photoconductive cell, Photovoltaic, Sensors, LED, LCD, Alphanumeric display, Photo couplers, Photodiode, LDR.

Instrumentation: Avometer, signal generator, oscilloscope.

Text Book:

1. S.G. Tarnekar, A.K. Teraja, B.L. Theraja : **Digital Systems: Principles and Applications (Part I and IV),** *S. Chand*

Books Recommended:

1. Albert Paul Malvino : **Electronic Principles,** *Career Education*
2. Robert L. Boylestad : **Introductory Circuit Analysis,** *Pearson*

EEE 1132: Basic Electronics Lab
Credits: 1 Contact Hours: 26
Year: First Semester: Odd

Prerequisite: None
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop basics knowledge on Electrical circuits and Electronics

Course Objective:
This course represents a laboratory course in introductory electrical and electronics. In this lab, they will learn basic circuit connection, use the basic electrical and electronics instruments. The students will also learn to use the oscilloscope, function generator and multi-meter properly. These instruments will be used to measure voltages, current, see the wave shape etc. from circuits they will build from actual electrical components.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **operate** different types of instruement like multimeter, oscilloscope, function generator, trainer etc.	**Modern tools usage**(PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **use** diodes, transistors etc. as circuits elements and study their characteristics	**Engineering knowledge** (PO4)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

CO3	To **Design and construct** basic electrical circuits with diode, OPAmp etc. and its various applications.	**Design/development of solutions** (PO3)	Cognitive domain – level 2	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/Experiments List:

1. To study I~V characteristics of a P-N junction diode.
2. To use PN junction diode as half-wave and full-wave rectifier.
3. To study I~V characteristics of Zener Diode and use it as a voltage regulator by varying VI and RL.
4. To study the input and output characteristics of a Transistor in CE configuration.
5. To study the characteristics of OP Amp in inverting and non inverting mode and use it as an adder.
6. To find out slew rate, Common Mode Rejection Ratio (CMRR), input offset voltage and output offset voltage of an OP Amp.

Text Book:
1. S.G. Tarnekar, A.K. Teraja, B.L. Theraja : **Digital Systems: Principles and Applications (Part I and IV),** *S. Chand*

Books Recommended:
1. Albert Paul Malvino : **Electronic Principles,** *Career Education*
2. Robert L. Boylestad : **Introductory Circuit Analysis,** *Pearson*

CSE1111: Introduction to Computer Systems
Credits: 2 **Contact Hours:** 26
Year: First **Semester:** Odd

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To accrue adequate fundamental knowledge required to build a sound base for studying computer science.

Course Objective:
In order to study some engineering course, a student must have some clear concept about the fundamental terms and terminologies of that subject. The objective of this course is to be able the student to understand the fundamental terminologies of computer science. They will be trained to construct a workstation computer from scratch. They will be demonstrated the operation of computers and its elements.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **demonstrate** the fundamental concepts of computers with the present level of knowledge of the students.	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation

CO2	To **explain** basic functions of CPU and Peripherals	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO3	To **Describe** Operating systems, networking and internet.	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Computer Basics: Introduction to Studying Computers, History and development of Computers, Generation of Computers, Types of Computers, Characteristics of Computer, Modern Digital Devices.

Computer Hardware and Peripherals: Basic Units of Computer Hardware, Internal structure of CPU and multi-core CPU, Functions of RAM, ROM and Cache memory, Basic functional mechanism of HDD, CD-ROM, SSD, Different types of Monitors, Projector, Printers, Scanner, Typical Computer specifications.

Software: Classifications, System software, Operating system concepts and importance, components and basic functions of DOS, Windows, Mac, Linux, Android and iOs operating system, Application software's and Utility programs, Malware.

Data Processing: Concepts of Data, Information, and Database, Traditional File Processing, and DBMS.

Computer Networks: Computer networks and its goals, Basic concepts on LAN, MAN, WAN and Internet systems, Internet services, Common Network Devices and Software, Introduction to Cloud Computing.

Text Books:

1. Peter Norton : **Introduction to Computer**, McGraw-hill Publishers
2. J. Stanley Warford : **Computer Systems,** Jones & Bartlett Publishers

Reference Books:

1. P. Norton : **Inside the PC,** Sam Publishers
2. L. Rosch : **Hardware Bible**, Braddy Publishing, Indianapolis
3. Subramanian : **Introduction to Computers**, Mcgraw-hill Inc.

CSE1112: Computer Maintenance and Engineering Drawing Lab
Credits: 1 **Contact Hours:** 26
Year: First Semester: Odd

Prerequisite: None
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To study how to assemble and dissemble computer and install different type of operating system.

Course Objective:
Computer graphics is one of the most exciting and rapidly growing computer fields and has many applications, including user interfaces, data visualization, computer-aided design, motion pictures and image processing. This unit concentrates on the hands-on experience of the fundamentals of computer graphics which are essential for computing professionals.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **demonstrate** how to assemble a computer and **Identify** the problems in a CPU and solve it	**Problem analysis** (PO2), **Design/Development of solutions** (PO3)	Cognitive domain – level 5	☒ Lecture Note ☐ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☐ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **demonstrate** how to install an Operating System, Application software and utilities software	**Engineering knowledge** (PO1) **Modern tool usage** (PO5)	Cognitive domain – level 4	☒ Lecture Note ☐ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO3	To **gain** and **acquire knowledge** over engineering drawing and **Apply** them to **Solve** different 3-D models and projection problems.	**Design/Development of solutions** (PO3) **Modern tool usage** (PO5)	Cognitive domain – level 4	☒ Lecture Note ☐ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in practical, Quizzes/Viva-voce, Attendance. Final numeric reward will be the compilation of:
Marks 25 [Practical 60%, Quizzes/Viva-voce 30%, Attendance 10%]

Name of the Experiment for Computer Maintenance

1. Assemble different parts of a Computer
2. Partition a computer hard disk
3. Install different types of Operating System (Windows, Linux etc.)
4. Install different types of application software and utilities software
5. Fault findings (Detect hardware related problems in CPU and fine the solution)
6. Getting familiar with DOS and its commands.

Name of the Experiment for Engineering Drawing

1. Use of drawing instruments.
2. Letter and font design and drawing.
3. Different types of line drawing and their uses.
4. 3 dimensional perspective drawing.
5. Axonometric drawing.
6. 3 dimensional oblique and isometric drawing.

CSE1121: Structural Programming Language
Credits: 3 Contact Hours: 39
Year: First Semester: Odd

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation This course is offered to introduce students with the algorithmic way of thinking and problem solving by programming language.

Course Objective:
To make students familiar with basic programming principles, good programming style, structured approach to program design, development, testing and documentation.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **formula**te problems step by step and design computer programs in a structured way	**Engineering knowledge:** (PO1)	Cognitive domain – level 1	☒Lecture Note ☒Text Book ☐Audio/Video ☐Web Material ☐Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **apply** fundamental programming concepts using high-level programming language to solve problems	**Engineering knowledge:** (PO1)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒Class Test ☒Final Exam ☐Assignment ☐Participation ☐Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Structured Programming Language fundamentals: C overviews, History and Features, Basic Structure of C Program and Hello World Program, C Program Development Environment

Variables, Constants, Data Types, Operators & Expression: Declaring variables and assigning values, input from keyboard, add comments, Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operators, Bitwise Operators, Special Operators, Arithmetic Expressions, Evaluation of Expressions, Type Conversions in Expressions, Operator Precedence and Associativity.

Program control statements: Decision Making Statements: if-else statement, switch statement; Looping Statements: for loop, while loop, nested if, do while loop, nested loop; Jump Statements: continue, break

Functions: Function prototype, recursion, parameters, arguments, scope rules and storage classes.

Arrays and Pointer: One and Multi-dimensional arrays, Character Arrays and Strings, Basic of Pointer, pointer expression, pointer arrays.

User defined data types and Input/ Output: Structures, Unions, Enumerations, Standard input and output, Formatted input and output, File access; Variable length argument list; Command line parameters; Error Handling; Graphics; Linking; Library functions.

Memory manipulation and Preprocessor: Dynamic Memory Allocation and Linked List, Macro substitution, File inclusion, Compiler Control Directives.

Text Book:

1. Steven Prata : **C Primer Plus,** *Addison-Wesley Professional*
2. Herbert Schildt : **C: The Complete Reference, McGraw-Hill Osborne Media**

Books Recommended:

1. Herbert Schildt : **Tech Yourself,** *McGraw-Hill Osborne Media*

CSE1122: Structural Programming Language Lab.
Credits: 2 **Contact Hours:** 52
Year: First **Semester:** Odd

Prerequisite: None
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation This course is offered for the students to achieve hands on experience on basic programming.
Course Objective:
To introduce students to give practical experience on basic programming principles, good programming style, design and solve the problems in a structured approach.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **formulat**e problems step by step and design computer programs in a structured way	**Engineering knowledge** (PO1)	Cognitive domain – level 1	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☐ Note book ☐ Presentation
CO2	To **apply** fundamental programming concepts using high-level programming language to solve problems	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual`	☒ CA ☒ Final Exam ☒ Assignment ☐ Note book ☐ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Introduction:
   a. How to write, save, compile, and run C program in Windows 10 using Code::Block
   b. How to write, save, compile, and run C program in Ubuntu using GCC
2. Variables, Constants, Data Types, Operators & Expression
3. Managing Input and Output Operations
4. User-defined functions
5. Conditional Statements
6. Looping Statements,
7. Array, Character Array and String
8. Searching and Sorting
9. Pointer
10. Structure and Union
11. File Processing
12. Dynamic Memory allocation
13. Recursion
14. Graphics Programming
15. Standard Template Library (STL)

1st Year (Even Semester)

ECON 1211: Engineering Economics
Credits: 2**Contact Hours:** 26
Year: First Semester: Even

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop basics knowledge on economics required for a professional engineer

Course Objective:
The main objective of this course is to teach students how markets and other governance structures organize core economic activities, such as production, distribution, and consumption, and the growth of productive resources. Students will learn about the determinants of macroeconomic conditions such as national output, employment, inflation etc. Students will also become familiar with the origins and implications of processes of international economic integration and differentiation economic policy.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	**Identify** the key theoretical models in micro, macro and econometrics, as well as the theoretical frameworks in several sub-fields.	**Engineering knowledge** (PO1)	Cognitive domain – level 6	☐Lecture Note ☐Text Book ☐Audio/Video ☐Web Material ☐Journal paper	☐ Class Test ☐ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	**Organize**, **interpret** and **analyze** economic data.	**Problem analysis** (PO2)	Cognitive domain – level 3	☐ Lecture Note ☐ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐Class Test ☐Final Exam ☐Assignment ☐Participation ☐Presentation
CO3	**Apply** economic theory and the statistical tools of economics to specific problems or questions.	**Design and Development of solution** (PO3)	Cognitive domain – level 4	☐ Lecture Note ☐ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☐ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:
Foundations of Engineering Economy
Engineering Economics: Description and Role in Decision Making, Performing an Engineering Economy Study, Professional Ethics and Economic Decisions , Interest Rate and Rate of Return, Terminology and Symbols , Cash Flows: Estimation and Diagramming , Simple and Compound Interest, Introduction to Spreadsheet Use

PE Progressive Example—The Cement Factory Case, Single-Amount Factors (F_P and P_F), Uniform Series Present Worth Factor and Capital Recovery Factor (P_A and A_P), Sinking Fund Factor and Uniform Series Compound Amount Factor (A_F and F_A), Factor Values for Untabulated i or n Values, Arithmetic Gradient Factors (P_G and A_G), Geometric Gradient Series Factors, Determining i or n for Known Cash Flow Values

Nominal and Effective Interest Rates
Nominal and Effective Interest Rate Statements, Effective Annual Interest Rates, Effective Interest Rates for Any Time Period, Equivalence Relations: Payment Period and Compounding Period, Effective Interest Rate for Continuous Compounding, Interest Rates That Vary over Time

Benefit/Cost Analysis and Public Sector Economics
PE Progressive Example—Water Treatment Facility, Public Sector Projects, Benefi t/Cost Analysis of a Single Project, Alternative Selection Using Incremental B/C Analysis, Incremental B/C Analysis of Multiple, Mutually Exclusive Alternatives, Service Sector Projects and Cost-Effectiveness Analysis

Effects of Inflation
Understanding the Impact of Inflation, Present Worth Calculations Adjusted for Inflation, Future Worth Calculations Adjusted for Inflation, Capital Recovery Calculations Adjusted for Inflation

After-Tax Economic Analysis
Income Tax Terminology and Basic Relations, Calculation of Cash Flow after Taxes, Effect on Taxes of Different Depreciation Methods and Recovery Periods, Depreciation Recapture and Capital Gains (Losses), After-Tax Evaluation, After-Tax Replacement Study, After-Tax Value-Added Analysis, After-Tax Analysis for International Projects, Value-Added Tax

Text Book:

1. P. E. Leland Blank and P. E. Anthony Tarquin : **Engineering Economy,** *McGraw Hill*

Books Recommended:

1. K. K. Dewett : **Modern Economic Theory, S. Chand Publishers**
2. H.L Ahuja, : **Advanced Economic Theory,** *S. Chand Publishers*
3. A. Asimakopulos : **An Introduction To Economic Theory: Microeconomics***, Oxford University Press*
4. A. Koutsoyiannis : **Modern Microeconomics,** *Palgrave Macmillan*

STAT1211: Statistics for Engineers
Credits: 2 **Contact Hours:** 26
Year: First **Semester:** Even

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To know basic theory of statistics and its applicability in real world situations.

Course Objective:
This course aims introduce statistics and its applications for science and engineering student. The objective is intended for students to solve some practical by statistical methods. It will help students develop skills in thinking and analyzing problems from a probabilistic and statistical point of view.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **explain** the different concepts of basic statistics, statistical distributions and probability.	**Engineering knowledge** (PO1) **Problem analysis** (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation

CO2	To **analyze** the real-life problems and **use** the acquired knowledge to solve those problems	**Problem analysis** (PO2)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO3	To **choose** the appropriate probability models to describe real world situations.	**Problem analysis** (PO2), **Design/development of solutions** (PO3)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Descriptive statistical data: Meaning and scope of statistics, Sources and type of statistical data, Representation of statistical data, Location, Dispersion and their measures. Skewness, Kurtosis and their measures. Moment and Cumulants and Practical examples.

Probability: Concept of probability. Sample Space, Events union and Intersection of Events. Probability of events. Laws of probability, Conditional probabilities, Bayes' Theorem, Chebyshev's Inequality and Practical examples.

Random variables and probability Distribution: Basic concepts, Discrete and continuous random variables, Density and distributional functions, Mathematical expectation and variance, Joint marginal and conditional density functions, Conditional Expectation and conditional variance, Moments and Cumulant generating functions. Characteristic function. Study of Binomial, Poisson, Normal and Bivariate Normal distribution and Practical examples.

Linear Regression and Correlation: Correlation, Rank correlation, Partial and Multiple correlations. Linear Regression for two variables. Principle of Least Squares Method. Lines of best fit Residual Analysis and examples.

Test of Significance: Basic ideas of Null hypothesis. Alternative hypothesis. Type-I error, Type-II error, level of significance, Degree of freedom, Rejection region and Acceptance region. Test of Single mean, Single variance, Two sample means and variances. Test for 2x2 contingency tables. Independence test and practical examples.

Text Book:

1. A. J. B. Anderson : **Interpreting Data**.*Chapman and Hall, London*
2. H. Cramer : **The Elements of Probability Theory**. *Wiley, N. Y*

Books Recommended:

1. P. Hoel, : **Introductory Statistics**, *Wiley and Sons, N. Y*.
2. D. V. Lindley : **Introduction to Probability and Statistics**. Vol-1 *C. U. P. London*
3. S. Lipschutz : **Probability**, *McGraw-Hill, N. Y.*
4. Mosteller, Rourke and Thomas : **Probability With Statistical Applications**, *Addison- Wesley*
5. F. L. Wolf : **Elements of Probability and Statistics**,*McGraw-Hill, N. Y.*
6. T. H. Wonnacot and R. J. Wonnacot : **Introductory Statistics**, *Wiley and Sons. N. Y.*
7. G. U. Yule, and M. G. Kendall : **An Introduction to the Theory of Statistics**, *Charles Griffin, London*

MATH 1221: Co-ordinate Geometry, Vector analysis and Complex Variable
Credits: 3 **Contact Hours:** 39
Year: First **Semester:** Odd

Prerequisite: MATH 1121 Differential and Integral
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To introduce students with Algebra, complex variables and vector analysis and their uses in engineering.

Course Objective:
The main objective of this course is to introduce the fundamentals of Algebra to solve some mathematical equation. This course teaches the students to understand trigonometric functions and calculating their values. The course also introduces the study of vectors and Euclidean geometry, lines and planes in three-dimensional space.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understand** Co-ordinate geometry, projection	**Engineering knowledge:** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **Apply** the concepts of complex variable to real world phenomena such as electrical networks,	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO3	To **understand** vector, divergence, gradient	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Co-ordinate Geometry: Co-ordinate Geometry of Two Dimensions: Change of Axes, Transformation of Co-Ordinates, Simplification of Equations of Curves.. Co-ordinate Geometry of Three Dimensions: System of Co-Ordinates, Distance between two Points, Section Formula, Direction Cosines and Projection, Planes and Straight Lines.

Vector Analysis: Vectors, The dot and cross product, Vector Differentiation and Integration, Gradient of a Function, Divergence and Curl of Vector and their Applications, Physical Significance of Gradient, Vector Identities, Integral Forms of Gradient, Tensors.

Complex Variable : Complex Number Systems, General Functions of a Complex Variable, Limits and Continuity of a Function of Complex Variable and Related Theorems, Complex Differentiation and the Cauchy-Riemenn Equations, Infinite Series, Convergence, Line Integral, Cauchy Integral Theorem, Cauchy Integral Formula, Liouville's Theorem, Taylor's and Laurent's Theorems, Singular Points, Residue, Cauchy's Residue Theorem, Contour Integration

Text Book:

1. H. B. Fine and H. D. Thompson : **Coordinate Geometry**, *The Macmillan Company*
2. M. R. Spiegel, S. Lipschutz, and D. Spellman **Vector Analysis and An Introduction to Tensor Analysis**, *McGraw-Hill* ,
3. W. Brown, R. V. Churchill C**omplex variables and Applications**, *McGraw-Hill.*

Books Recommended:

1. S. L. Loney : **The Elements of Coordinate Geometry.** *Macmillan and Co.*

PHY 1211: Basic Electricity and Electrical Circuits
Credits: 3 Contact Hours: 39
Year: First Semester: Odd

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To know basic Electrical and Magnetic laws required to understand computer hardware

Course Objective:
The aim of this course to provide the basic phenomena of electricity as they relate to the basic operation of computer hardware and their design. The course will cover electrical filters circuits, the electrostatics, capacitance, inductance and networks analysis.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **identify** different types of electrical and magnetic phenomena	**Problem analysis** (PO2)	Cognitive domain – level 5	☐☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **apply** the Gauss's, Kirchhoffs, Faraday's and Ampere's law to solve different types of electrical problems	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO3	To **identify** different types of filters and network theorems	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Electrostatics: Electric dipole; electric field due to a dipole; dipole on external electric field; Gauss's Law and its applications.

Capacitors: Parallel plate capacitors with dielectric; dielectrics and Gauss's Law; susceptibility, permeability, and dielectric constant; energy stored in an electric field. Electric Current: Electron theory of conductivity; conductor, semiconductors and insulators; superconductors, current and current density; Kirchhoffs Law and its applications.

Electomagnetic Induction: Faraday's experiment; Faraday's law; Ampere's law, motional e.m.f.; self and mutual inductance galvanometers-moving coil, ballistic and deadbeat types.

Networks Analysis: Kirchhoff's laws; Superposition theorem; Millman's theorem; Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Mesh and Node circuit analysis, Reduction of complicated networks, T and p-section network.

DC and AC Circuits: D.C. circuits with LR, RC, and LCR in series; A.C. circuits with LR, RC, LC, and LCR in series.

Text Book:

1. J David Halliday, Robert Resnick and Kenneth S. Krane : **Physics (Part-I & II),** *Wiley*
2. J David Halliday, Robert Resnick and Kenneth S. Krane : **Physics (Part-I & II),** *Wiley*

Books Recommended:

1. Arthur Frederic Kip : **Fundamentals of Electricity and Magnetism**, *McGraw-Hill Inc.*
2. M. S. Huq : **Concepts of Electricity and Magnetism,***Students' Publications*

CSE 1211: Introduction to Digital Electronics
Credits: 3 **Contact Hours:** 39
Year: First Semester: Even

Prerequisite: EEE 1131: Basic Electronics
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop basics knowledge on Introduction to Digital Electronics

Course Objective:

Digital electronics is essential to understanding the design and working of a wide range of applications, from consumer and industrial electronics to communication, from embedded systems, and computers to security and military equipment. As the devices used in these applications decrease in size and employ more complex technology. It is essential for students and engineers to fully understand both the fundamentals and also the design, implementation and application principles of digital electronics, devices and integrated circuits, thus enabling them to use the most appropriate and effective technique to suit their technical needs. Through this course, students are expected to achieve a basic understanding of number systems and representations, different type of codes, logic gates and Boolean algebra, DTL, TTL and CMOS integrated circuits, basic combinational and sequential logic design, timer and A/D-D/A converters. Ultimately, it is hoped that through learning this course students will be able to acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics and impart how to design Digital Circuits as well as a necessary foundation for further study of digital systems, computer architecture and VLSI design in the future.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **explain** number systems, different type of codes, binary arithmetical operations,	**Engineering Knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **identify** different types of digital electronic circuit using various mapping tools and procedures the basics of sequential circuits	**Engineering Knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☒ Participation ☐ Presentation
CO3	To **Explain** the fundamental knowledge of analog and digital electronics	**Engineering Knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Fundamentals of Digital Logic System: Number Systems, weighted and non-weighted codes, error detection code, Binary addition and subtraction, 2's compliment methods.

Logic Gates and Boolean Algebra, Logic Circuit Design, Adder, Substractor, Minimization Techniques: Algebraic Simplification, Karnaugh Map Method, Quine-McCluskey method, Consensus method.

Switching Devices, switching characteristics of diodes, transistor and FETs. Integrated Circuit Logic Families: DTL & TTL logic family, standard TTL series characteristics, other TTL series, TTL loading rules, TTL open-collector outputs, tristate TTL. The ECL family. Digital MOSFET circuits, characteristics, CMOS circuits, CMOS tristate logic, TTL driving CMOS, CMOS driving TTL.

Flip-Flops (FF) and related devices: Transistor Latch, NAND gate latch, NOR gate latch, D latch. Clock signals and Clocked FFs: Clocked SR, JK and D Flip-Flops, Master/Slave JK FF, timing diagram of different FFs, Edge-triggered and level-triggered timing diagrams.

555 Timer: Architecture of 555 Timer, different application of 555 timer, 555 as monostable, bistable and astable Multivibrators
A/D And D/A Converters: Sample and hold circuit, weighted resistor and R -2 R ladder D/A Converters, specifications for D/A converters. A/D converters: Quantization, parallel -comparator, successive approximation, counting type, dual-slope ADC, specifications of ADCs.

Text Book:

1. Ronald J. Tocci : **Digital Systems: Principles and Applications,** *Prentice Hall*
2. V. K. Jain : **An Introduction to Switching Theory and Digital Electronics**, *Khanna Publishers, New Delhi*

Books Recommended:

1. M. Morris Mano : **Digital Logic and Computer Design***, Prentice Hall*
2. William H. Gothmann : **Digital Electronics,** *Prentice Hall*

CSE 1212: Introduction to Digital Electronics LAB
Credits: 1 Contact Hours: 26
Year: First Semester: Even

Prerequisite: EEE 1131: Basic Electronics, EEE 1132: Basic Electronics Lab
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop basics knowledge on Introduction to Digital Electronics

Course Objective:
To provide hand-on experience in designing and implementing basic logic circuits, combinational and sequential circuits. The laboratory exercises are designed to give students ability to design, build, and implement digital circuits. Laboratory assignments progress from investigation of the properties of basic logic gates and flip-flops to the design of combinational and sequential circuits.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **construct** basic combinational circuits and verify their functionalities	**Modern tool usage:** (PO5)	Cognitive domain – level 2	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **apply** the design procedures to design basic combinational and sequential circuits	**Modern tool usage:** (PO5)	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO3	**To Implement** different multivibrators and D/A, A/D converters	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. To study and verify the truth table of logic gates
2. Implementation of different logic function
3. To realize half/full adder and half/full subtractor.
   i. Using X-OR and basic gates
   ii. Using only NAND gates.
4. To verify BCD to excess –3 code conversion using NAND gates. To study and verify the truth table of excess-3 to BCD code converter. (Vice versa)
5. Parity generator and checker
6. To convert given binary numbers to gray codes. (Vice versa)

7. Truth table verification of Flip-Flops:
    i. SR
    ii. JK
    iii. D- Type
    iv. T- Type.
8. Design and testing of Bistable, Monostable and Astable multivibrators using 555 timer.
9. Design and testing A/D and D/A converters
10. Design and test DTL and TTL logic gates

Text Book:

1. Ronald J. Tocci : **Digital Systems: Principles and Applications,** *Prentice Hall*
2. V. K. Jain : **An Introduction to Switching Theory and Digital Electronics**, *Khanna Publishers, New Delhi*

Books Recommended:

1. M. Morris Mano : **Digital Logic and Computer Design***, Prentice Hall*
2. William H. Gothmann : **Digital Electronics,** *Prentice Hall*

CSE 1221: Object Oriented Programming
Credits: 3 **Contact Hours:** 39
Year: 1st **Semester:** Even

Prerequisite: CSE1121 Structural Programming Language
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation Introduce how to design a computer program by making them out of objects that interact with one another.

Course Objective:
The main objective of this course is to provide necessary knowledge on how to approach programing in Object Oriented manner using Java, how to develop programs with graphical user interface (GUI) using event driven programing and how to apply OOP design patterns for solving complex problems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **identify** classes, objects, members of a class and relationships among them needed for a specific problem	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☒ Presentation
CO2	To **create** Java application programs using OOP principles and proper program structuring	**Modern tool usage:** (PO5)	Cognitive domain – level 2	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☒ Presentation
CO3	To **apply** object-oriented design patterns in solving OOP problems.	**Engineering knowledge** (PO1)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Introduction: Object Oriented Programming Concepts and features, Java as OOP language, Typical Java Development Environment. Java's Primitive Data Types, Operator (arithmetic and logical) and Control Structures.

Classes and Objects: Java Classes, Objects, Methods and instance variables, Program Modules in Java, static Methods, static Fields, Methods with Multiple Parameters, Java API Packages.

Arrays: Arrays, Enhanced for Statement, Passing Arrays to Methods, Variable-Length Argument Lists, Using Command-Line Arguments.

Classes and Objects: A Deeper Look: Encapsulation and data hiding, the notions of data abstraction and abstract data types (ADTs), Use of keyword this, use of static variables and methods, to import static members of a class, Controlling Access to Members, Inheritance, Polymorphism, Packages

Exception Handling: How exception and error handling works, to use try, throw and catch to detect, indicate and handle exceptions respectively, to use the finally block to release resources, to declare new exception classes.

Files and Streams: To create, read, write and update files, to retrieve information about files and directories, Java input/output stream class hierarchy, differences between text files and binary files, Sequential-access and random-access file processing.

GUI Programming: The design principles of graphical user interfaces (GUIs), to build GUIs and handle events generated by user interactions with GUIs, to handle mouse events and keyboard events, to use layout managers to arrange GUI components.

~~Design Patterns: Overview, Common Design patterns - Singleton, Factory and Abstract Factory, Builder, Adapter, Iterator, Observer, Strategy patterns~~.

Text Book:

1. Herbert Schildt : **Java: The Complete Reference, Ninth Edition 9th Edition***, Oracle Press*

Books Recommended:

1. Allen B. Downey & Chris Mayfield : **Think Java: How to think like a computer scientist,** *O' Reilly*
2. Vaskaran Sarcar : **Java Design Patterns,** *Apress*

CSE 1222: Object Oriented Programming Lab
Credits: 2 **Contact Hours:** 52
Year: 2nd **Semester:** Even

Prerequisite: CSE1121 Structural Programming Language
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To be able to write code in object oriented manner and apply various OOP concepts to solve real world problems

Course Objective:
To introduce students about the object-oriented programming principles, To make students familiar with fundamental features of Java and object oriented programming skills required to build highly reusable, robust and maintainable software systems

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools

CO1	To **implement** command line and GUI programs using classes and objects in java	**Modern tool usage** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **analyze** real world problems to be solved in an object oriented manner	**Design/development of solutions** (PO3)	Cognitive domain – level 3	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

This course is based on the theory course CSE1222 and will cover the lab assignments based on the following topics

1. Classes and objects, instance variables, and instance methods
2. Constructors, overloaded constructors
3. Member access modifiers: public, private, protected, package
4. Inheritance, method overriding, Interface
5. Polymorphism
6. Multithreading
7. Exception Handling
8. Java IO
9. GUI programing using ~~AWT~~ and Swing
10. ~~GoF Design pattern implementation~~

Text Book:

1. Herbert Schildt : **Java: The Complete Reference, Ninth Edition 9th Edition**, *Oracle Press*

Books Recommended:

1. Allen B. Downey & Chris Mayfield : **Think Java: How to think like a computer scientist,** *O' Reilly*
2. Vaskaran Sarcar : **Java Design Patterns,** *Apress*

2nd Year (Odd Semester)

ACCO2111: Industrial Management and Accountancy
Credits: 2 **Contact Hours:** 26
Year: Second **Semester:** Odd

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To understand the role of management and accountancy in modern commercial realm.

Course Objective:
This course gives students a good understanding about the concept of management and accountancy. The objective of this course is to enhance a manager's ability to make effective economic decisions in the context of organizational growth and development. It also explains the accountancy which is concerned with keeping the business deals and transactions in order.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understand** different theories and their practices in the field of management and accountancy	**Engineering knowledge** (PO1), **Problem analysis** (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO2	To **design** an agreement control system and responsibility accounting.	**Design/development of solutions** (PO3) , **Project management and finance** (PO11)	Cognitive domain – level 1	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO3	To **analyze** projects using cash flow approach	**Problem analysis** (PO2), **Design/development of solutions** (PO3)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Industry: Commerce-Industry: Meaning & Characteristics of Industry, Types of Industry; Business: Meaning & Objectives of Business, Types of Business: Sole Proprietorship, Partnership, Joint Stock Company, State Enterprise and Cooperative Society.

Fundamentals of Management: Meaning of Management, Principles of Management, Functions of Management, Levels of Management, Roles of Management, Scientific Management and Core Management skills.

Factory Location and Plant Layout: Factors Determining Location of Factory, Steps in Location, Factors Influencing Layout, Types of Layout, Problems of Layout.

Work-Environment and Plant Utility: Meaning, Importance, Factors Affecting Work Environment, Plant Utility, Lighting, Ventilation, Air-conditioning, Sanitation and Noise Control.

Sole Proprietorships: Features, Advantages, Disadvantages of Sole Proprietorship, Sustainability of Sole proprietorships.

Man Power Planning & Motivation: Need, Objectives, Manpower Planning Process, Recruitment, Selection and Training, Issue in Managing People, Maslow's Need Hierarchy, Social Needs and Productivity, Hygiene and Motivators.

Conflict & Union Management Perspective: Meaning, Process of Conflict, Types of Conflict, Industrial Conflict Resolution Methods, Negotiation Skills, Growth of Trade Unions, Functions, Structure, Leadership and Management in the Trade Union, Collective Bargaining.

Accountings: History, Scope and Nature of Accounting, Purpose of Accounting, Information and Uses

Transaction: Meaning and Features, Accounting Equation, Meaning and Classification of Account, Double entry System, Rules for Determining Debit and Credit, Accounting cycle.

Journal, Ledger and Trial Balance: Meaning, Features, Necessity, Rules, Double and Triple Column Cash Book and Practical Problems.

Work Sheet: Meaning, Purpose, Adjustment Entries and 10 Columns Work Sheet.

Cost Terms Concepts and Classification: Meaning of Cost, Manufacturing and Non Manufacturing Costs, Period and Product Costs, Variable and Fixed Costs, Direct and Indirect Costs, Differential, Opportunity and Sunk Costs, Schedule of Cost of Goods Manufactured, Schedule of Cost of Goods Sold and Income Statement.

Cost-Volume-Profit Relationship: Contribution Margin and Ratio, Break-even Analysis, CVP relationship in Graphical Form and Target Net Profit Analysis.

Text Book:

1. M. C. Shukla : **Business Organization and Management**,*S. Chand Publisher.*

Books Recommended:

1. Harold Koontz and Heinz Weihrich : **Management**, *Tata McGraw-Hill.*
2. Krajewski and Ritzman : **Operation Management**,*Addison-Wesley Publishing Company*
3. David A. Decenzo and Stephen P. Robbins : **Human Resource Management**, *John Wiley & Sons publisher.*
4. HermansonEtar : **Accounting Principles**, *Business Publications*
5. Ray H. Garrison : **Managerial Accounting**,*Irwin Professional Publishing*

STAT 2111: Theory of Statistics
Credits: 2 **Contact Hours:** 26
Year: Second **Semester:** Odd

Prerequisite: STAT1211 Statistics for Engineers
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To introduce students with statistical and probabilistic study of real life problems.

Course Objective:

The main objectives of the course are to provide students with theoretical foundations and methods of theory of statistics,to provide students with knowledge of typical statistical problems statement and mathematical methods for solving them, to develop practical skills of the statistical methods and theories application to real data sets..

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understand** different theories of probability distribution the methods of coefficient and error estimation.	**Engineering knowledge:** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To d**emonstrate** knowledge of statistical theory and to solve the problems related with science and engineering.	**Engineering knowledge** (PO1)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO3	To **apply** theoretical and experimental research,	**Problem analysis** (PO2)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Sampling Distributing: Fisher's Lemma. Study of Chi^2 Distribution, T-Distribution and F-Distribution, Properties, uses & Applications. Distribution of sample correlation coefficient in the null case. Sampling Distribution of the Medians and Range.

Elements of Point Estimations: Basic Concepts. Consistent estimates. Unbiased estimates. Mean and variance of estimates. Ideas of Efficiency. Principle of Maximum Likelihood. Illustration from Binomial, Poisson & Normal Distributions.

Test of Significance: Basic ideas of Null hypothesis. Alternative hypothesis. Type-I error, Type-II error, level of significance, Degree of freedom, Rejection region and Acceptance region. Test of Single mean, Single variance, Two sample means and variances. Test for 2x2 contingency tables. Independence test and practical examples.

Decision Rules: Statistical decisions; Statistical hypothesis; Critical region, Best critical region; Two types of errors; procedure of Test of hypothesis; Most powerful test, standard Errors.

Test of Significance: Test of single mean & single variance. Comparison of two sample Means, proportions and Variances. Bartlett's test for homogeneity of variances. Test for correlation and Regression coefficients. Exact test for 2*2 tables. Test for r*c tables. Three-Way contingency tables. Large Sample Test of Significance. Non-parametric Test, One Sample and two Sample Sign Test. Run Test and Rank Sum Test.

Text Book:

1. Mood, Graybill and Boes : **Introduction to the Theory of Statistics**, *McGraw-Hill, N. Y.*
2. R. L. Anderson, T. A. Bancroft : **Statistical Theory in Research**, *McGraw-Hill N. Y. Banctoft, T.*

Books Recommended:

1. G. Beaumont : **Intermediate Mathematical Statistics**,*Chapman and Hill, London*
2. Gutman, Wilks and Hunter **Introductory Engineering Statistics**, *John Wiley and Sons.*
3. P. G. Hoel : **Introduction to Mathematical Statistics**,*John Wiley and Sons, N. Y.*
4. R. V. Hogg. and A. T. Graig : **Introduction to Mathematical Statistics**,*CollierMacmilan, N. LY.*
5. B. W. Lindgren : **Statistical Theory**,*Collier-Macmillan Co; N. Y.*
6. G. B. Weatheril : **Intermediate Statistics Methods**,*Chapman and Hall, London*

MATH 2131: Differential Equations and Optimization
Credits: 3 **Contact Hours:** 39
Year: Second **Semester:** Odd

Prerequisite: MATH 1121 Differential and Integral, MATH1221 Co-ordinate Geometry, Vector analysis and Complex Variable

Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Motivation To understand the formation, solution and applications of differential equations.

Course Objective:

The main objective of this course is to provide necessary background of matrices and use of matrices to solve systems of linear equations. This course introduces the topic of differential equations: first order and second order and the way to solve the equation.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **analyze** the different order differential equation and find the solution of the equation.	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **understand** the Basic of Multivariable Calculus	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO3	To **understand** the Optimization Problem Formulation.	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:

Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Differential Equations: Solutions of first order and first degree and first-order and higher degree equations with variable coefficients, Solution of Higher-Order linear differential equations, Series solution of linear differential equation, Series solution of second order equation with variable coefficients, Solutions of partial differential equation, Laplace's equation and transformation, Poisson's equation, Helmholtz's equation, Diffusion equation, Green's function solution, Integral equation.

Basic of Multivariable Calculus
Multivariable functions, Limit and continuity, Partial Derivatives, Total Derivative, Vector Functions, Gradient, Physical interpretation of Gradient, Existence of Minimum and a Maximum, Continuity of Functions, Taylor's Theorem, Convex Functions

Optimization Problem Formulation
Statement of an Optimization problem, Historical development, Classification of Optimization problems and techniques, Single variable optimization problem, Iterative algorithmic approach.

Unconstrained Optimization. Necessary and Sufficient conditions for optimality, Convexity, Steepest Descent Method. Constrained Optimization. Necessary conditions for optimality, sufficient conditions for optimality, sensitivity of solution, Sequential Quadratic Programming

Text Books:

1. W. G. Kelley, A. C. Peterson : **Differential Equations**, **An Introduction with Applications**, *Harcourt Academic Press.*
2. A. D. Belegundu, T. R. Chandrupatla : **Optimization Concepts and Applications in Engineering**, *Cambridge University Press.*

Books Recommended:

1. Philip E. Gill, Walter Murray, and Margaret H. Wright : **Practical Optimization.** *Academic Press,*
2. Tanenbaum and Pollard : **Ordinary Differential Equations**, *Dover Publications.*
   Shepley L. Ross : **Introduction to Ordinary Differential Equations**, *Wiley.*

CSE 2111: Digital System Design
Credits: 3 **Contact Hours:** 39
Year: Second **Semester:** Odd

Prerequisite: CSE1211: Introduction to Digital Electronics
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop basics and design knowledge on Digital Systems

Course Objective:
The Objective of this course is to familiarize the student with fundamental principles of digital design. It provides coverage of classical hardware design for both combinational and sequential logic circuits .This course will guide on how to develop and apply Verilog coding styles for synthesis and data-path structures.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **identif**y the basics of Combinational and Sequential circuits, Boolean Algebra	**Problem analysis**: (PO2)	Cognitive domain – level 2	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO2	**T**o **design** a Sequential/Conditional circuits, Counter, Register, Decoder, MUX, PLA	**Design/development of solutions**: (PO3)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☒ Participation ☐ Presentation

CO3	To **design** digital control circuits for daily applications	**Design/development of solutions** (PO3)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☒ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Combinational Logic: Code converters, advanced arithmetic circuits, carry-look-ahead adder, binary parallel adder, BCD adder. Magnitude comparator.

MSI logic circuits: Encoders, decoders, multiplexers, demultiplexers, application od decoder and multiplexer: realizing for min-terms and max-terms, Binary Multiplier Parity generator and checker. Sequential Circuits: Latches, flip flops (FF), analysis of clocked sequential circuits, state reduction and assignments.

Registers and Counters: Registers, shift registers, parallel loading of shift register, counters, synchronous and asynchronous counter, up and down counter, ripple counter, counters using SR and JK FF, design of sequential counter, application of counter: parallel to serial communication, other types of counters.

Memory and Programmable Logic: Random access memory (RAM), memory addressing, Programmable Array Logic (PAL), Programmable Logic Array (PLA), Introduction to CPLDs, FPGAs,

Introduction to hardware description language (HDL), Verilog HDL/VHDL, Syntax and program structure of HDL (Verilog HDL/VHDL). Application of HDL: Description and simulation of common combinational circuits using HDL: Adder, decoder, multiplexer etc. Description and simulation of sequential circuits, registers, counters.

Text Book:

1. Ronald J. Tocci : **Digital Systems: Principles and Applications,** *Prentice Hall*
2. M. Morris Mano : **Digital Logic and Computer Design***, Prentice Hall*

Books Recommended:

1. V. K. Jain : **An Introduction to Switching Theory and Digital Electronics**, *Khanna Publishers, New Delhi*
2. William H. Gothmann : **Digital Electronics,***Prentice Hall*

CSE 2112: Digital System Design Lab
Credits: 1 Contact Hours: 26
Year: Second **Semester:** Odd

Prerequisite: CSE1212 Introduction to Digital Electronics Lab
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop basics and design knowledge on Digital Systems

Course Objective:
The Objective of this course is to familiarize the student with fundamental principles of digital design. It provides coverage of classical hardware design for both combinational and sequential logic circuits .This course will guide on how to develop and apply Verilog coding styles for synthesis and data-path structures.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To u**se** Digital Logic Experimental Board to implement Decoder, Encoder, Multiplexer, Demultiplexer	**Modern tool usage:** (PO5).	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☐ Assignment ☒ Note book ☐ Presentation
CO2	To **use** Digital Logic Experimental Board to implement Counter, Register,	**Modern tool usage:** (PO5).	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☐ Assignment ☒ Note book ☐ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Design of Adder And Subtractor
2. Design of 4-Bit Adder and Subtractor
3. Design and Implementation of Code Convertor
4. Design and Implementation of Magnitude Comparator
5. Design and Implementation of 4:1 Multiplexer and 1:4 Demultiplexer
6. Construction and Verification of 4 Bit Ripple Counter and Mod 10 Counter (Asynchronous)
7. Design and Implementation of 3 Bit Synchronous Up/Down Counter
8. Design and Implementation of Shift Register

Text Book:

1. Ronald J. Tocci : **Digital Systems: Principles and Applications,** *Prentice Hall*
2. M. Morris Mano : **Digital Logic and Computer Design***, Prentice Hall*

Books Recommended:

1. V. K. Jain : **An Introduction to Switching Theory and Digital Electronics**, *Khanna Publishers, New Delhi*
2. William H. Gothmann : **Digital Electronics,***Prentice Hall*

CSE 2121: Data Structure
Credits: 3 **Contact Hours:** 39
Year: Second **Semester:** Odd

Prerequisite: CSE1121: Structural Programming Language
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To learn all accumulated expertise in computing and use them in data storage and access so as to write cleaner code that run much faster.

Course Objective:

The main objective of this course is to provide necessary knowledge on different data structures and efficient storage mechanisms of data for an easy access. Data structures make the program easier to understand and debug. It also introduces various techniques for representation of the data in the real world.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	**Understand** data structures, its types, and applications of different data structures.	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO2	**Evaluate** algorithms and data structures in terms of time and memory complexity.	**Problem analysis** (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO3	**Formulate** new solutions for programing problems using learned algorithms and data structures	**Design/development of solutions** (PO3)	Cognitive domain – level 1	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Arrays: Maximization, ordered lists, sparse matrices, representation of arrays.

Stacks, Queues and Recursion: Different types of stacks and queues: Circular, dequeues, etc; evaluation of expressions, multiple stacks and queues;

Recursion: Direct and indirect recursion, depth of recursion; Simulation of Recursion, Removal of recursion; Towers of Hanoi.

Links Lists: singly linked lists, linked stacks and queues, the storage pool, polynomial addition, equivalence relations, sparse matrices, doubly linked lists and dynamic storage management, generalized lists, garbage collection and compaction.

Trees: Basic terminology, binary trees, binary tree representations, binary tree traversal; Extended binary trees: 2-trees, internal and external path lengths, Huffman codes/algorithms; threaded binary trees, binary tree representation of trees; Application of Trees: Set representation, decision trees, games trees: Counting binary trees, Binary Indexed tree, Segment tree, Trip tree, Suffix tree, Merge Sort tree, Red-black tree, Splay tree, K-d tree, UFDS.

Graphs: Introduction, definitions and terminology, graph representations, traversals, connected components and spanning trees, shortest path and transitive closure, activity networks, topological sort and critical paths, enumerating all paths.

Symbol Tables: static tree tables, dynamic tree tables; Hash Tables: Hashing functions overflow handling, theoretical evaluation of overflow techniques.

Files: file, queries and sequential organizations: Indexing Techniques: Cylinder-surface indexing hashed indexes, tree indexing-B-trees; Tree indexing.

Text Book:

1. Seymour Lipshultz : **Data Structures (Schaum's Outline Series)**,*Tata McGraw-Hill*
2. E. Horowitz and S. Sahni : **Fundamentals of Data Structures**,*Galgotia*.

Books Recommended:

1. Edward M. Reingold & Wilfred J. Hansen : **Data Structures**,*Addison Wesley Publishers*
2. Robert L. Kruse : **Data Structures and Program Design**, *Prentice Hall*

CSE 2122: Data Structure Lab
Credits: 1 Contact Hours: 26
Year: Second **Semester:** Odd

Prerequisite: CSE1121: Structural Programming Language
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To learn all accumulated expertise in computing and use them in data storage and access so as to write cleaner code that run much faster.

Course Objective:
The main objective of this Lab course is to develop computer program based on theory course CSE2121 (Data Structure) in C or C++ or Java language.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **implement** elementary data structures such as array, stack, queue, linked list, tree, graph	**Design/development of solutions:** (PO3)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **apply** data structures to solve real world problems.	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Design, develop and implement a program for the following Array operations
    a. Creating an Array of N Integer Elements
    b. Display of Array Elements with Suitable Headings
    c. Inserting an Element (ELEM) at a given valid Position (POS)
    d. Deleting an Element at a given valid Position (POS)
2. Design, Develop and Implement a program for the following Array operations
    a. Creating an Array of N Integer Elements
    b. Sort the elements using Bubble Sort Algorithm
    c. Search an item using Linear Search Algorithm
    d. Search an item using Binary Search Algorithm
3. Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX)
    a. Push an Element on to Stack
    b. Pop an Element from Stack
    c. Display the status of Stack

4. Design, Develop and Implement a Program for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.
5. Design, Develop and Implement a Program for the following Stack Applications
    a. Evaluation of Postfix expression with single digit operands and operators: +, -, *, /, %, ^
    b. Solving Tower of Hanoi problem with n disks
6. Design, Develop and Implement a Program for the following Recursion Applications
    a. Calculate the factorial of n
    b. b. Display the Fibonacci sequence of n numbers
7. Design, Develop and Implement a menu driven Program for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX)
    a. Insert an Element on to Circular QUEUE
    b. Delete an Element from Circular QUEUE
    c. Display the status of Circular QUEUE
8. Design, Develop and Implement a program for the following operations on Singly Linked List (SLL) of Student Data with the fields: ID, Name, Dept, Sem, Mobile
    a. Create a SLL of N Students Data by using front insertion.
    b. Display the status of SLL and count the number of nodes in it
    c. Perform Insertion / Deletion at End of SLL
    d. Perform Insertion / Deletion at Front of SLL
    e. Perform Insertion / Deletion after a given node
9. Design, Develop and Implement a program for the following operations on Binary Search Tree (BST) of Integers
    a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2
    b. Traverse the BST in Inorder, Preorder and Post Order
    c. Search the BST for a given element (KEY) and report the appropriate message
10. Design, Develop and Implement a program for the following operations on Complete Binary Search Tree of Integers
    a. Create a Heap of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2
    b. Sort the list using Heap Sort Algorithm.
11. Design, Develop and Implement a Program for the following operations on Graph(G) of Cities
    a. Create a Graph of N cities using Adjacency Matrix.
    b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS method
12. Design, Develop and Implement a Program for the following operations on Graph(G) of Cities
    a. Create a Weighted Graph of N cities using Adjacency Matrix.
    b. Print the shortest path from a weighted graph using Warshall's Algorithm.
13. Given a File of N employee records with a set K of Keys(4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2- digit) of locations in HT. Let the keys in K and addresses in L are Integers. Design and develop a Program in C that uses Hash function H: K → L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

CSE 2131: Discrete Mathematics
Credits: 3 **Contact Hours:** 39
Year: Second Semester: Odd

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop basics knowledge on Discrete Mathematics

Course Objective:
To develop logical thinking and its application to engineering and computer science will provides a powerful tool for reasoning correctly about mathematics, algorithms, and computers. The subject enhances student's ability to reason and ability to present a coherent and mathematically accurate argument. Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to use mathematically correct terminology and notation, construct correct direct and indirect proofs, and apply logical reasoning to solve computational problems precisely.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **express** and **evaluate** basic logic statements, proposition and predicate logic, rules of inference, methods of proof and mathematical induction	**Engineering knowledge** (PO1)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☒ Participation ☐ Presentation
CO2	To **demonstrate** an understanding of binary relations and functions, graph and trees,	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☒ Participation ☐ Presentation
CO3	To s**olve** sequence and counting problems and problems of recurrence relations and recursion	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Mathematical Logic: Connectives, normal Forms, theory of inference for proposition calculus, predicate calculus, inference theory of predicate calculus, method of proof, mathematical induction.

Sets: Basic concept of set theory, operation of sets, ordered pairs and n-tuples.

Relation and ordering: Relations, properties of Binary relation in a set, composition of binary relation, relation matrix and graph of a relation, partial ordering, path in relation and di-graph.

Functions: definition, composition of function, inverse function, binary and array operation.

Graph: Introduction to graph, graph terminology, representing graph and graph isomorphism, paths, reachability, connectivity, Euler and Hamilton path, shortest path problems, graph colouring, matrix representation of graph.

Trees: Introduction of trees, application of trees, tree traversal, labelling trees, trees and sorting, spanning trees, minimal spanning tree, undirected trees.. Algebraic structure: Algebraic system, general properties, some simple algebraic system.

Text Book:

1. Kenneth H. Rosen : **Discrete Mathematics and Its Applications**, *McGraw-Hill*

Books Recommended:

1. J. P. Tremblay and R. Manohar : **Discrete Mathematics structures with applications to Computer Science***, McGraw-Hill*
2. Seymour Lipschutz : **Theory and Problems of Discrete Mathematics**,Schaum's Outline Series,*McGraw-Hill*
3. Bernard Kolman, Robert Busby, Sharon C. Ross : **Discrete Mathematical Structures**, *Prentice Hall*
4. C.L. Liu : **Elements of Discrete Mathematics**, *McGraw-Hill.*

CSE2142: Writing Professional Code Lab
Credits: 1 **Contact Hours:** 26
Year: Second **Semester:** Odd

Prerequisite: CSE1222: Object Oriented Programming Lab
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To know how to work with real code in a real coding environment.
Course Objective: Being a professional developer is about managing change, evolving a codebase, maintaining quality, and keeping your users and your business safe. As a new coder, step up your game as you learn and practice key skills that developers use every day. Work with a collection of code in a version control system like Git, use open source (OSS) libraries, make updates to existing code, improve its readability, and even take a look at security. This will be practical experience with real code in a real coding environment.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **practice** Writing professional code (clean code)	**Design/development of solutions:** (PO3)	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **apply** Version controlling and Collaborating system using git and GitHub	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Rewrite an unprofessionally written smelly code in a professional way
2. Create git repo and perform basic git operation
3. Create GitHub account and push your local code to GitHub
4. Create branches and merge them together
5. Add collaborator to your repo and work as a team
6. Writing Readme markdown file
7. Work on open source project

Text Book:
1. Robert C. Martin : **D Clean Code: A Handbook of Agile Software Craftsmanship,** *Prentice Hall*

2nd Year (Even Semester)

LAW 2211: Cyber and Intellectual Property Law
Credits: 2 **Contact Hours:** 26
Year: Second **Semester:** Even

Prerequisite: None

Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Motivation To provide a deep understanding of cyber law concepts and while explaining intellectual property concepts, making students aware of their rights for the protection of their invention done.

Course Objective:
This course aims to understand the different theoretical and cross-disciplinary approaches related to cyber-security and the regulations of the Internet. Also, to make the students knowledgeable about the current ICT policy and law of Bangladesh, as well as International cyber law. This course also intends to teach students Intellectual property concept and fundamental knowledge of patents, copyrights, trademarks, designs and Information Technology Act. Students also get awareness of importance of acquiring the patent and copyright for their innovative works and get the knowledge of plagiarism in their innovations which can be questioned legally.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	**Illustrate** the Laws of governing cyberspace and intellectual property right issues in the cyberspace.	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO2	**Analyze** different types of cybercrimes and legal frameworks to deal with various cybercrimes problems.	**Problem analysis** (PO2)	Cognitive domain – level 3	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☐ Assignment ☐ Participation ☒ Presentation
CO3	**Develop** the importance of the digital evidence in prosecution and compare laws of different countries for handling evidence.	**Design/development of solutions** (PO3)	Cognitive domain – level 2	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☒ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 2 hours.
A class participation mark (10%).

Course Contents:

Cyber Law

Cyber Law: Definition Nature, Scope, Utility of Cyber Law, Origin and Development of Cyber Law and Internet.

Cyber Crime: Jurisdiction and Cyber Crime, Types of Cyber Crime, Criminal Justice in Bangladesh and Implications on Cyber Crime; Protection of Copyrights and Intellectual Property right. Invasion of Privacy, Constitutional basis of Privacy, Unsolicited dE-Mail, Defamation, Harassment and e-Mail Abuse, Present Legal Protection.

ICT Policy in Bangladesh: e-Readiness in Bangladesh- e-Commerce in Bangladesh, e-Governance in Bangladesh, e-Learning/Education in Bangladesh, e-Journal in Bangladesh, e-Voting in Bangladesh.

Electronic Evidence: Digital Signature, Electronic Evidence in Bangladesh, Legal Effects of Electronic Evidence. The Information and Communication Technology Act-2006, Digital Security Act-2018.

Intellectual Property Law

Intellectual Property Law: Basic Concepts of IP Law, Nature of IPR, Computer-related intellectual property rights; Copyright- Original and development of copyright law, subject matter of copyright protection, Rights protected by copyright, Neighboring rights, Limitations of Copyright protecting, Piracy and infringement, Remedies.

Patent: Patents and technological development, Requirements for patentability and ownership of patents, Scope of exclusive rights and duration of protection, Patents infringement, defenses and remedies.

Trademarks: Reasons for the protection of trademarks, Acquisition of trademark right, Registration procedure, Duration of protection and renewal, Termination.

Text Book:

1. Md. Borhan Uddin : **Principles of Cyber Law (Bangladesh Perspective),** *Shams Publications*

Books Recommended:

1. V. D. Dudej : **Information Technology & Cyber Laws**, *Commonwealth Publishers.*
2. Arpad Bogsch : **Universal Copyright Convention: An Analysis and Commentary**, *Bowker*
3. Alan Daubeny Russell Clarke : **Copyright in Industrial Designs**, *Sweet and M.*
4. VivckSood : **Cyber Law Simplified**,*Tata McGraw Hill Publications.*

MATH 2231: Numerical Methods
Credits: 2 **Contact Hours:** 26
Year: Second **Semester:** Even

Prerequisite: CSE1121 Structural Programming Language
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To know the story of how functions, derivatives, integrals, and differential equations are handled as strings of numbers in the computer.

Course Objective:
This course provides a foundation in some fundamental numerical methods for problem solving in a scientific computing environment. The primary objective of the course is to develop the basic understanding of numerical algorithms and skills to implement algorithms to solve mathematical problems such as findings roots of the linear and non-linear equations, approximation and interpolation data, solving the problem involving integration and differentiations etc. on the computer.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **analyze** the mathematical errors.	**Problem analysis** (PO2)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO2	To **Solve** the complex mathematical problems using only simple arithmetic operations.	**Problem analysis** (PO2)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Approximations and Errors: Accuracy and Precision, Error Definitions, Round-Off Errors, Truncation Errors.

Roots of Equations: Graphical Methods, The Bisection Method, The False-Position Method, Simple One-Point Iteration, The Newton-Raphson Method, The Secant Method.

Systems of linear algebraic equations: Gauss Elimination, Solving Small Numbers of Equations, Naive Gauss Elimination, Pitfalls of Elimination Methods, Matrix Inversion and Gauss –Seidel, The Matrix Inverse, Error Analysis and System Condition.

Curve Fitting: Linear Regression, Polynomial Regression, Multiple Linear Regression, Newton's Divided-Difference Interpolating Polynomials, Lagrange Interpolating Polynomials, Coefficients of an Interpolating Polynomials, Curve Fitting with sinusoidal Functions.

Numerical Differentiation and Integration : The Trapezoidal Rule, Simpson's Rules, Integration with Unequal Segments, Romberg Integration, Gauss Quadrature, High-Accuracy Differentiation Formulas, Richardson Extrapolation, Derivatives of Unequally Spaced Data.

Pseudorandom-number generators, the FFT.

Text Book:

1. Steven C. Chapra, Raymond P. Canale : **Numerical Methods for Engineers**, *McGraw-Hill*

Books Recommended:

1. S. S. Kuo : **Computer Applications of Numerical Methods***, Addison-Wesley*
2. S. S. Sastry : **Introductory Methods of Numerical Analysis** *Prentice-Hall of India Pvt. Ltd.*
3. Press, Teukolsky, Vetterling and Flannery : **Numerical Recipes in C**: The Art of Scientific Computing,CambridgeUniversity Press.

MATH 2232: Numerical Methods LAB
Credits: 1 Contact Hours: 26
Year: First Semester: Even

Prerequisite: CSE1121 Structural Programming Language
Course Type: ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation : To introduce the fundamentals of numerical methods used for the solution of engineering problems.

Course Objective:
To provide the solution of polynomial equations to find roots using numerical methods, to find interpolation formula from given sets of data values, to find curve fitting procedure, to find solution of numerical integration and differentiation. The laboratory exercises are designed to give students ability to implement algorithms programmatically to solve those methods.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understand** basics of numerical methods.	**Engineering knowledge usage:** (PO1)	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **estimate** roots of polynomial equations using numerical methods.	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO3	**To solve** integration and differentiation numerically.	**design/development of solutions** (PO3)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab works/Experiments:

1. To find the roots of non-linear equation using Bisection method.
2. To find the roots of non-linear equation using False-Position method.
3. To find the roots of non-linear equation using Newton's method.
4. Determination of roots of a polynomial.
5. To solve problems using Newton's forward difference method of interpolation
6. To solve problems using Lagrange method of interpolation
7. Determination of polynomial using method of least square curve fitting
8. To solve the system of linear equations using Gauss - elimination method.
9. To solve the system of linear equations using Gauss - seidal iteration method
10. To solve the system of linear equations using Gauss - jordan method.
11. To integrate numerically using trapezoidal rule.
12. To integrate numerically using simpson's rules.
13. To find numerical solution of ordinary differential equations by euler's method.
14. To find numerical solution of ordinary differential equations by 4th Order Runge- kutta method.

Text Book:

1. S. S. Sastry : **Introductory Methods of Numerical Analysis** *Prentice-Hall of India Pvt. Ltd.*

Books Recommended:

1. Press, Teukolsky, Vetterling and Flannery : **Numerical Recipes in C**: The Art of Scientific Computing,CambridgeUniversity Press.
2. S. S. Kuo : **Computer Applications of Numerical Methods***, Addison-Wesley*

MATH 2241: Linear Algebra
Credits: 3 **Contact Hours:** 39
Year: Second **Semester:** Even

Prerequisite: MATH 1121 Differential and Integral Calculus, MATH1221 Co-ordinate Geometry, Vector analysis and Complex Variable, MATH 2131 Differential Equations and Optimization

Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Motivation To develop a mathematical base for signal processing, machine learning and mathematical modeling.

Course Objective:

The main objective of this course is to provide fundamental ideas of linear algebra and introduce the power of linear algebra to simplify calculations in computer science and engineering. To achieve this objective, every major concept in the course is given geometric interpretation so that students can visualize the idea.

The student will study linear equations, matrix algebra, vector spaces, linear algebra concepts to model, solve, and analyze real-world situations.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	**T**o **understand** the Matrices operations.	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☐ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☐ Presentation
CO2	To **find** the dimension and basis of various vector spaces.	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☐ Presentation
CO3	To **interpret and analyze** numerical data, mathematical concepts, and identify patterns to formulate and validate reasoning	**Problem analysis**: (PO2)	Cognitive domain – level 4	☒ Lecture Note ☐ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☐ Presentation

Assessment and Marks Distribution:

Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Definition of Matrices,

Equality of two Matrices, Addition, Subtraction and Multiplication of Matrices, Equivalence of Matrices, Positive and Negative Matrices, Adjoint of Matrices, Transpose and Inverse of Matrices, Rank and Normal form of Matrices,

System of Linear Equations, Solution of Homogeneous and Non-Homogeneous Systems, Determination of Eigen Values and Eigen Vectors, Solutions of Matrix Differential Equations.

Linear Algebra:

Vector Space, Subspace, Sum and Direct Sum, Basis and Dimension, Hilbert Space, Normed Linear Space, Branch Space.

Linear Transformation: Range, Kernel, Nullity, Singular and Non-Singular Transformation.

Linear Operations: Matrix Representation of a Linear Operator, Change of Basis, Similarity and Linear Mapping. Norms and inner products, Orthogonal complements, orthonormals sets, Gram-schmidt orthogonalization process. Diagonalization: Properties of Eigenvalues and Eigenvectors, Positive definite Matrices, Matrix Decomposition.

Text Book:

1. David C. Lay : **Linear Algebra and its Application,** *Pearson*
2. M. L. Khanna : **Matrices,** *Jai Prakash Nath and Co*

Books Recommended:

1. Gilbert Strang : **Introduction to Linear Algebra,** *Wellesley - Cambridge Press.*
2. Erwin Kleinfeld and Margaret Kleinfeld : **Understanding Linear Algebra Using MATLAB,** *Prentice Hall*

CSE 2211: Theory of Computation
Credits: 3 **Contact Hours:** 39
Year: 2nd **Semester:** Even

Prerequisite: CSE2131 Discrete Mathematics
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation Mathematical study of computing machines and their capabilities.

Course Objective:
The goal of this course is to provide students with an understanding of basic concepts and techniques used in Theory of Computation. In this course we cover finite automata, pushdown automata, Context free Grammars and Turing machines. We also cover Pumping Lemma for Regular Language & Context Free Language.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **Iden**tify different types of abstract model of computing machines and their capabilities and properties.	**Engineering knowledge (PO1)**	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **analyze** different types of formal languages and their corresponding formal grammars	**Problem analysis (PO2)**	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Fundamentals : Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and nondeterministic finite automaton, transition diagrams and Language recognizers.

Finite Automata: NFA with null transitions – Significance, acceptance of languages. Conversions and Equivalence: Equivalence between NFA with and without null transitions, NFA to DFA conversion, minimization of FSM, equivalence between two FSM's, Finite Automata with output- Moore and Mealy machines.

Regular Languages: Regular sets, regular expressions, identity rules, Constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions. Pumping lemma of regular sets, closure properties of regular sets

Grammar Formalism: Regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and FA, inter conversion, Context free grammar, derivation trees, and sentential forms. Rightmost and leftmost derivation of strings.

Context Free Grammars: Ambiguity in context free grammars. Minimization of Context Free Grammars. Chomsky normal form, Greibach normal form, Pumping Lemma for Context Free Languages. Enumeration of properties of CFL.

Push Down Automata: Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, interconversion. Introduction to DCFL and DPDA.

Turing Machine: Turing Machine, definition, model, design of TM, Computable functions, recursively enumerable languages. Church's hypothesis, counter machine, types of Turing machines. , linear bounded automata and context sensitive language.

Computability Theory: Chomsky hierarchy of languages, decidability of problems, Universal Turing machine, undecidability of posts correspondence problem, Turing reducibility, Definition of P and NP Problems, NP complete and NP hard problems.

Text Book:

1. Joha E. Hopcroft, Jeffery Ullman : **Introduction to Automata theory, Languages & Computation,** *Narosa Publishers*
2. K.L.P. Mishra & N.Chandrasekaran : **Theory of Computer Science**, *PHI Learning.*
3. Michael Sipsev : **Theory of Computation***, Cenage Learning*

CSE2221: Design and Analysis of Algorithms
Credits: 3 **Contact Hours:** 39
Year: Second **Semester:** Even

Prerequisite: CSE1121: Structural Programming Language, CSE2121: Data Structure
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation This course is offered to provide an introduction to mathematical modeling of computational problems.

Course Objective:
To make students familiar with common algorithms, algorithmic paradigms, data structures, advanced algorithms, advanced data structures, performance analysis of algorithms, and designing an efficient algorithm.Algorithms help to acquire necessary skills to recognize problem scenarios and identify the right algorithms that can be used, to develop a new algorithm or modify an existing one.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **desig**n an efficient algorithm in a structured way.	**Design/development of solutions:** (PO3)	Cognitive domain – level 1	☒Lecture Note ☒Text Book ☐Audio/Video ☐Web Material ☐Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **compare** different algorithms in terms of time and memory complexity	**Problem analysis:** (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Analysis of algorithm: Time complexity, Space complexity

Sorting: Insertion sort, Bubble sort, Counting sort, Merge sort, Quick sort,

Searching: Linear search, Binary search (on discrete domain and on continuous domain)

Uninformed search: DFS, BFS, Dijkastra, IDDFS, Meet-in-the-middle, Informed search, A* search, IDA*

Local search: Random restart hill climb, Simulated annealing, Local beam search, Genetic algorithm

Game theoretic search: Minimax search, Alpha-beta pruning

Constraint satisfaction problem: Backtrack , Algorithm x

Data structure: BST, Heap (priority queue), Merge sort tree (interval based sorted array), Treap (array merge, split and accumulation), UFDS (solving connectivity problem)

Dynamic programming: Subset sum / 0-1 knapsack, Interval DP

Greedy: Activity selection

String: KMP, Rabin Karp, Suffix array

Geometry: Line sweep, Jarvis march, Graham scan

Text Book:

1. Thomas H. Cormen, Clifford Stein, Ronald L. Rivest, Charles E. Leiserson : **Introduction to Algorithms,** *The MIT Press*

Books Recommended:

1. AnttiLaaksonen : **Competitive Programmer's Handbook,** *Springer*
2. AnttiLaaksonen **Guide to Competitive Programming: Learning and Improving Algorithms Through Contests,** *Springer*

CSE2222: Design and Analysis of Algorithms Lab.
Credits: 1Contact Hours: 26
Year: Second **Semester:** Even

Prerequisite: CSE1121: Structural Programming Language, CSE2121: Data Structure
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation This course is offered for the students to achieve implementation details of complex computational problems solutions based on algorithm.

Course Objective:
To develop programs for solving a well-specified computational problems on the basis of well-designed algorithm and make a relation between algorithm and programming.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **solve** problems using appropriate algorithm	**Design/development of solutions: (PO3)**	Cognitive domain – level 1	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☐ Note book ☐ Presentation
CO2	To i**mplement** major algorithms and analyze their performance	**Problem analysis:** (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☐ Note book ☐ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents//List of Experiment:

1. Sorting an array using
    a. Insertion sort
    b. Bubble sort
2. Searching a key in an array using
3. c. Linear search
4. d. Binary search (discrete domain and continuous domain)
5. Using divide and conquer approach for sorting: Merge Sort
6. Using divide and conquer approach for sorting: Quick Sort
7. Linear time sorting: Counting Sort
8. Uninformed searching using
    a. Depth First Search (DFS)
    b. Breath First Search (BFS)
    c. Meet-in-the-middle
    d. Iterative Deepening Depth First Search (IDDFS)
    e. Dijkstra
9. Informed searching using
    a. A* search
    b. IDA* search
10. Local searching using
    a. Random restart hill climbing
    b. Simulated annealing
    c. Local bean search
    d. Genetic algorithm
11. Game theoretic searching
    a. Minimax search
    b. Alpha-beta pruning
12. Constraint satisfaction problem
    a. Backtracking
    b. Algorithm X
13. Data Structure
    a. Binary search tree (BST)
    b. Heap (priority queue)
    c. Merge sort tree (interval based sorted array)
    d. Treap (array merge, split and accumulation)
    e. UFDS (solving connectivity problem)

14. Dynamic programming
    a. Subset sum / 0-1 knapsack
    b. Interval DP
15. Greedy approach
    a. Activity selection problem
16. String matching
    a. KMP
    b. Rabin Karp
    c. Suffix array
17. Computational geometry
    a. Line sweep
    b. Jarvis march
    c. Graham scan

CSE 2231: Computer Architecture and Organization
Credits: 3 **Contact Hours:** 39
Year: Second Semester: Even

Prerequisite: EEE1131: Basic Electronics, CSE2111: Digital System Design
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop basics and design knowledge on Computer Architecture and Systems

Course Objective:
To provide students with a fundamental understanding of the functional components of a computer system, and how they are organized. The emphasis of the module is on the hardware aspects of a system, and how hardware is used during the execution of software. This is a core component of all computer science related degree courses. Practical skills will also be developed in the use and construction of computer components, and their interfacing to microprocessors.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **explain** the basic knowledge of Computer Architecture and its organization	**Engineering knowledge:** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO2	To **illustrate** how Computer Systems works, its design objectives	**Problem analysis:** (PO2)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO3	To **show** the designing procedure of a processor, memory and storage	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Concepts and Terminology: Digital computer components Hardware & Software and their dual nature, recent development, Role of Operating Systems (OS).

Processor Design: Introduction: Processor organization, information representation, number formats; Fixed Point Arithmetic: Addition, subtraction, multiplication, division; ALU Design: Basic ALU organization, floating point arithmetic.

Control Design: Hardwired control: Design methods, multiplier control unit, CPU control unit; Basic concept of Micro programmed Control, Control memory optimization.

Memory Devices and its Organization: Different types of semiconductor memory, magnetic memory, optical memory, virtual memory, memory hierarchies; High-speed Memories: Interleaved memories, caches, associative memories. System Organization: Communications: Introduction, bus control; IO Systems: Programmed IO, DMA and interrupts, IO processors.

Application HDL for microcomputer design: Description of Adder, ALU by using HDL, implementation of a simple microcomputer system using HDL.

Text Book:

1. John P. Hayes : **Computer Architecture and Organization,** *McGraw-Hill.*
2. M. Morris Mano : **Computer Architecture,** *Prentice Hall.*

Books Recommended:

1. Kai Hwang and Faye A. Briggs : **Computer Architecture and Parallel Processing**, *McGraw-Hill.*
2. William Stallings : **Computer Organization and Architecture: Designing for Performance**, *Prentice Hall.*

CSE 2232: Computer Architecture and Organization Lab
Credits: 1 **Contact Hours:** 26
Year: Second Semester: Even

Prerequisite: EEE1131 Basic Electronics, CSE2111: Digital System Design
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop basics and design knowledge on Computer Architecture and Systems

Course Objective:
This course represents a laboratory course of computer architecture and organization. They can extend their previous hardware knowledge by implementing different types of the module which is on the hardware aspects of a system and can also learn how hardware is used during the execution of software. Their practical knowledge will be developed of constructing of computer components and their interfacing to microprocessors.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **develop** the design of the problems in Computer Architecture and Organization	**Design/Development of solutions:** (PO3)	Cognitive domain – level 2	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

CO2	To **show** the designing procedure of a processor, memory and storage	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/Experiment Lis:

1. Title: **Synchronous Data Transfer**

   Outline:
   - To design and implement a digital circuit to transfer data serially
   - At the sender end the parallel data is converted to serial data to transfer the data to receiver using a single data line.
   - At the receiver end the serial data will be reconstructed to its parallel form.
   - Both sender and receiver circuits should be synchronized using a single clock.

2. Title: **Memory operations**

   Outline:

   - To design and implement a memory subsystem to store data in memory and then display the stored data into LED
   - Writing the following data into corresponding memory addresses using synchronized counter

Address	Data
60	F0
61	E1
62	D2
. . .	. . .
6F	0F

   - Display the stored data into LED

3. Title: **Frequency counter**

   Outline:

   - To design and implement a frequency counter. The input frequency will be divided by a constant divisor N (N=1, 2, …, 15) before feeding it to desired frequency counter. The output of the frequency counter should be show on a 7-segment display
   - Design a circuit for dividing the input frequency by a constant divisor N, where N is integer and variable. N should be easily changeable.
   - Design a circuit to count frequency and show the output on a 7-segment display.

4. Title: **Analog to Digital Conversion**

   Outline:

   - To design and implement a circuit to convert analog signal (potential difference) into digital data by using an Analog to Digital Converter than store the data in a latch and display the converted digital data using LED
   - Design a circuit with controls to initialize the conversion process.
   - Decode port if multiple input analog input lines available on ADC IC and required to digitize multiple analog input signals.
   - Design circuit to store digital signal in a letch automatically. (Required to synchronized with ADC IC)

5. Title: **Arithmetic circuit control design**

Outline:

- To design and implement arithmetic circuits with selection variable S_0& S_1 and operand A (4 bits), B (4 bits) & C_{in} that generates the following operations:

S_0	S_1	C_{in}=0	C_{in}=1
0	0	F=A+B	F=A+B+1
0	1	F=A	F=A+1
1	0	F=B'	F=B'+1
1	1	F=A+B'	F=A+B'+1

- Construct truth table and K-Map to generate Boolean equations for the arithmetic circuit.
- Implement the circuit for according to the Boolean equations.

6. Title: **Arithmetic circuit control design**

Outline:

- To design and implement arithmetic circuits with selection variable S_0& S_1 and operand A (4 bits), B (4 bits) & C_{in} that generates the following operations:

S_0	S_1	C_{in}=0	C_{in}=1
0	0	F=A	F=A+1
0	1	F=A-B-1	F=A-B
1	0	F=B-A-1	F=B-A
1	1	F=A+B	F=A+B+1

- Construct truth table and K-Map to generate Boolean equations for the arithmetic circuit.
- Implement the circuit for according to the Boolean equations

CSE 2242: Technical Writing and Presentation
Credits: 1 Contact Hours: 13
Year: Second Semester: Even

Prerequisite: None
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To learn principles, techniques and skills to conduct scientific, technical or business writing and oral presentation

Course Objective:

This is a course which aims to give students a formal and methodical exposure to Academic and Technical writing and professional communication skills. They will learn Principles, techniques, and skills needed to conduct scientific, technical, or business writing. This course provides students with the methodology needed to construct and to deliver oral presentations, create tables, graphs, and charts, and write a variety of reports and proposals.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **produce** documents in a variety of professional genres such as memos, proposals, and analytical reports	**Communication:** (PO10)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☐ Final Exam ☒ Assignment ☐ Participation ☐ Presentation

CO2	To **produce** documents that respond to the needs of multiple audiences, including international/global audiences	**Communication:** (PO10)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☐ Final Exam ☒ Assignment ☐ Participation ☐ Presentation
CO3	To **Create** effective multimedia presentations.	**Communication:** (PO10)	Cognitive domain – level 1	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☐ Final Exam ☒ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Introduction to Technical Writing, Resumes and Job Application Letters, memos and business letter, research proposal, project report writing, preparation of power point presentation, poster presentation

Text Book:

1. Mike Markel : Technical Communication, 11th edition, Bedford/St. Martins
2. Craig *Baehr* and Kelli *Cook Cargile* : The Agile Communicator: Principles and Practices in Technical Communication, Kendall Hunt Publishing

Books Recommended:

1. John M. Swales & Christine B. Feak : Academic Writing for Graduate Students, 3rd Edition: Essential Skills and Tasks, Michigan ELT

CSE2252: Web Application Development Lab
Credits: 1 **Contact Hours:** 26
Year: Second **Semester:** Even

Prerequisite: CSE1222: Object Oriented Programming Lab
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation

Course Objective: This course deals with all thing's server-side and based on the NodeJS platform. Brief overview of the Web protocols: HTTP and HTTPS. NodeJS and NodeJS modules: Express for building web servers. On the database side, basic CRUD operations, NoSQL databases, in particular MongoDB and Mongoose for accessing MongoDB from NodeJS. The REST concepts and building a RESTful API. Implement Authentication and security, and Finally, Backend as a service (BaaS) approaches, including mobile BaaS, both open-source and commercial BaaS services.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **demonstrate** an understanding of server-side concepts, CRUD and REST	**Design/development of solutions:** (PO3)	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

CO2	**To build** and configure a backend server using NodeJS framework	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO3	To **build** a RESTful API for the front-end to access backend services	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Created a Node module using Express router to support routes for the REST API.
2. Implement schema and model and a REST API to support different endpoint enabling the interaction with the MongoDB database
3. Assign user privileges i.e. Allow anyone to perform GET operations and only an Admin to perform POST, PUT and DELETE operations
4. Perform CRUD operation over RESTful API

3rd Year (Odd Semester)

CSE 3111: Software Engineering
Credits: 3 **Contact Hours:** 39
Year: Third **Semester:** Even

Prerequisite: CSE1221: Object Oriented Programming, CSE2121: Data Structure, CSE2221: Design and Analysis of Algorithms

Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Motivation To show the skills and processes needed to complement technical understanding of software products in order to make you a more effective software developer in an engineering team.

Course Objective:

This course provides an in-depth study of the process of developing software systems, including the use of software processes in actual product development, techniques used to ensure quality of the software products and maintenance tasks performed as software evolves. By the end of the course, students will understand the role of software processes in the development of software and will have experienced several types of processes, from rigid to agile. Students will also become familiar with a variety of modern technologies and development techniques and understand their connection to software processes.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **descri**be different theories of how software can be developed	**Engineering knowledge:** (PO1)	Cognitive domain – level 2	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **apply** appropriate methods for the design and implementation of modern software systems	**Design/development of solutions** (PO3)	Cognitive domain – level 3	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☒ Assignment ☒ Participation ☐ Presentation
CO3	To **constr**uct and work in large development groups, with different individual roles in order to be prepared to participate in large scale IT projects.	**Individual work and teamwork:** (PO9)	Cognitive domain – level 6	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☐ Assignment ☒ Participation ☒ Presentation

Assessment and Marks Distribution:

Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Introduction: Introduction to software engineering, Importance of software, The Software evolution, Software characteristics, Software components, Software applications, Crisis-Problem and causes.

Software development life-cycle: Requirement Engineering, Design, Coding, Testing, Deployment and Maintenance etc.

Software Process Model: Waterfall Process, Spiral Process, Evolutionary Prototyping Process, Rational Unified Process, Agile Process, Unified Software Process, Choosing a Model, Lifecycle Documents

Requirement Engineering: General Definition, Software Intensive Systems, Functional and Nonfunctional Requirements, User and System Requirements, Problem analysis, requirement specification, validation,

matrices, monitoring and control, Gathering Requirements: The agile way, User Stories: The currency of agile development, Characteristics of good user stories, Generating User Stories, Modeling Requirements, Analyzing Requirements, Requirements Prioritization, Requirements Engineering Process, Agile Estimation and Planning, Estimation Styles and Process, Velocity, Release Planning, Release Tracking

System Design: Problem partitioning, abstraction, Cohesiveness, coupling, structured approach, functional versus object-oriented approach, UML Structural Diagrams: Class Diagrams, Component Diagram, Deployment Diagram, UML Behavioral Diagram: Use Case, Sequence, and State Transition Diagram, Software Architecture, Prescriptive vs. Descriptive Architecture, Architectural Evolution, Architectural Degradation, Architectural Recovery, Architectural Elements, Components, Connectors, and Configuration, Deployment Architectural Perspective, Analyzing Requirements, Refining Classes and Attributes, Adding Attributes, Identifying Operations, Refining the Class Diagram

Coding: TOP-DOWN and BOTTOM-UP structure programming, information hiding, programming style, and internal documentation, verification, metrics, monitoring and control, Software Refactoring: Reasons to Refactor, Refactoring Risks, Cost of Refactoring, When Not to Refactor.

Software Testing: Failure, Fault and Error, Verification Approaches, Pros and Cons of Approaches, Testing Granularity Levels, Alpha and Beta Testing, Black and White Box Testing Introduction**,** Black-Box Testing: Systematic Functional Testing Approach, Test Data Selection, Category Partition Method, Produce and Evaluate Test Case Specifications, Generate Test Cases from Test Case Specifications, Model Based Testing, Finite State Machines, White-Box Testing**:** Coverage Criteria, Statement Coverage, Control Flow Graphs, Test Criteria Sub-Sumption, MC/DC Coverage, test plan, test case specification, Software testing strategies, Verification and validation, Unit and Integration Testing, Alpha and Beta testing, System testing and debugging.

Deployment and maintenance: What is deployment? Is deployment the problem? Key issues around deployment, Deployment itself, Continuous Integration and Deployment, Maintenance, Maintenance challenges, Software evolution and release management, Re-engineering.

Text Book:

1. Roger S. Pressman : **Software Engineering**, A practitioner's Approach, McGraw-Hill
2. Ian Sommerville : **Software Engineering**, *Pearson Education.*

Books Recommended:

3. Richard Fairley : **Software Engineering Concepts**, *McGraw-Hill.*
4. Robert N. Charette : **Software Engineering Environments***, McGraw-Hill.*
5. S. L. Pfleeger and J.M. Atlee : **Software Engineering Theory and Practice,** *Pearson Education.*
3. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran : **Fundamentals of Computer Algorithms**, *Galgotia Publications*

CSE 3112: Software Engineering Lab
Credits: 1 **Contact Hours:** 26
Year: Third **Semester:** Even

Prerequisite: CSE1222: Object Oriented Programming Lab, CSE2122: Data Structure Lab, CSE2222: Design and Analysis of Algorithms Lab

Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Motivation To Demonstrate the skills and processes needed to complement technical understanding of software products in order to make you a more effective software developer in an engineering team.

Course Objective:

This Laboratory course provides an in-depth study of the process of developing software systems, including the use of software processes in actual product development, techniques used to ensure quality of the software products and maintenance tasks performed as software evolves. By the end of the course, students will be able to demonstrate the role of software processes in the development of software and will have experienced several types of processes, from rigid to agile. Students will also become familiar with a variety of modern technologies and development techniques and understand their connection to software processes.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **combine** all SDLC Phases and produce a quality software and deploy.	**Design/development of solutions**: (PO3)	Cognitive domain – level 6	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **apply** different tools on each SDLC Phases to promote rapid development	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Analyze requirements on a specific problem and produce SRS
2. Produce architectural design for the produces SRS document
3. Create UML diagram and detail design
4. Write Unit Test for each and every module
5. Write Code in predefined object-oriented programming language
6. Deploy code on server and maintain for further changes

CSE3121: Database Management Systems
Credits: 3 **Contact Hours:** 39
Year: Third **Semester:** Odd

Prerequisite: CSE2131 Discrete Mathematics
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To know basic of database design and implementation, database security, integrity and concurrency.

Course Objective:

The main objective of this course is to provides a solid technical overview of database management systems, using a current database product as a case study. In addition to technical concerns, more general issues are emphasized. These include data independence, integrity, security, recovery, performance, database design principles, and database administration.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understand** the primary concepts of database management systems.	**Engineering knowledge** (PO1)	Cognitive domain – level 2	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation

CO2	To **construct** E-R diagram for real-world application scenarios, convert into relational tables, normalize it, populate and formulate SQL queries on the data.	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☐ Presentation
CO3	To **criticize** a database design and improve the design by normalization.	**Problem analysis**: (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☒ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Introduction: Database system concept; Purpose of database system; View of data; Data models; Conventional file processing; Transaction management; Storage management; Database administrator.

Database Model: Entity-relationship model; Relational model, Network model; Hierarchical model, Database languages, Relational algebra, Integrity constraint, Generalization and Specialization, Developing an ER Diagram.

Structured Query Language: Basic Structure of SQL, String operations, Different set operations, Aggregate functions, Handling NULL values, Nested Subqueries, View definition, Modification of the Database: Deletion, Insertion and Update operations, Domain Types in SQL, Alteration of Table Structure.

Database Design: Functional dependencies and normal forms; Object-oriented databases; Distributed database; multimedia database, object-relational database, Intelligent database.

File System Structure & Data Warehouse: File organization and retrieval; File indexing; Hashing. Basic concepts of data warehouse and data mart.

Transactions: Introduction to transaction, ACID Properties, Transaction State, Schedule, Conflict Serializability and View Serializability.

Recovery System: Failure Classification, Recovery and Atomicity, Recovery Algorithm , Buffer Management, Failure with Loss of Nonvolatile Storage, Remote Backup Systems.

OLTP and NoSQL Systems: Basic Concepts of OLAP, Comparison between OLAP and OLTP, Introduction to NoSQL Systems.

Text Book:

1. A. Silberschatz : **Database System Concepts**,*McGraw-Hill.*
2. James Martin : **Principles of Database Management**, *Prentice-hall Of India Pvt Ltd*

Books Recommended:

1. Ullman : **Database Management systems**, *Prentice-Hall Publication.*
2. Abey : **Oracle 8i a Beginners Guide**, *McGraw Hill.*

CSE3122: Database Management Systems Lab
Credits: 1 **Contact Hours:** 26
Year: Third **Semester:** Odd

Prerequisite: CSE2131 Discrete Mathematics
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop ability to design, develop/create, and manipulate a relational database using a DBMS.

Course Objective:
This lab course is designed for the students to achieve a hands-on experience in using DBMSs (e.g., MySQL, Oracle, etc.). The idea is to give them practical experience in retrieving information from a database system efficiently and effectively. Theoretical lectures are completed by lab practice where theoretical knowledge is applied.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **Design and implement** a database schema and populate the database.	**Modern tool usage:**. (PO5)	Cognitive domain – level 5	☒ Lecture Note ☐ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☐ Assignment ☒ Note book ☐ Presentation
CO2	To **Formulate** queries using SQL statements /commands.	**Modern tool usage** (PO5)	Cognitive domain – level 5	☒ Lecture Note ☐ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☐ Final Exam ☐ Assignment ☒ Note book ☐ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Create database and table.
2. Alter/Drop Table
3. Create table with integrated constraints (Primary key, Foreign Key)
4. Insert delete update SQL query (with condition)
5. Select query with multiple conditions
6. String operation using SQL
7. Nested subquery
8. Joining
9. Create a simple trigger
10. Create a simple function/procedure

CSE 3131: Web Engineering
Credits: 3 **Contact Hours:** 39
Year: Four **Semester:** Even

Prerequisite: CSE2252 Web Application Development Lab
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To provide students with conceptual and practical knowledge, and skills required to develop web applications and web services.

Course Objective:
The course introduces students to the discipline of web Engineering including the methods and techniques used in web-based system development. This course draws upon student's previous programming and computing experience to develop practical web development and maintenance skills.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **describe** the basic concepts and techniques of web engineering.	**Engineering knowledge:** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **apply** the web engineering methodologies for Web application development.	**Problem Analysis** (PO2),	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO3	To **Identify** and **discuss** the security risk of a Web application.	**Investigation** (P04)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Web Engineering: Attributes of Web based system and Application, Web App Engineering Layers, Web Engineering Process

Web App Project: Formulation Web based Systems, Planning for Web Engineering Project, Building Web Engineering Team, Web App Project Management, Metrics for web engineering and Apps.

Web Apps Analysis: Requirement Analysis, Analysis Model, Web Apps Estimation, Content Model.

Web Apps design: Design issues of Web Apps, Interface Design, Typography, Layout design, Aesthetic Design, Content Design, Architecture Design, Navigation Design, Object Oriented Hypermedia Design, Design Metrics for web Apps.

Web Apps Implementation: Client side scripting: Java Script, AJAX, JQuery; Server Side Scripting: ASP.NET, PHP; Framework: PHP MVC frameworks (Code Igniter, Symfony, Zend, CakePHP) ASP.NET MVC Framework, Web Service.

Web Apps Security: Encryption techniques (digital signatures, certificates, PKI), Security threats, Securing client/server interactions, Vulnerabilities at the client (desktop security, phishing, etc.) and the server (cross-site scripting, SQL injections, etc.), Building Secure Web Apps.

Testing Web Apps: Content Testing, User Interface Testing, Navigation Testing, Configuration Testing, Security Testing, Performance Testing.

Maintenance of Web Applications: Web Server and Database server load balancing, web apps performance assessment, Application usage monitoring and report generation

Text Book:

1. Roger Pressman and David Lowe : **Web Engineering**, *Tata McGraw Hill Edition*, 2008

Books Recommended:

1. Imar Spaanjaars : **Beginning ASP.NET 4.5.1: in C# and VB,** *Wrox*
2. Branko Ajzele : **Mastering PHP 7**, *Packt Publishing*
3. Holovaty, Adrian, Kaplan-Moss, Jacob : **The Definitive Guide to Django: Web Development Done Right,** *Apress*

CSE 3132: Web Engineering Lab
Credits: 1 **Contact Hours:** 26
Year: Fourth **Semester:** Even

Prerequisite: CSE2252 Web Application Development Lab
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation Web Engineering Lab is an introduction to the design, creation, and maintenance of web pages and websites which will help the students to evaluate website quality, learn how to create and maintain quality web pages, learn about web design standards

Course Objective:
This course is an introduction to programming for the World Wide Web. We will cover all the major pieces of how websites work. This will include the relationship between clients and servers, how web pages are constructed, and how the internet works. Several web technologies will be examined in depth

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understand** Detail knowledge of the relationship between client and server and client-side and server-side programming	**Modern tool usages** (PO5)	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **apply** Practical knowledge of languages of HTML, CSS, Java Scripts, Ajax, and PHP/C# to develop web application	**Life-long learning: (PO12)**	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Creating form with HTML
2. Web page design with CSS
3. Java Script Programming
4. Asynchronous Programming with AJAX
5. Programming with PHP
6. Web Database connectivity and data manipulation
7. AngularJS/ NodeJS/ ExpressJS with PHP
8. Programming C#.NET and ASP.NET with Visual Studio

Text Book:

1. Roger Pressman and David Lowe : **Web Engineering**, *Tata McGraw Hill Edition*, 2008

Books Recommended:

1. Imar Spaanjaars : **Beginning ASP.NET 4.5.1: in C# and VB,** *Wrox*
2. Branko Ajzele : **Mastering PHP 7**, *Packt Publishing*
3. Holovaty, Adrian, Kaplan-Moss, Jacob : **The Definitive Guide to Django: Web Development Done Right,** *Apress*

CSE 3141: Compiler Design
Credits: 3 **Contact Hours:** 39
Year: 3rd Semester: Odd

Prerequisite: CSE2211 Theory of Computation, CSE2221 Design and Analysis of Algorithms, CSE2121 Data Structure

Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Motivation To know basic structure of compiler and design of phases of compiler such as lexical analyzer, parser etc.

Course Objective:

The main objective of this course is to make the student to understand the process involved in a compiler, create an overall view of various types of translators, linkers, loaders, and phases of a compiler, understand what is syntax analysis, various types of parsers especially the top down approach, awareness among students the various types of bottom up parsers, understand the syntax analysis and, intermediate code generation, the role of symbol table and its organization, code generation, machine independent code optimization and instruction scheduling.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **know** and analyze the various phases of compiler.	**Engineering knowledge (PO1)**	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **design** and **implement** lexical analyzer, parser, and syntax directed translation scheme and optimize code generation.	**Design/development of solutions (PO3), Modern tool usage (PO5)**	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:

Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Fundamentals: Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, Introduction: Introduction to compiler, compiler and translator, the structure of a compiler.

Grammars: Notation and concepts for languages and Grammars, sets and string, Discussion and classification of Grammars, Scanner regular expression, regular definition, finite automata, LL and LR Grammars, ambiguous grammar.

Parsing: Basic parsing technique, parsers, shift reduce parsing, operator-procedure parsing, top-down parsing, bottom up parsing, predictive parsing.

Syntax: Syntax directed translation, intermediate code generation, polish notation, parse tree and syntax trees, quadruples, triples, Boolean expression.

Symbol Table: Perspective and motivation of symbol table. Symbol table content, operation on symbol table, organization of symbol table.

Code Optimization: Code optimization, sources of optimization, basic blocks, folding, loop optimization, flowgraph, induction variable elimination, reduction in strength, code motion.

Error Handling: Compile time error handling, error detection, error recovery, error repair.

Coding: Code generation, object programs, problems in code generation, a machine model, a simple code generator, register allocation and assignment peephole optimization.

Text Book:

1. Alfred V. Aho and Jeffrey D. Ullman : **Principles of Compiler Design**, *Addison-Wesley Publication*.
2. A.J. Holub : **Compiler design in C**, *Prentice-Hall of India*

Books Recommended:

1. Trembly and Sorensen : **Theory and Practices of Compiler Writing**,*McGraw-Hill computer science series.*

CSE 3142: Compiler Design Lab
Credits: 1 Contact Hours: 26
Year: 3rd Semester: Odd

Prerequisite: CSE2211 Theory of Computation, CSE2221 Design and Analysis of Algorithms, CSE2121 Data Structure

Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Motivation To enlighten the student with knowledge base in compiler design and its applications.

Course Objective:

The objective of this course is to implement NFA and DFA from a given regular expression, to implement different types of parser and to implement front end of the compiler by means of generating Intermediate codes and finally to implement code optimization techniques.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **demonstrate a** working understanding of the process of lexical analysis, parsing and other compiler design aspects.	**Design/development of solutions (PO3), Modern tool usage (PO5)**	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Assignments + Continuous assessment due in different times of the semester (20%)
A comprehensive lab exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Write a C program that read the following string:
   " Md. Tareq Zaman, Part-3, 2011"
   a) Count number of words, letters, digits and other characters.
   b) Separates letters, digits and others characters.

2. Write a program that read the following string:
   " Munmun is the student of Computer Science & Engineering".
   a) Count how many vowels and Consonants are there?
   b) Find out which vowels and consonants are existed in the above string?
   c) Divide the given string into two separate strings, where one string only contains the words started with vowel, and another contains the words started with consonant.

3. Write a program that abbreviates the following code:
   CSE-3141 as Computer Science & Engineering, 3rd year, 1st semester, Compiler Design, Theory.

4. Build a lexical analyzer implementing the following regular expressions:
   Integer variable = (i-nI-N)(a-zA-Z0-9)*
   ShortInt Number = (1-9)|(1-9)(0-9)|(1-9)(0-9)(0-9)|(1-9)(0-9)(0-9)(0-9)
   LongInt Number = (1-9)(0-9)(0-9)(0-9)(0-9)+
   Invalid Input or Undefined = Otherwise

5. Build a lexical analyzer implementing the following regular expressions:
   Float variable = (a-hA-Ho-zO-Z)(a-zA-Z0-9)*
   Float Number = 0.(0-9)(0-9)|(1-9)(0-9)*.(0-9)(0-9)
   Double Number = 0.(0-9)(0-9)(0-9)+|(1-9)(0-9)*.(0-9)(0-9)(0-9)+
   Invalid Input or Undefined = Otherwise

6. Build a lexical analyzer implementing the following regular expressions:
   Character variable =ch_(a-zA-Z0-9)(a-zA-Z0-9)*
   Binary variable = bn_(a-zA-Z0-9)(a-zA-Z0-9)*
   Binary Number = 0(0|1)(0|1)*
   Invalid Input or Undefined = Otherwise

7. Write a program to recognize C++
   i) Keyword ii) Identifier iii) Operator iv) Constant

8. Write a program which converts a word of C++ program to its equivalent token.
   RESULT:
   Input: 646.45
   Output: Float
   Input: do
   Output: Keyword
   Input: 554
   Output: Integer
   Input: abc
   Output: Identifier
   Input: +
   Output: Arithmetic Operator

9. Write a program to convert the following regular grammar to a regular expression that can describe the words of the language { 0n10m | n, m 1}:
   S □ 0S
   S □ 0B
   B □ 1C
   C □ 0C
   C □ 0

10. Write a program that will check an English sentence given in present indefinite form to justify whether it is syntactically valid or invalid according to the following Chomsky Normal Form:
   S □ SUB PRED
   SUB □ PN | P
   PRED □ V | V N
   PN □ Sagor | Selim | Salma | Nipu
   P □ he | she | I | we | you | they
   N □ book | cow | dog | home | grass | rice | mango
   V □ read | eat | take | run | write

11. Write a program to implement a shift reducing parsing.

12. Write a program to generate a syntax tree for the sentence a+b*c with the following grammar:
   E □ E+E|E-E|E*E|E/E|(E)|a|b|c

13. Write a program which checks a validity of C++ expression derived by the following grammar:
   E □ E A E | (E) | ID
   A □ + | - | * | /
   ID □ any valid identifier | any valid integer
   RESULT:
   Input: Enter a string: 2+3*5
   Output: VALID
   Input: Enter a string: 2+*3*5
   Output: INVALID

14. Write a program to generate FIRST and FOLLOW sets using a given CFG.

15. Write a program to generate a FOLLOW set and parsing table using the following LL(1) grammar and FIRST set:
   Grammar FIRST set
   E□ TE' {id, (}

E'□+TE' | ϵ {+, ϵ }
T □ FT' {id, (}
T' □*FT' | ϵ {*, ϵ }
F□ (E) | id {id, (}

16. Write a program to generate a parse tree of predictive parser using the following parsing table:

	id	+	*	(	)	$
E	E□TE'			E□TE'		
E'		E'□+TE'			E'□ϵ	E'□ϵ
T	T□FT'			T□FT'		
T'		T'□ϵ	T'□*FT'		T'□ϵ	T'□ϵ
F	F□id			F□(E)		

17. Write a program that converts the C++ expression to an intermediate code of Post-fix notation form.
RESULT:
Input: Enter infix expression: (A – B) * (D/E)
Output: Postfix: AB – DE / *

18. Write a program that converts the C++ statement to an intermediate code of Post-fix notation form.
RESULT:
Input: Enter infix statement: if a then if c-d then a+c else a*c else a+b
Output: Postfix: acd - ac + ac * ? ab + ?

CSE 3151: Engineering Ethics and Environment Protection
Credits: 2 Contact Hours: 26
Year: First Semester: Even

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation
Course Objective:
The aim of this course is to create awareness on Engineering Ethics and Human Values and instill Moral and Social Values to appreciate the rights of others. It will also help the learners to understand the relationship between technology and environment and the implied social costs and benefits

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understan**d the basic perception of profession, professional ethics and various moral issues	**Ethics: (PO8)**	Cognitive domain – level 2	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **understand** various social issues and evaluate the effects of the use of technology on social culture, economic, legal, health welfare of the society	**The Engineers and the society (PO6)**	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO3	To **Identify** and evaluate the effects of the use of technology on environment	**Environment and sustainability (PO7)**	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Course Contest:

Morals, values and Ethics, Integrity, Work ethic, Service learning, Civic virtue, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self - confidence, Character, Spirituality, Introduction to Yoga and meditation for professional excellence and stress management.

Senses of 'Engineering Ethics', Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory, Gilligan's theory, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories

Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk, Respect for Authority, Collective Bargaining, Confidentiality, Conflicts of Interest, Occupational Crime, Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Discrimination

Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Moral Leadership –Code of Conduct, Corporate Social Responsibility

Impact of technology on society: Innovation and creativity, the history and the trend of technology on the social and culture on society.

Environmental protection and related issues, Role of the engineer in energy conservation ecological balance and sustainable development

Text Book:

1. Mike W. Martin and Roland Schinzinger : **Ethics in Engineering,** *Tata McGraw Hill, New Delhi, 2003*
2. Govindarajan M, Natarajan S, Senthl Kumar V. S : **Engineering Ethics**, *Prentice Hall of India, New Delhi, 2004.*
3 S.F. Johnson, J.P. Gostelow and W.J. King : **Engineering and Society Challenges of Professional Practice,** *Prentice-Hall, 2000.*
4 L.S. Hjorth, B.A. Eichler and A.S. Khan : **Technology and Society: A bridge to the 21st Century,** *Prentice-Hall, 2000.*

Books Recommended:

1. Laura P. Hartman and Joe Desjardins : **Business Ethics: Decision Making for Personal Integrity and Social Responsibility,** *Mc Graw Hill education, India Pvt. Ltd. New Delhi 2013.*
2. Charles E. Harris, Michael S. Printchard and Michael J. Rabins : **Engineering Ethics - Concepts and Cases,** *Cengage Learning, 2009.*
3. Charlies B. Fleddermann : **Engineering Ethics,** *Pearson Prentice Hall, New Jersey, 2004.*

CSE 3162: Mobile Application Development Lab
Credits: 1 **Contact Hours:** 26
Year: Third **Semester:** Odd

Prerequisite: CSE1222: Object Oriented Programming Lab, CSE2252: Web Application Development Lab
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation This Lab introduces you to the design and implementation of Android applications for mobile devices. Learn the basics of mobile application development using Android as the platform and Java and Kotlin as the programming language.

Course Objective:

This Laboratory course introduces you to the design and implementation of Android applications for mobile devices. You will develop an app from scratch, assuming a basic knowledge of Java, and learn how to set up Android Studio, work with various Activities and create simple user interfaces to make your apps run smoothly. You will also build upon concepts from the prior course, including handling notifications, using multimedia and graphics and incorporating touch and gestures into your apps.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **demonstrate** through a simple application the understanding of the basic concepts of Android.	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Android Platform and Development Environment
2. Develop an application that use The Activity Class
3. Develop an application that use Intents, Permission, and Fragments
4. Develop an application that use different User Interface Classes
5. Develop a Modern Artistic UI which comply google design guideline
6. Develop an application that use AsyncTasks
7. Develop an application that use Notifications
8. Develop an application that use different Graphics elements
9. Develop an application that use Location
10. Build an app completely from scratch like Daily Selfie
11. Prepare to build an Android App in Group or 2 or 3 students and publish in amazon Appstore and google Playstore for final project presentation

ICE3161: Communication Engineering
Credits: 2 **Contact Hours:** 26
Year: Third **Semester:** Even

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop fundamental concepts on Communication system.

Course Objective:

The major objectives of this course are to build the fundamentals of basic communication system, necessity and mechanism of modulation, demodulation and multiplexing techniques. The technical aspects of data communications such as transmission impairments, error detection and control. Understanding of the characteristics of various communication media and satellite communication systems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **demonstrate** the mechanism, components and influencing factors of communication systems.	**Engineering knowledge** (PO1)	Cognitive domain – level 2	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation

CO2	To **apply** the concepts of data and signal, different modulation, demodulation and multiplexing schemes.	**Engineering knowledge** (PO1)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☐ Presentation
CO3	To **explain** the characteristics of different guided and unguided media and satellite communication systems.	**Engineering knowledge** (PO1)	Cognitive domain – level 2	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Fundamentals: Communication Engineering Fundamentals, Waveforms Spectra, Periodic waveforms and its properties, Fourier series, Noise and its different types.

Amplitude Modulation: Amplitude modulation, Amplitude modulation index, Frequency spectrum for sinusoidal AM

Frequency Modulation: Frequency Modulation, Sinusoidal FM, Frequency spectrum for Sinusoidal FM, FM transmitter. Phase Modulation.

Pulse modulation, Pulse Codes Modulation (PCM), Quantization, Compression, PCM Receiver, Differential PCM, Delta Modulation, Pulse Frequency Modulation (PFM), Pulse Time Modulation (PTM), Pulse Position Modulation (PPM).

Digital Communication: Digital Communication, Basic Digital Communication System, Synchronization, Asynchronous Transmission, Probability of Bit Error in Base band Transmission, Matched Filter, Eye Diagrams, Digital Carrier Systems, Amplitude Shift keying, Frequency Shift Keying, Phase Shift Keying, Differential Phase Shift Keying,

Radio Wave Propagation, Mode of Propagation, Satellite Communication, Fiber Optic Communication: Fiber Optic Communication, Propagation within a Fiber, Modes of Propagation, Losses in Fibers, Light sources for Fiber optics, Photo detectors.

Text Book:

1. Behrouz A. Forouzan : **Data Communications and Networking**,*Tata McGraw-Hill Edition*

Reference Books:

1. William Stallings : **Data and Computer Communications**, *Prentice Hall International, Inc.*
2. John M. Senior : **Optical Fiber Communications**,*Prentice-Hall of India Pvt Ltd*

3rd Year (Even Semester)

CSE 3211: Project Planning & Management
Credits: 3 **Contact Hours:** 39
Year: Third **Semester:** Odd

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To study how organizations, use computer systems and design solutions to help them operate more efficiently and effectively.

Course Objective:
This course is designed to prepare IT project managers, novice or experienced, with project management skills needed to better manage IT projects. The students who take this course will be able to improve their management skills and abilities to define the project scope, create a workable project plan, and manage within the budget and schedule.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **Develop** of project plans	**Design and Development of solution** (PO3)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation
CO2	To **prepare** project estimates and project schedules	**Project management and finance**(PO11)	Cognitive domain – level 2	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation
CO3	To **develop** the habit of working in team and organization in agile and lean methods	**Individual work and team work(PO9)**	Cognitive domain – level 2	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☒ Assignment ☒ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Project Management: Role of project managers identifying the range of matters that are their concern and the qualities they need to display, the central role of quality management in project planning and control.

Project Life-Cycle: Identify the start and end of a project, Identify those processes, mainly concerned with project justification and initiation that have to take place before the execution of a project can start, Describe the typical steps in the conventional project and system life cycles,

Estimation: Estimation methodology, formal models for size Estimation, translating size Estimate into effort Estimate, Translating effort Estimates into schedule Estimate, common challenges during Estimation.

Risk Management: Risk management cycle, Risk identification: common tools and techniques, Risk Quantifications, Risk Monitoring, Risk Mitigation, Risks and Mitigation in the context of global project teams, Metrics in risk management.

Agile Software Development: Cost of Change in the context of software development. Intro to Software Development Models, Importance of Agile. Agile Manifesto: Principles, Benefits and Challenges of Agile, Agile: When to Use and When NOT to! Applying an Agile Mindset to a Project, Agile Frameworks, Agile Values and Principles, Continuous Integration, Testing Strategy, High Level Scrum Process,

Scrum: Sprint Planning, Sprint Tracking, Sprint Execution and Daily Standups, Sprint Review, Sprint Retrospective.

XP: XP Values and Principles, XP Practices, XP Process Model, Test First Development, Refactoring, Pair Programming, Scrum vs XP

Lean: Lean for software development, Amplify Learning / Create Knowledge, Defer Commitments, Build Quality In, Deliver Fast, Optimize the whole, Five Principles of Lean Manufacturing, Video: Lean vs. Agile, Eliminate Waste, Lean Principle: Respect People

Kanban: Kanban for Software Development, Value Stream Mapping, Lean Metrics: Tracking Flow Based Methods like Kanban, Intro to Kaizen with Examples, The 5 Whys

Text Book:

1. Ramesh Gopalaswamy : **Managing Global Projects**, *Tata McGraw Hill, 2013*
2. Watts Humphrey : **Managing the Software Process,** *Pearson Education, 2000*
3. Pankaj Jalote : **Software Project Management in Practice***, Pearson Education, New Delhi,* 2002.

Books Recommended:

1. Cotterell and Bob Hughes : **Software Project Management,** *McGraw-Hill Higher Education Publication-2009*
2. Don Yeates : **Project Management for Information Systems,** *Prentice Hall Publication- 2007*

CSE 3221: Digital Signal Processing
Credits: 3 **Contact Hours:** 39
Year: Third Semester: Odd

Prerequisite: MATH 2241: Linear Algebra
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce ,
Motivation To know basic of the digital signal processing concepts and its analysis

Course Objective:
This course is designed to provide students with a comprehensive treatment of the important issues in design, implementation and applications of digital signal processing concepts and algorithms. The course will cover some traditional topics such as transforms and filter design including DFT, FFT, Z-transform.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **identify** the digital signals in time and frequency domain	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☐ Presentation

CO2	To **analyze** different characteristic of digital signal in frequency domain	**Problem analysis:** (PO2)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO3	To **construct** different types of digital filter	**Design/Development of solutions:** (PO3)	Cognitive domain – level 2	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Introduction: signals, systems and signal processing, classification of signals, the concept of frequency in continuous time and discrete time signals, analog to digital and digital to analog conversion, Sampling and quantization.

Discrete time signals and systems: Discrete time signals, discrete time systems, analysis of discrete time linear time invariant systems. Discrete time systems described by difference equations, implementation of discrete time systems, correlation and convolution of discrete time signals.

The z-transform: Introduction, definition of the z-transform, z-transform and ROC of infinite duration sequence, properties of z-transform inversion of the z-transform, the one-sided z-transform.

Frequency analysis of signals and systems: Frequency analysis of continuous time signals, Frequency analysis of discrete time signals, Properties of Fourier transform of discrete time signals, Frequency domain characteristics of linear time invariant system, linear time invariant systems as frequency selective filters, Inverse systems and deconvolution.

The Discrete Fourier Transform: The DFT, Properties of the DFT, Filtering method based on the DFT, Frequency analysis of signals using the DFT. Fast Fourier Transform Algorithms: FFT algorithms, applications of FFT algorithm. Digital Filters: Design of FIR and IIR filters.

Wavelet and multiresolution processing.

Adaptive filters: Adaptive system, kalman filters, RLS adaptive filters, the steepest-descent method, the LMS filters.

Application of DSP: Speech processing, analysis and coding, Matlab application to DSP.

Text Book:

1. J. G. Prokis : **Digital Signal Processing,** *Prentice-hall Of India*
2. R. G. Lyon : **Understanding Digital Signal Processing,** *Orling Kindersley India*

Books Recommended:

1. Defatta : **Digital Signal Processing,***Wiley India Pvt Ltd*
2. P. R. Babu : **Digital Signal Processing**, *Scitech Publication*

CSE 3222: Digital Signal Processing Lab
Credits: 1 **Contact Hours:** 26
Year: Third Semester: Odd

Prerequisite: MATH 2241: Linear Algebra
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To know basic of the digital signal processing concepts and its analysis

Course Objective:
This course represents a laboratory course in digital signal processing. In this lab, they will learn about MathLab software where they will construct basic signal. They will also learn about different types of signal. They also implement different types of algorithms of various types of signal transformation.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **identify** different types of problems in digital signal	**Design/Development of solutions:** (PO3)	Cognitive domain – level 3	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **construct** different types of signal and digital filter	**Modern tool usage:** (PO5)	Cognitive domain – level 2	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:
1. Develop a program for generating elementary signal functions like Sine and Cosine sequences
2. Develop a program for generating Unit Step signal
3. Develop a program for generating Unit ramp signal
4. Develop a program for generating exponential signal
5. Develop a program for finding the convolution between two sequences/signal
6. Develop a the program for finding the Autocorrelation of a sequence/signal
7. Develop a the program for finding the cross correlation of a sequence/signal
8. Develop a the program for finding the DFT
9. Develop a program for z-transform.
10. Develop a program for inverse z-transform
11. Develop a program for designing FIR Filters
12. Develop a program for designing IIR Filters
13. Read a Speech sound file
14. Show the effect of sampling, e.g. over, under, aliasing effect
15. Show the effect of filtering- low pass, windowing
16. Reconstruction of signal
17. Add white and color noise to speech at particular SNR- show waveform, spectrogram, etc
18. Show the FFT with changing different parameters
19. Show the effect of filters on noisy speech- adaptive
20. Calculate the SNR

CSE 3231: Microprocessor and Assembly Language
Credits: 3 **Contact Hours:** 39
Year: Third **Semester:** Even

Prerequisite: CSE2111: Digital System Design, CSE2231: Computer Architecture and Organization
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop knowledge on Microprocessor architecture and programming skills with Microprocessor

Course Objective:
This course introduces to Engineering Graduates the Microprocessor and its Assembly Language programming. The course is designed based on the popular Intel 8086 microprocessor and provides good understanding of the microprocessor operation at the address, data, and control level. The course also covers the software part through teaching of assembly language programming techniques. Microprocessor Interface hardware and support chips are also examined in detail.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **identify** the basics knowledge of the architecture of 8086/8085 microprocessors.	**Engineering knowledge** (PO1)	Cognitive domain – level 6	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☐ Assignment ☐ Participation ☒ Presentation
CO2	To **explain** how a microprocessor operates.	**Problem Analysis** (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☐ Assignment ☐ Participation ☒ Presentation
CO3	To **apply** earned knowledge in software and hardware applications.	**Design/Development of Solutions** (PO3)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Microprocessor Fundamentals: Architecture of a microprocessor, Data bus, address bus, control bus, I/O units and memory. Architecture of Intel 8086 Microprocessor, its execution unit and bus-interface unit, its registers and flags.

Programming Model: Programming model of 8086 processor, segment-offset address and physical address calculations, even and odd addressing, introduction of different addressing modes, Operating systems and BIOS, Memory organization of a PC, Introduction to IMB PC Assembly Language, Assembly Language syntax, Program Data, Variables, Named constants, program structure, memory models, Input/Output instruction, Running program, Program Segment Prefix.

The processor status and the Flag register, Overflow condition, Debugging a program, Flow control: Flow control instructions, Conditional jumps, signed versus unsigned jumps, High-level language structures, branching and looping structures. Logic Operation: Logic, Shift and Rotate Instruction, some common

applications of Shift and Rotate operations. Data Structure: The Stack and Introduction to Procedures, Basic stack operations,

Arithmetic Operation: Multiplication and Division Instructions, signed versus unsigned multiplications, Divide overflow, Signed Extension of Dividend. Arrays: Arrays and related addressing modes, DUP operator, Register indirect modes, Based and Indexed addressing modes. String Manipulation: The string instructions, director flag, Moving a string, storing a string, Loading a string, scanning a string, comparing strings, substring operation.

Text Book:

1. Ytha Yu and CharlersMarut : **Assembly Language Programming and Organization of the IBM PC,** *McGraw- Hill*

Books Recommended:

1. Rafiquzzaman : **Microprocessor and Microcomputer based System Design,** *Crc Press Publication*
2. D. V. Hall : **Microprocessors and Interfacing**, *McGraw-Hill*
3. Ramesh Goanker : **Microcomputer Interfacing**, *McGraw-Hill*

CSE 3232: Microprocessor and Assembly Language Lab
Credits: 1 Contact Hours: 26
Year: Third **Semester:** Even

Prerequisite: CSE2111: Digital System Design, CSE2231: Computer Architecture and Organization
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop knowledge on microprocessor architecture and programming skill in assembly language for real world applications.

Course Objective:
The main objective of this lab course is to develop assembly language program for 8086 microprocessor based on theory course CSE3231 (Microprocessor and Assembly Language) using Microsoft Macro-Assembler (MASM) simulator/emulator.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	**To solve** string processes and number processing problems.	**Design/development of solutions:** (PO3)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☐ Assignment ☒ Note book ☒ Presentation
CO2	**To apply** earned knowledge in software and hardware applications.	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☐ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1 Case Conversion and String Reversal Problems:
   a. Write an assembly language program to implement a case conversion program that will read a string (a line of characters of letters, digits, punctuation symbols, and others) as input and then convert the letters into its opposite case as output. Here, the characters which are not belonged to letters will remain be unchanged
   b. Write an assembly language program to implement a string reversal program that will read a string (a line of characters of letters, digits, punctuation symbols, and others) as input and then make the reverse form of the string as output. You have to solve this problem in two ways such as (i) using array (ii) using stack

2 String Searching Problems:
   a. Write an assembly language program to implement a searching program that will read a string (a line of letters of English alphabet) as input and then find out the first capital letter which is occurred first and last capital letter which is occurred last in the alphabetical order as output. Your program will display a message with "No Capitals" when there is no capital letter in the string.
   b. Write an assembly language program to implement a searching program that will read a string (a word of letters of English alphabet either all in uppercase or all in lowercase but not both) as input and then find out the longest sequence of letters in the word in alphabetical order.
   c. Write an assembly language program to implement a searching program that will read two strings (two words of letters of English alphabet either all in uppercases or all in lowercases but not both) as input and then determine whether a string is a substring of another string or not.

3 Counting and Sorting Problems:
   a. Write an assembly language program to implement a counting program that will read a string (a line of characters of letters, digits, punctuation symbols, and others) as input and then count the number of Vowels, Consonants, Digits, and Spaces in the string as output.
   b. Write an assembly language program to implement a sorting program that will read a string (a word of letters of English alphabet either all in uppercase or all in lowercase but not both) as input and then sort the letters in the word in alphabetically (i) ascending order (ii) descending order.

4 Series Summation and Factorial Calculation Problems:
   a. Write an assembly language program to implement a series summation program that will read a number N as input and then calculate the summation value of the series 1 + 2 + --- + N.
   b. Write an assembly language program to implement a factorial calculation program that will read a number N as input and then determine the factorial value of N.

5 Even-Odd and Prime Number Testing Problems:
   a. Write an assembly language program to implement an even-odd testing program that will read a number N as input and then determine whether N is an even number or an odd number.
   b. Write an assembly language program to implement a prime number testing program that will read a number N as input and then determine whether N is a prime number or not.

6 Sorting Problem:
   a. Write an assembly language program to implement a sorting program that will read an array of numbers as input and then sort the numbers in (i) ascending order (ii) descending order as output.

CSE 3241: Operating Systems
Credits: 3 Contact Hours: 39
Year: Third Semester: Even

Prerequisite: CSE1111 Introduction to Computer Systems, CSE2121 Data Structure, CSE2231 Computer Architecture and Organization

Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Motivation To develop basics knowledge on Operating system design and principles.

Course Objective:

To achieve high-level understanding of the structure and design of operating systems, their applications and services; and the relationships between its functional components.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **explain** responsibilities of contemporary operating system; the structure of operating systems,	**Engineering knowledge (PO1)**	Cognitive domain – level 3	☒Lecture Note ☒Text Book ☐Audio/Video ☐Web Material ☐Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☐ Presentation
CO2	To **explain** operating system design and its impact on application system design and performance.	**Engineering knowledge (PO1)**	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒Class Test ☒Final Exam ☒Assignment ☐Participation ☐Presentation
CO3	To **analyze** and **evaluate** operating system features	**Engineering knowledge (PO1)**	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Introduction: Introduction to OS, operating system functions, evaluation of O.S., Different types of O.S.: batch, multi-tasking, time-sharing, real-time, distributed, parallel.

System Structure: Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), operating system services, system calls.
Process Management: Processes Concept, process scheduling, operations on processes, co-operating processes, inter-process communication.

Threads: Overview of threads, benefits of threads, user and kernel threads.

CPU scheduling: Scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, Priority, multi-level queue, feedback queue), evaluations of algorithms, multi-processor scheduling, process affinity.

Process Synchronization: Race condition, critical section problem, critical region, synchronization hardware, classical problems of synchronization, semaphores.

Deadlocks: System model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

Storage Management: Memory Management: Background, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging.

Virtual Memory: Background, demand paging, page fault handling, page replacement, page replacement algorithms, allocation of frames, thrashing.

File Systems: File concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance.

I/O Management: I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and non-blocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance.

Disk Management: Disk reliability, disk formatting, boot block, bad blocks.

Protection & Security: Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption.

Text Book:

1. A. Silberschatz, P. B. Galvin, Greg Gagne : **Operating Systems Concepts**, *Wiley Publisher*.
2. Donovan : **Systems Programming**, *McGraw-Hill.*

Books Recommended:

1. A. S. Tanenbaum : **Modern Operating Systems**, *Prentice-Hall*
2. Terrence : **Unix System Programming in C++,***Prentice Hall* Publication

CSE 3242: Operating Systems Lab
Credits: 1 **Contact Hours:** 26
Year: Third **Semester:** Even

Prerequisite: CSE1111 Introduction to Computer Systems, CSE2121 Data Structure, CSE2231 Computer Architecture and Organization

Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Motivation To develop basics on Operating System Design and to analyze its different features.

Course Objective:

To learn shell programming and the use of filters in the UNIX/LINUX environment. To be exposed to C programming using system calls. To learn to use the file system related system calls. To be familiar with implementation of CPU scheduling, page replacement and deadlock management algorithms.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **compare** the performance of various CPU Scheduling Algorithms.	**Engineering knowledge** (PO1)	Cognitive domain – level 3	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **implement** deadlock avoidance, and Detection Algorithms.	**Design/development of solutions** (PO3)	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO3	**To analyze** the performance of the various memory allocation and page replacement algorithms.	**Problem analysis** (PO2)	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments

1. Basics of UNIX/LINUX commands.
2. Shell programming
3. Implementation of CPU scheduling. a) Round Robin b) SJF c) FCFS d) Priority
4. Implement all file allocation strategies
5. Implement Semaphores for handling process synchronization
6. Implement Bankers algorithm for Dead Lock Avoidance and detection
7. Implement the all page replacement algorithms a) FIFO b) LRU c) LFU
8. Implement Paging Technique of memory management
9. Implement Threading & Synchronization Applications

Hardware and Software Requirements:

High configuration PCs equipped with required software C, C++, Java, Equivalent complier, Microsoft windows 8/10(64/32 bit), Linux operating system.

CSE 3251: Computer Networks
Credits: 3 **Contact Hours:** 39
Year: Third **Semester:** Odd

Prerequisite: ICE3161 Communication Engineering

Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Motivation To develop basics knowledge on designing, installing, maintaining and monitoring Computer Network and its standard protocols.

Course Objective:

This course gives students an opportunity to learn about computer network organization and implementation, theoretical understanding of computer networks and finally gaining practical experience in designing communication protocols, installation, monitoring, and troubleshooting of current LAN systems.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understand** networking basics, its topology, protocols for different layers, IEEE standards	**Engineering knowledge** (PO1)	Cognitive domain – level 2	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO2	To **choose** media type, protocol necessary, topology required for a practical use	**Engineering knowledge** (PO1)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☐ Presentation
CO3	To **apply** security principles to networks of a corporate office	**Engineering knowledge** (PO1)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Introduction: Basic concept of computer network; Network classification, structure/topology; Protocol Hierarchies; Open System Interconnection; Example networks.

Physical layer: Guided physical transmission media, UTP, STP, Optic fiber, Wireless Media, IEEE standards, baseband and passband transmission, PSTN; circuit and packet switching, Mobile telephone system; ADSL.
Data Link Layer: Data link layer design issues; Framing, Error detection and correction; Elementary data link protocols; Sliding window protocols; The data link layer in the Internet.

Medium Access Sub-layer: Multiple Access Protocols: ALOHA; CSMA/CD Protocol; Collision-free protocols; Wireless LAN protocols; Ethernet; Bluetooth; Datalink layer switching.

Network Layer: Network layer design issues; IP address and subnet masking, Routing algorithms; Congestion control algorithms; Internetworking; Network layer in the internet; Network layer in ATM networks.

Transport Layer: The transport service; Elements of transport protocols; three-way handshake; TCP Congestion Control, The internet transport protocols;

Presentation Layer: Data Compression techniques, Frequency Dependent Coding, Context Dependent Encoding.

Application Layer: DNS-Domain Name System; Electronic Mail; The World Wide Web; Multimedia..

Text Book:
1. Andrew S. Tanenbaum : **Computer Networks**, Prentice Hall

Books Recommended:
1. Behrouz A. Forouzan : **Data Communications and Networking,** Mcgraw-Hill
2. William Stallings : **Data and Computer Communications**, Pearson Prentice Hall

CSE 3252: Computer Networks Lab
Credits: 1 **Contact Hours:** 26
Year: Third **Semester:** Odd

Prerequisite: ICE3161 Communication Engineering
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop practical knowledge on installing, maintaining and monitoring Computer Network.
Course Objective:
This lab course is designed for the students to achieve a hands-on experience on basic computer network. Theoretical lectures are completed by lab practice where theoretical knowledge is applied. Students become familiar with the basic protocols of computer networks and can learn how these protocols can be used appropriately to assist in network design and implementation.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To p**repare** a reliable computer network.	**Modern tool usage:**. (PO5)	Cognitive domain – level 3	☐ Lecture Note ☐ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☐ Assignment ☒ Note book ☐ Presentation

CO2	**To demonstrate** basic configuration of network servers as well as switches and routers.	**Modern tool usage** (PO5)	Cognitive domain – level 2	☐ Lecture Note ☐ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☐ Assignment ☒ Note book ☐ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments :

1: Constructing cross and straight Ethernet cable.
2: Configure basic TCP/IP network for file sharing between two PCs.
3: Configure DHCP, DNS, Web and Email server in Linux/Unix and Windows platform.
4: Configure basic Layer 2 and Layer 3 switch in CLI (Command Line Interface). (Physical/ Simulator).
5: Configure VLAN using Layer 3 switch in CLI (Command Line Interface). (Physical/ Simulator.

4th Year (Odd Semester)

CSE4111: Parallel Processing and Distributed System
Credits: 3 **Contact Hours:** 39
Year: Fourth **Semester:** Odd

Prerequisite: CSE1121: Structural Programming Language, CSE2221: Design and Analysis of Algorithms
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation This course is offered for the students to make aware of the potentially vast computing performance improvements that can be obtained with parallelism and exploit this potential when the need arises.

Course Objective:
To make students familiar with multicore programming, shared-memory programming, distributed-memory programming, levels of parallelism, designing efficient parallel algorithm, and programming for massively parallel processor.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understa**nd data parallel and task parallel programming pattern to develop a high-performance parallel application.	**Engineering knowledge**. (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **design** parallel algorithm for the purpose of exploiting parallel processors	**Design/development of solutions:** (PO3)	Cognitive domain – level 1	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Parallel Processing: Necessity of ever-increasing performance, Building parallel systems, Writing parallel programs

Parallel Hardware and Software: Modifications to the von Neumann model, Parallel hardware and software, Parallel program design

Distributed-Memory Programming with MPI: MPI programs, Collective communication, MPI derived data types, Parallel sorting algorithm, Trapezoidal rule in MPI, Performance evaluation of MPI program.

Shared-Memory Programming with Pthreads: Processes, Threads, Pthreads, Critical sections, Busy-waiting, Mutexes, Producer-consumer synchronization and semaphores, Barriers and condition variables, Read-write locks, Cache coherence, False sharing, Thread safety.

Shared-Memory Programming with OpenMP: Trapezoidal rule in OpenMP, Reduction clause, Parallel for directive, Odd-even transposition sort, Scheduling loops.

Parallel Program Development: Two n-Body solvers, Tree search.

Data Parallelism and CUDA C: Data parallelism, CUDA program structure, Vector addition kernel, Device global memory and data transfer, Kernel functions and threading

Program and Network Properties: Conditions of parallelism, Program partitioning and scheduling, Program flow mechanisms, System interconnect architecture.

Pipelining and Superscalar Techniques: Linear pipeline processors, Nonlinear pipeline processors, Instruction pipeline design

Scalable, Multithreaded and Dataflow Architecture: Latency-hiding techniques, Principles of multithreading, Fine-grain multicomputer.

Text Book:

1. Kai Hwang, Nagrsh Jotwani : **Advanced Computer Architecture: Parallelism, Scalability, Programmability,** *McGraw Hill Education Private Limited*

Books Recommended:

1. Peter Pacheco : **An Introduction to Parallel Programming,** *Elsevier Inc.*
2. David B. Kirk, Wen-Mei W. Hwu : **Programming Massively Parallel Processors,** *Elsevier Inc.*

CSE4112: Parallel Processing and Distributed System Lab
Credits: 1 **Contact Hours:** 26
Year: Fourth **Semester:** Odd

Prerequisite: CSE1121: Structural Programming Language, CSE2221: Design and Analysis of Algorithms
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation This course is offered for the students to achieve implementation details of developing a high performance parallel application through programming and use of parallel hardware.

Course Objective:
To introduce students to give practical experience on programming with multicore CPU, many threads GPU, parallel program using MPI, Pthreads, OpenMP, Java RMI and CUDA C for programming massively parallel processor.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **Implement** parallel program in different levels of parallelism	**Design/development of solutions:** (PO3)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☐ Note book ☐ Presentation
CO2	To **develop** parallel version of sequential program	**Modern tool usage:** (PO5)	Cognitive domain – level 1	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☐ Note book ☐ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/ Experiments Lists

1. MPI program that prints greeting from all the processes
2. Parallelizing the Trapezoidal rule for numerical integration using MPI
3. Parallel odd-even transposition sort using MPI
4. Matrix-vector multiplication using Pthreads.
5. Estimate the value of π using Pthreads.
6. A multithreaded linked list
7. Pthreads read-write locks
8. Parallelizing the Trapezoidal rule for numerical integration using OpenMP

9. Parallel odd-even transposition sort using OpenMP
10. Estimate the value of π using OpenMP.
11. Parallelizing the counting sort using OpenMP
12. Parallelizing the reduced solver using OpenMP
13. Remote method for searching a key using Java RMI
14. Kernel function for vector addition using CUDA C

CSE4121: Object Oriented Design and Design Patterns
Credits: 3 **Contact Hours:** 39
Year: Fourth **Semester:** Odd

Prerequisite: CSE1221: Object Oriented Programming
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation You will discover how to create modular, flexible, and reusable software, by applying object-oriented design principles and guidelines and create interactive applications by incorporating design patterns.

Course Objective: This course takes Java beginners to the next level by covering object-oriented analysis and design. You will discover how to create modular, flexible, and reusable software, by applying object-oriented design principles and guidelines. And, you will be able to communicate these designs in a visual notation known as Unified Modelling Language (UML). And the second part of this course extends object-oriented analysis and design by incorporating design patterns to create interactive applications. Through a survey of established design patterns, you will gain a foundation for more complex software applications. Finally, you will identify problematic software designs by referencing a catalog of code smells.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **analyze** and design the object-oriented model for a problem.	**Problem analysis**: (PO2)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **apply** object-oriented modeling principles and design guidelines to create a flexible, reusable, maintainable design.	**Design/development of solutions** (PO3)	Cognitive domain – level 3	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☐ Final Exam ☐ Assignment ☒ Participation ☐ Presentation
CO3	To **demonstrat**e how to use design patterns to address user interface design issues.	**Modern tool usage:** (PO5)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☐ Final Exam ☒ Assignment ☒ Participation ☐ Presentation
CO4	To **Identif**y the most suitable design pattern to address a given application design problem.	**Design/development of solutions** (PO3)	Cognitive domain – level 4	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☒ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Part A: Object-Oriented Design

Object-Oriented Analysis and Design: Good software design begins before coding. After establishing the initial software requirements, design practices involve two main activities: conceptual design and technical design. importance of design and object-oriented thinking, and how to design software using techniques like CRC cards.

Object-Oriented Modeling: Best software design practices have evolved alongside programming languages. Today, all developers should be familiar with abstraction, encapsulation, decomposition, and generalization, which are fundamental principles in object-oriented design. You will learn all of these principles and how they are expressed in Object Oriented Programming and communicated visually in Unified Modelling Language.

Design Principles: Additional design principles will help you to create code that is flexible, reusable, and maintainable. You will learn about coupling and cohesion, separation of concerns, information hiding, and conceptual integrity. You will also learn to avoid common pitfalls with inheritance, and ways to express software behavior in UML.

Part B: Design Patterns

Creational & Structural Patterns: Design patterns help to solve common design issues in object-oriented software. You will learn what they are and how they can be applied. You will learn the creational and structural design patterns. You will continue to learn and practice expressing designs in UML, and code some of these patterns in Java.

Behavioural Design Patterns: You will continue learning useful design patterns and add them to your toolbox. You will learn the behavioral patterns. This will include communicating them in UML and coding them in any OOP Language.

Working with Design Patterns & Anti-patterns: You will learn a design pattern that is very useful for user interfaces: model-view-controller, or MVC. Then you will learn some principles underlying the design patterns, to create software that is flexible, reusable, and maintainable. Finally, you will learn some of the symptoms of bad design, which we call code smells or antipatterns.

Text Book:

1. Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Jim Conallen, Kelli A. Houston : **Object-Oriented Analysis and Design with Applications**, 3rd Edition, *Addison-Wesley Professional*
2. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, Grady Booch : **Design Patterns: Elements of Reusable Object-Oriented Software,** *Addison-Wesley Professional*

CSE4122: Object Oriented Design and Design Patterns Lab
Credits: 1 **Contact Hours:** 26
Year: Fourth **Semester:** Odd

Prerequisite: CSE1222: Object Oriented Programming Lab
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation You will implement how to create modular, flexible, and reusable software, by applying object-oriented design principles and guidelines and create interactive applications by incorporating design patterns.

Course Objective: This laboratory course takes Java beginners to the next level by covering object-oriented analysis and design. Students will discover how to create modular, flexible, and reusable software, by applying object-oriented design principles and guidelines. And, they will be able to communicate these designs in a visual notation known as Unified Modelling Language (UML). And the second part of this course extends object-oriented analysis and design by incorporating design patterns to create interactive applications. Through a survey of established design patterns, you will gain a foundation for more complex software applications. Finally, students will identify problematic software designs by referencing a catalog of code smells.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **Generate** UML diagram for different components of a software	**Design/development of solutions:** (PO3)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **Breakdown** existing software and rewrite with appropriate design pattern	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Draw a UML class diagram of an Object-Oriented model for a given topic
2. Create a UML sequence diagram that will show your clients how the system's classes will interact
3. Create a UML state diagram to communicate the state of the system.
4. Draw a UML diagram of a full software project
5. Rewrite a given program based on a given UML diagram using different Structural Design Pattern
6. Write program using different Creational design pattern
7. Write program using different Behavioral design pattern
8. Create a UML class diagram that displays the basic MVC pattern for a web application and write code for that UML diagram.

CSE 4131: Artificial Intelligence
Credits: 3 **Contact Hours:** 33
Year: Fourth **Semester:** Even

Prerequisite: CSE2131 Discrete Mathematics, MATH2241 Linear Algebra
Course Type ☒ Theory ☒ Laboratory work ☐ Project work ☒ Viva Voce
Motivation To develop basic knowledge on artificial Intelligence (AI) and its applications.

Course Objective:

This course expose the most fundamental knowledge on how to realize the intelligent of human behaviors incorporated in a computer system. The student will able to know the fundamental knowledge of AI, different logical expression, knowledge representation, reasoning, resolution, manipulation and a general understanding of AI principles and practice. They understand how to build simple knowledge-based expert systems and various AI search optimization strategies (uninformed, informed algorithms). They also achieve the knowledge on AI programming tools and techniques for real-life problem solving.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **apply** the propositional logic, predicate logic (PL), semantic rules for statements, inference rules for the logical expression	**Engineering knowledge** (PO1)	Cognitive domain – level 3	☒Lecture Note ☒Text Book ☐ Audio/Video ☒Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☐ Presentation
CO2	**T**o **explain** logics of monotonic & non-monotonic, searching techniques, Bayesian probabilistic theorem & algorithms and expert systems to find out the decision for the specific problem.	**Problem analysis**: (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒Text Book ☐ Audio/Video ☒Web Material ☐ Journal paper	☒ Class Test ☒Final Exam ☒Assignment ☒ Participation ☐ Presentation
CO3	To **explain** inductive learning, einforcement learning,neural networks, two-layer & three layer neural net, supervised and unsupervised learning, learning	**Problem analysis**: (PO2)	Cognitive domain – level 5	☒Lecture Note ☒ Text Book ☐ Audio/Video ☒Web Material ☐ Journal paper	☒ Class Test ☒Final Exam ☒Assignment ☒ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:
Introduction: History of AI, AI problems, AI Applications, Areas of AI, Intelligence, Knowledge, Types of Knowledge.

Knowledge Representation: Knowledge representation, Syntax and semantics for Propositional Logic, Predicate Logic (PL), Semantic Rules for statements, Inference Rules, Syntax and Semantics for First Order Predicate Logic (FOPL), Properties of Wffs, Clausal Conversion Procedure, Unification algorithm, Resolution in Propositional Logic, Resolution in Predicate Logic.

Reasoning under uncertainty: Truth Maintenance System (TMS), Logics of Monotonic & Non-monotonic systems, Conceptual dependencies, Bayesian probabilistic theorem for decision, Fuzzy logic, Fuzzy and Crisp logic, membership functions, Fuzzy logic and fuzzy sets

Searching Techniques & Algorithms in AI: Blind or Uninformed Search, Breadth-First Search, Depth-First search, Informed Or Directed search, Hill Climbing search, Best-First Search

Expert systems: Phases in building Expert System, Expert System Architecture, Knowledge Base (KB), Navigational Capability /Inference Engine, Rule Based Expert Systems

Artificial Neural Networks: Biological Neuron, The McCulloch-Pitts model, Neuron Models, Applications of Neural Networks, Two-layer & Three layer neural net, Supervised learning, unsupervised learning

Planning and Learning: Planning with state space search, conditional planning, continuous planning, Multi-Agent planning, Inductive learning, Reinforcement learning, Learning with decision trees

AI programming languages: Introduction to python programming language, Python Operators: Arithmetic, Logical, Comparison, Assignment, Bitwise & Precedence, Machine Learning algorithms with Python, Turbo PROLOG,

knowledge representation, domain, predicate, clauses, database, back tracking, unification, list, string operations, windows, Graphics and file operations using prolog. Basic concept on other logic programming

Text Book:

1. D. W. Patterson : **Introduction to Artificial Intelligence and Expert System** *Prentice-Hall of India.*
2. Carl Townsend : **Introduction to Turbo Prolog,** *Sybex Inc.*

Books Recommended:

1. Elaine Rich, Kevin Knight and Shivashankar B.Nair : **Artificial Intelligence,** *Tata McGraw-Hill, India, 3rd Edition 2009*
2. Patrick Henry Winston : **Artificial intelligence**, *Pearson Education Inc*. 3rd Edition 2011
3. N. P. Padhy : **Artificial Intelligence and Intelligent System**, *Oxford University Press*
4. Bratko, I : **Prolog Programming for Artificial Intelligence,** *Addison Wesley***.**
5. Clocksin, W.F. and Mellish, C.S. **Programming in Prolog: Using the ISO Standard**, *Springer.*

CSE 4132: Artificial Intelligence Lab
Credits: 1 Contact Hours: 26
Year: Fourth **Semester:** Even

Prerequisite: CSE2131 Discrete Mathematics, MATH2241 Linear Algebra
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☒ Viva Voce
Motivation To solve the basic problems on artificial Intelligence (AI) and its applications.
Course Objective:
This Lab course exposes on AI programming tools and techniques for real-life problem solving methods. Students will able to solve problems based on AI and they can make intelligent interface for a system. They can understand how to solve rule-based expert systems problems. Students can perform decision-based learning algorithms.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **apply** the rules to solve the problems, with variables rules, execution rules, input & output predicates and other built in predicates	**The engineer and society** (PO4)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **compute** the arithmetical operations compound objects, dynamic and static databases, variables	**Problem analysis**: (PO2)	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

CO3	To **Demonstrate** expert systems tasks, Backpropagation neural networks & machine learning.	**Modern tool usage**: (PO5)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☐ CA ☐ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiment:

1. To understand Prolog fundamentals, prolog objects, bound & free variables, goals & compound goals, backtracking
2. Write program using rules to solve problems, variables rules, and execution rules.
3. Write program using arithmetical operations, compound objects .
4. Write program using dynamic and static databases, removing facts from database, creating menu structures.
5. Write program using input &output predicates and other built in predicates like fail, cut, repeat predicates etc.
6. Write program using lists, finding and deleting element from a lists, string operations, concatenation.
7. Write program using windows, graphics and sound, display, edit predicates .
8. Write program with expert systems tasks,, production systems
9. Write program with frame-based system, getting and charting facts .
10. Write program to solve 8-puzzle problem using best first search.
11. Write program with Back propagation neural network algorithm for learning.
12. Project on AI problems

Text Book:

1. Carl Townsend : **Introduction to Turbo Prolog,** *Sybex Inc.*
2. Clocksin, W.F. and Mellish, C.S. : **Programming in Prolog: Using the ISO Standard**, *Springer.*
3. Richard L. Halterman : **Fundamentals of Python Programming,** Southern Adventist University, September 29, 2019

Books Recommended:

1. Brian Heinold : **A Practical Introduction to Python Programming**, Department of Mathematics and Computer Science, Mount St. Mary's University, ©2012 Brian Heinold
2. D. W. Patterson : **Introduction to Artificial Intelligence and Expert System** *Prentice-Hall of India.*
3. Patrick Henry Winston : **Artificial intelligence**, *Pearson Education Inc*. 3rd Edition 2011

CSE 4141: Microprocessor Interfacing and Microcontrollers
Credits: 3 **Contact Hours:** 39
Year: Fourth **Semester:** Odd

Prerequisite: CSE2111: Digital System Design, CSE3231: Microprocessor and Assembly Language
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop hardware knowledge and programming skills on computer interfacing

Course Objective:

The main objective of this course is to provide knowledge on basis of interfacing techniques, interfacing devices and to make the student understand on critical programming techniques for using peripheral devices so that they develop skill in designing real world applications. The presentation of work is very important part of this course. Therefore, this course aims to improve their capacity to explain any design using proper English and to use mathematical notation and terminology correctly.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **identi**fy the basics knowledge required for microprocessor interfacing	**Engineering knowledge** (PO1)	Cognitive domain – level 6	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation
CO2	To **apply** knowledge for real world application using programmable Interface device	**Design/Development of Solutions** (PO3)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation
CO3	To **explain** the use of microcontroller and development board for real world applications.	**Problem Analysis** (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:
Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Interfacing peripherals: Peripheral I/O and memory mapped I/O, Interfacing with external memory, microprocessor controlled data transfer and peripheral controlled data transfer, Interfacing with LED, seven segment display, Push-button keys, commercial AD and DA converter, ADC 0809, Flash ADC, ADC 0820

Programmable Interface device**:** Interfacing 8355/8755 Programmable I/O ports, 8255 Programmable peripheral interface, Block diagram of 8255, its different mode of operation, Interfacing A/D converter using 8255, Application of 8259, 8257 PPI. AUD, RS 232 standard, Software versus programmable hardware approach, software controlled asynchronous serial I/O, 8251 programmable communication interface and its block diagram,

Microcontroller programming: Architecture of microcontroller of 8051 family, programming model, register, instruction set, enhanced 8051 features, Microchip ATmega328P architecture, ATmega328 architecture, ATmega1280 architecture, ATmega256 architecture. Arduino development board and its programming model. Introduction of Raspberry Pi. Internet of Things (IoT).

Text Book:
1. Rafiquzzaman : **Microprocessor and Microcomputer based System Design,***CRC-Press*
2. Ramesh Goanker **Microcomputer Interfacing**, *McGraw-Hill*

Books Recommended:
1. D. V. Hall : **Microprocessors and Interfacing**, *McGraw-Hill*
2. Y. Liu and G. A. Gibson : **Microcomputer Systems: 8086/8088 Family**, *Prentice-Hall*
3. Artwick : **Microcomputer Interfacing**, *Prentice Hall.*
4. James E. Powell : **Designing User Interfaces**, *Microtrend Books San Marcos, CA, USA*
5. D. V. Hall : **Microprocessors and Interfacing**, *McGraw-Hill*

CSE 4142: Microprocessor Interfacing and Microcontrollers
Credits: 1 Contact Hours: 26
Year: Fourth Semester: Odd

Prerequisite: CSE2111: Digital System Design, CSE3231: Microprocessor and Assembly Language
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop hardware knowledge and programming skills on computer interfacing and apply the knowledge to real world applications.

Course Objective:
To enable the interconnection and integration of the physical world with digital devices, microcontroller, Arduino development board, and to give core concepts of IoT, In addition to these, this lab aims to give concepts on the role and scope of smart sensors for insuring convergence of Technologies and multidisciplinary engineering practices and to improve the awareness of IoT related cyber legislation

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **apply** knowledge for real world applications targeting microcontroller board and IoT	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **apply** knowledge for real world applications using Arduino development board	**Design/development of solutions:** (PO3)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. How to display some texts on an LCD panel using 8051 microcontroller board.
2. How to implement a traffic controlling system using some LEDs using 8051 microcontroller board..
3. Analog and digital communication with Arduino
4. Reading and writing on SD cards or EPROM with Arduino
5. Demonstration of IR and sonar sensor with Auduino
6. Demonstration of Motor Shield with Auduino
7. Demonstration of Steeper motor Shield with Auduino
8. Demonstration of Servo motor Control Shield with Auduino
9. Demonstration of Bluetooth Shield with Auduino
10. Demonstration of Ethernet Shield with Auduino
11. Demonstration of Wifi Shield with Auduino

CSE 4151: Computational Geometry
Credits: 3 Contact Hours: 39
Year: Four Semester: Odd

Prerequisite: MATH1221 Co-ordinate Geometry, Vector analysis and Complex Variable
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To know the techniques and concepts needed for the design and analysis of geometric algorithms and data structures.

Course Objective:
The course aims to involve students to rigorous algorithmic analysis for problems in Computational Geometry. And introduce them to applications of Computational Geometry to graphical rendering. Teach them the notions of Voronoi diagrams and Delaunay Triangulations. And develop expected case analyses for linear programming problems in small dimensions.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understand** the usage of a variety of geometric data structures and algorithms	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **identify** and **compare** the characteristics and the performance of geometric data structures and algorithms	**Engineering knowledge** (PO1)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO3	To **apply** fundamental techniques for designing data structures and algorithms suitable for geometric problems	**Engineering knowledge** (PO1)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Introduction: historical perspective, geometric preliminaries. Convex hulls algorithms in 2d and 3d, lower bounds.

Triangulations: polygon triangulations, representations, point-set triangulations, planar graphs;

Voronoi diagrams: construction and applications, variants;

Delayney triangulations: divideand- conquer, flip and incremental algorithms, duality of Voronoi diagrams, min-max angle properties;

Geometric searching: point location, fractional cascading, linear programming with prune and search, finger trees, concatenable queues, segment trees, interval trees;

Visibility: algorithms for weak and strong visibility, visibility with reflections, art-gallery problems;

Arrangements of lines: arrangements of hyperplanes, zone theorems, many-faces complexity and algorithms;

Combinatorial geometry: Ham-sandwich cuts, Helly's theorems, k-sets, polytopes and hierarchies, polytopes and linear programming in d-dimensions, complexity of the union of convex sets, simply connected sets and visible regions;

Sweep techniques: plane sweep for segment intersections, Fortune's sweep for Voronoi diagrams, topological sweep for line arrangements; Randomization in computational geometry: algorithms, techniques for counting; Robust geometric computing; Applications of computational geometry.

Text Book:

1. M. d. Berg, O. Schwarzkopf, M. v. Kreveld and M. Overmars : **Computational Geometry: Algorithms and Applications**, *Springer.*

Books Recommended:

1. F. P. Preparata and M. I. Shamos : **Computational Geometry: An Introduction**, *Springer*.
2. J. O. Rourke : **Computational Geometry in C**, *Cambridge University Press*.

CSE4152: Computational Geometry Lab
Credits: 1 **Contact Hours:** 26
Year: fourth **Semester:** Odd

Prerequisite: MATH1221 Co-ordinate Geometry, Vector analysis and Complex Variable
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop practical knowledge on the algorithms of Computational geometry.

Course Objective:
This lab course is designed for the students to achieve a hands-on experience on the basic algorithms of Computational Geometry. Theoretical lectures are completed by lab practice where theoretical knowledge is applied.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **implement** the basic algorithms of computational geometry	**Engineering knowledge** (PO1)	Cognitive domain – level 3	☒ Lecture Note ☐ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☐ Assignment ☒ Note book ☐ Presentation
CO2	To **apply** the concept of computational geometry to solve real-world problems.	**Problem analysis** (PO2)	Cognitive domain – level 3	☒ Lecture Note ☐ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☐ Final Exam ☐ Assignment ☒ Note book ☐ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Convex hull in 2D & 3D: incremental algorithm
2. Convex hull in 3D: divide and conquer algorithm.
3. Intersecting two convex polygons.
4. Linear programming by prune and search.
5. Visibility polygon
6. Binary space partitions and visibility in 2D & 3D
7. Facility location, by prune and search
8. 3D convex hull and Delaunay flips
9. Proximity graphs
10. Computing the Voronoi diagram from the Delaunay triangulation
11. Computing the Voronoi diagram incrementally
12. Counting k-sets

13. Finding ham-sandwich-cuts
14. Arrangements of lines: incremental algorithm
15. Kirkpatrick's algorithm for point location
16. Motion planning for a point robot
17. Shortest path for a polygonal robot
18. Handling an arm robot
19. Intersection of segments (points in general position)
20. Intersection of segments (allowing collinearities)
21. Edge-insertion for optimal triangulation

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CSE4161: Digital Image Processing
Credits: 3 **Contact Hours:** 39
Year: Fourth Semester: Odd

Prerequisite: CSE3221 Digital Signal Processing
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop basics knowledge on Digital Image Processing

Course Objective:
This course introduces the basic concepts and methodologies of digital image processing. The covered topics include image representation and storage, image enhancement, high-dimensional spectral analysis, spatial and frequency domain image filtering, binary image processing, edge detection, image segmentation, feature extraction and image compression. It also familiarizes image analysis techniques and concepts.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **describe** the terminology and concept of digital image processing	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☐ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **apply** image enhancement and filtering techniques	**Problem analysis** (PO2)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO3	To **interpret** image segmentation and restoration	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO4	To **apply** morphological processing in pattern recovery	**Problem analysis** (PO2)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☐ Final Exam ☒ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Introduction and Fundamental to Digital Image Processing: What is Digital Image Processing, Origin of Digital Image Processing, Examples that use Digital Image Processing, Fundamental steps in Digital Image Processing, Components of Digital Image Processing System, Image sensing and acquisition, Image sampling, quantization and representation, Basic relationship between pixels.

Image Enhancement in the Spatial Domain & Frequency domain: Background, Basic gray level transformation, Histogram processing, Basics of spatial filtering, Smoothing and Sharpening Spatial filters, Introduction to Fourier Transform and the Frequency Domain, Discrete Fourier Transform. Smoothing and Sharpening Frequency-Domain filters.

Image Restoration: Image Degradation/Restoration Process, Noise models, Restoration in presence of noise, Inverse Filtering, Minimum Mean Square Filtering, Geometric mean filter, Geometric transformations.

Color Image Processing: Color Fundamentals, Color models, Basis of full color image processing, Color transformations.

Image Compression: Fundamentals, Image compression models, Error free compression, Lossy compression.

Morphological image processing: Preliminaries, Dilations and Erosion, opening and closing, Some basic morphological algorithms.

Image Segmentation: Detection of Discontinuities, Edge linking and boundary detection, Thresholding, Region oriented segmentation.

Representation, Description and Recognition: Representation-chain codes, polygonal approximation and skeletons, Boundary descriptors-simple descriptors, shape numbers, Regional descriptors- simple, topological descriptors, Pattern and Pattern classes- Recognition based on matching techniques.

Text Book:

1. Rafael C. Gonzalez and Richard E. Woods : **Digital Image Processing (*4th Edition*) ,** *Prentice Hall.*

Books Recommended:

1. David Vernon : **Machine Vision: Automated Visual Inspection and Robot Vision,** *Prentice Hall.*
2. William K. Pratt : **Digital Image Processing: PIKS Scientific Inside, 4th Edition,** *John Wiley.*
3. Pitas Ioannis : **Digital Image Processing Algorithms and Applications,** *John Wiley*

CSE4162: Digital Image Processing Lab
Credits: 1 **Contact Hours:** 26
Year: Fourth Semester: Odd

Prerequisite: CSE3221 Digital Signal Processing
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop practical knowledge on Digital Image Processing

Course Objective:
The lab work is not a course in system or processing programming. Its objective is to get you into image processing as soon as possible and acquire an understanding of the purpose and result of selected processes of digital image processing. The work in the course will consist of several homework assignments. In general, the practice with assignment makes this course more understandable to the students. The lab assignments must be done individually and should be submitted on or before the specified deadline.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **demonstrate** basic operations for image conversion	**Modern tool usage** (PO5)	Cognitive domain – level 2	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **explain** the different point processing operations for image enrichment	**Problem analysis** (PO2)	Cognitive domain – level 2	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO3	To **evaluate** the performance of different filtering techniques for image enhancement	**Design/Development of solutions** (PO3)	Cognitive domain – level 1	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Introduction to Matlab to implement digital image processing techniques.
2. Sampling, Resampling, quantization, histogram processing, different arithmetic operations on image.
3. Implementation of basic intensity transformation with point processing techniques and their related functions; concept of spatial filtering, image smoothing and sharpening using different filters.
4. Image enhancement in frequency domain including Fourier transform, Discrete Fourier transform and different high pass filter & low pass filters.
5. Implementation of different edge detection methods and image segmentation.
6. Restoration of image degradation, imposing noise on image, remove noise using filters and measure of filter performance in image enhancement using quantitative approach e.g. PSNR.
7. Implementation of different morphological operations and their application in image enhancement.
8. Comparative study on different algorithms on image compression.

Text Book:

1. Rafael C. Gonzalez and Richard E. Woods : **Digital image processing using Matlab**

Books Recommended:

1. William K. Pratt : **Digital Image Processing: PIKS Scientific Inside, 4th Edition,** *John Wiley.*
2. Pitas Ioannis : **Digital Image Processing Algorithms and Applications,** *John Wiley*

CSE4171: Computer Simulation and Modeling
Credits: 3 **Contact Hours:** 39
Year: Four **Semester:** Odd

Prerequisite: MATH2231: Numerical methods
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop fundamental knowledge of computer simulation and modelling and understand its necessity and applicability

Course Objective:
In many real-life scenarios, it is not possible to apply a new hypothesis directly to the system. In that situation simulation is the only solution to test the new ideas' usability or applicability. For situations, where complex mathematical computation is needed, computer-generated simulation is the must. Modeling real-world objects in a computing system are an integral part of computer simulation. Bing a CS graduate, each student must have some core knowledge about computer simulation and modeling. And they must be familiar with some popular simulation tools too.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **explain** the different terminologies related with computer modeling and simulation.	**Engineering knowledge** (PO1) **Problem analysis** (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation
CO2	To **analyze** the real-life problems and create different types of model of it.	**Problem analysis** (PO2)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO4	To **produce** the computer simulated solution for a given real world scenario.	**Modern tool usage** (PO5)	Cognitive domain – level 1	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☒ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Simulation methods: Introduction to Simulation, Random number generator, analogue simulation of continuous system, Discrete system simulation, Simulation of a pert network, Statistical analysis of result, Validation and verification techniques, Application of simulation to problems e.g. business, operation research, operating system, Computer design and Introduction to simulation packages.

Modeling: Introduction to modeling techniques, Problems, models and systems, Modeling concepts, Logic for (conceptual) modeling, Logic programming for conceptual modeling, Concepts of relational modeling and its practice. Some practical modeling e.g. Relational Database modeling, Different methods for Curves and surface modeling, Fractals, Polyhedral modeling with Euler's formula, Advanced modeling, Procedural models. Case Study: Simulation and Modeling software: Blender, Python and OpenCV or Classic C/C++ GD Library.

Text Books:

1. J. A. Spriet : **Computer Aided Modelling & Simulation**, *Academic Press, Inc. Orlando, FL, USA.*
2. Richard Lehman : **Computer Simulation and Modeling**, *Lawrence Erlbaum Associates Publishers.*
3. G. Cordon : **System Simulation**, Prentice Hall.

CSE4172: Computer Simulation and Modeling Lab
Credits: 1 **Contact Hours:** 26
Year: Four **Semester:** Odd

Prerequisite: MATH2231: Numerical methods
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To put the knowledge gained from CSE4131: Computer Simulation and Modelling theory course into practice and deepen the understandings more.

Course Objective:
The lab is primarily based on the theory course "CSE4131: Computer Simulation and Modeling" to practically exercise and implement the knowledge gathered there. General-purpose programming and modeling tools like C/C++/OpenCV, Python and Blender are utilized throughout.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **implement** random number sequence generators and carryout different type of tests on the generated sequences.	**Modern tool usage** PO5	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **use** different types of data scrapping techniques to gather information from the open web for analysis.	**Modern tool usage** PO5	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual`	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO3	To **produce** different real-world object models that are ready for use in simulation.	**Modern tool usage** PO5	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual`	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

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Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Implementation of different random number generation algorithms
2. Implementation of different categories of tests for checking the properties of randomness of any given number sequence
3. Implementation of simple to complex net crawlers and bot users for different forms of web scrapping scenarios;
4. Conceptualization and materialization of different real-world object models with simple physics.

Text Books:

1. Narsingh Deo : **System Simulation with Digital Computer**, *Englewood Cliffs, N.J.: Prentice-Hall.*
2. G. Cordon : **System Simulation**, Prentice Hall.
3. Ryan Mitchell : **Web Scrapping with Python,** *O'Reilly Media, Inc.*
4. John M. Blain : **The Complete Guide to Blender Graphics Computer Modeling & Animation,** *CRC Press.*

CSE4181: User Interface and User Experience Design (UI/UX Design)
Credits: 3 **Contact Hours:** 39
Year: Four **Semester:** Odd

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To accrue adequate knowledge about designing artifacts that allow the users to meet their needs in the most effective efficient and satisfying manner.

Course Objective:
The course introduces the novice to a cycle of discovery and evaluation and a set of techniques that meet the user's needs. The course mantra is that "Design is a systematic and data driven process." Students will gain an understanding of the critical importance of user interface and user experience design. They will also learn industry-standard methods for how to approach the design of a user interface and user experience along with key theories and frameworks that underlie the design of most interfaces you use today. This course will demonstrate how the costs of bad design can often be severe (in user experience, money, and even human lives).

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **create** new design from scratch	**Design/development of solutions** (PO3)	Cognitive domain – level 5	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☒ Assignment ☒ Participation ☒ Presentation
CO2	To **jud**ge existing design and suggest improvements	**Design/development of solutions** (PO3)	Cognitive domain – level 6	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☐ Class Test ☐ Final Exam ☒ Assignment ☒ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:
UI Introduction: UI Design and Why it Matters, User Interface Hall of Fame / Shame, Case Study
UI Design Process: Design Process Introduction, Designing to Address a Problem w/o Solution Ideas, Designing for a known solution direction, Designing to iterate on/improve an existing solution, Common Elements, Usability Engineering and Task-Centered Approaches, Use Cases, Personas, Tasks, and Scenarios, Design-Centered Approaches, Design-Centered Methods & When They Work Best, Pulling it all Together: Best from Each; Practical Techniques

Psychology and Human Factors for UI Design: Fitts' Law, Short- and long-term memory, attention, Perception and visualization, hierarchy, Mistakes, Errors, and Slips, Conceptual models, The Gulf of Execution and the Gulf of Evaluation, Design Principles: Visibility, Feedback, Mappings, Constraints, Interacting beyond individuals

(social psychology), High-Level Models: Distributed Cognition, Activity Theory, Situated Action, Interface Critiques, Overview and Properties of a Good Critique, Psychology and Human Factors: Shortcuts to Understanding Your Users

User Experience Design Overview: Important Terms and Concepts, Features of Good Design, User Engagement Ethics, General Resources, Overview of User Experience Design

Requirement Gathering: Types of Users and Types of Data, Discovery Technique, Naturalistic Observation, Survey, Focus Group, Interview, User Results, Presenting Task Findings, Elements of Requirement Gathering
Designing Alternatives: Review of Design Goals, Design Alternatives. Prototyping: Resources and Tools for Prototyping, Resources for Prototyping. Evaluation: Resources for Evaluation

Text Book:

1. Donald A. Norman : **The Design of Everyday Things**

Books Recommended:

1. Jesse James Garret : **The Elements of User Experience**
2. Jenifer Tidwell : **Designing Interfaces: Patterns for Effective Interaction Design**

CSE4182: User Interface and User Experience Design (UI/UX Design) Lab
Credits: 1 **Contact Hours:** 26
Year: Four **Semester:** Odd

Prerequisite None
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To accrue adequate practical knowledge about designing artifacts that allow the users to meet their needs in the most effective efficient and satisfying manner.

Course Objective:
The course introduces the novice to a cycle of discovery and evaluation and a set of techniques that meet the user's needs. The course mantra is that “Design is a systematic and data driven process.” Students will gain an understanding of the critical importance of user interface and user experience design and practically demonstrate them. They will also work on industry-standard methods for how to approach the design of a user interface and user experience along with key theories and frameworks that underlie the design of most interfaces you use today.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	Create new UI design from scratch	**Design/development of solutions** (PO3)	Cognitive domain – level 5	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	Gain practical experience in UX Design	**Design/development of solutions** (PO3)	Cognitive domain – level 6	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Case Studies
2. UI Disasters, including GPS fails
3. Corporate Value: Citibank ATM
4. Microsoft Office 2007 Ribbon
5. International Children's Digital Library
6. Taxes and Tickets
7. AirBnB vs. CouchSurfing
8. Task:

1) User research and ideation
   First prototype
   Cognitive Walkthrough and heuristic evaluation
   Second prototype and user test plan
   User test
   Carry out a significant, realistic project from start to finish, applying UX methods in an iterative design process
   a. Produce a portfolio project that can show employers what you can do

Text Book:

1. Donald A. Norman : **The Design of Everyday Things**

Books Recommended:

1. Jesse James Garret : **The Elements of User Experience**
2. Jenifer Tidwell : **Designing Interfaces: Patterns for Effective Interaction Design**

CSE4191: Blockchain
Credits: 3 **Contact Hours:** 39
Year: Fourth Semester: Odd

Prerequisite: None

Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Motivation It is ideal for programmers and designers involved in developing and implementing blockchain applications, and anyone who is interested in understanding its potential.

Course Objective:

This Course introduces blockchain, a revolutionary technology that enables peer-to-peer transfer of digital assets without any intermediaries, and is predicted to be just as impactful as the Internet. More specifically, it prepares learners to program on the Ethereum blockchain.

The course covers a range of essential topics, from the cryptographic underpinnings of blockchain technology to enabling decentralized applications on a private Ethereum blockchain platform.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **recognize** foundational concepts of blockchain, .	**Engineering knowledge** (PO1)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☒ Participation ☐ Presentation

CO2	To **design**, code, deploy and execute a smart contract.	**Design/development of solutions** (PO3)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☒ Participation ☐ Presentation
CO3	To **design** and develop end-to-end decentralized applications (Dapps).	**Design/development of solutions** (PO3)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:
Blockchain Defined: Practitioner's Perspective, ConsenSys, Blockchain Defined: Bitcoin & Blockchain, Blockchain Structure, Basic Operations, Beyond Bitcoin. Ethereum Blockchain: Smart Contracts, Practitioner's Perspective: The Enterprise, Ethereum Structure, Ethereum Operations, Incentive Model.

Algorithms & Techniques: Public-Key Cryptography, Hashing, Transaction Integrity, Securing Blockchain
Trust Essentials: Decentralized Systems, Consensus Protocol, Practitioner's Perspective: Decentralized Governance, Robustness, Forks. Smart Contract Basics: Smart Contract Basics: Why Smart Contracts? Smart Contracts Defined, Processing Smart Contracts, Deploying Smart Contracts.

Solidity: Solidity: Structure, Basic Data Types & Statements (Bidder Data & Functions Demos), Specific Data Types, Data Structures, Access Modifiers & Applications. Putting it all Together: Developing Smart Contracts, Time Elements, Validation & Test, Client Applications, Practitioner's Perspective: Shared Rules & Trust
Best Practices: Evaluating Smart Contracts, Designing Smart Contracts Remix Web IDE

Decentralized Applications (Dapps): Blockchain Server, Dapp Defined, Ethereum APIs, Practitioner's Perspective: Public Network Architecture. Truffle Development: Truffle IDE, Test-Driven Development, Web Interface & Testing.

Design Improvements: Solidity Features, Event Handling, Oraclize. Application Models & Standards: Dapp Models, Dapp Standards. Permissioned Blockchains: Hyperledger, Fabric Services, Fabric Model & Functions, Composer, Microsoft Azure.

Decentralized Applications Platforms: Augur, Grid+, Challenges & Solutions: Consensus, Scalability, Privacy & Confidentiality, Escrow & Multi-sig. Alternative Decentralized Solutions: Interplanetary File System, Hashgraph, Social Imperative, Practitioner's Perspective: Market Adoption

Text Book:
1. Tiana Laurence : **Blockchain for Dummies**, Wiley, Year: 2019

Books Recommended:
1. Horst Treiblmaier, Roman Beck : **Business Transformation through Blockchain**: *Volume I & II, Palgrave Macmillan, Year: 2019*
2. Jai Singh Arun; Genarro Cuomo; Nitin Gaur **Blockchain for Business**, *Addison-Wesley Professional, Year: 2019*
3. Xiwei Xu, Ingo Weber, Mark Staples **Architecture for Blockchain Applications**, *Springer, Year: 2019*

CSE4192: Blockchain Lab
Credits: 1 **Contact Hours:** 26
Year: Fourth **Semester:** Odd

Prerequisite: None
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation It is ideal for programmers and designers involved in developing and implementing blockchain applications, and anyone who is interested in understanding its potential.

Course Objective:
This Course introduces blockchain, a revolutionary technology that enables peer-to-peer transfer of digital assets without any intermediaries, and is predicted to be just as impactful as the Internet. More specifically, it prepares learners to program on the Ethereum blockchain.
The course covers a range of essential topics, from the cryptographic underpinnings of blockchain technology to enabling decentralized applications on a private Ethereum blockchain platform.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **creat**e nodes on a private Ethereum blockchain	**Design/development of solutions** (PO3)	Cognitive domain – level 6	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **design** develop and test a smart contract	**Design/development of solutions** (PO3)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO3	To **design** and develop a decentralized application	**Design/development of solutions** (PO3)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Course Contents:
1. create nodes on a private Ethereum blockchain, create accounts, unlock accounts, mine, transact, transfer Ethers, and check balances.
2. To design, develop and test a smart contract for a problem using Solidity language and Remix IDE.
3. To apply incremental development method and best practices.
4. Design and develop a decentralized application (Dapp) using Truffle Integrated Development Environment (IDE)
5. Explain and apply the concepts of test-driven development
6. Steps in Dapp development using Truffle IDE.
7. Install IPFS on your compute machine

8. Use command line interface (CLI) to IPFS to add a file on IPFS
9. Use the web interface to the IPFS to view your peers and add (drag and drop) files to IPFS
10. Add a folder of files to IPFS using the web interface to the IPFS, view the hash of the folder and the files on the CLI
11. Use IPFS to share files with others
12. The base-58 addressing scheme of IPFS objects

Text Book:

1. Tiana Laurence : **Blockchain for Dummies**, *Wiley, Year: 2019*

Books Recommended:

1. Horst Treiblmaier, Roman Beck : **Business Transformation through Blockchain**: Volume I & II, *Palgrave Macmillan*
2. Jai Singh Arun; Genarro Cuomo; Nitin Gaur : **Blockchain for Business**, *Addison-Wesley Professional*
3. Xiwei Xu, Ingo Weber, Mark Staples : **Architecture for Blockchain Applications**, *Springer*

CSE4192: Thesis/Project (Part-I)
Credits: 1 Contact **Hours: 26**
Year: Fourth **Semester:** Even

Prerequisite: None
Course Type ☐ Theory ☐ Laboratory work ☒ Project work ☒ Viva Voce
Motivation To design a develop a project from their knowledge they have acquired from their undergraduate program

Course Objective:
Each student has to complete one project in the combined duration of two semesters of Part-IV. In odd semester course CSE 4192 (Part-I), a student has to make a proposal defense at the end of the semesters. The defensed project has to be completed in the continuation course CSE 4292 (Part-II) in even semester of Part-IV. This course is designed for the students to achieve their skills function effectively as an individual and as a member or leader of diverse teams and in multidisciplinary settings

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Assessment tools
CO1	To **Construct** a real world project based on their acquired knowledge	**Individual work and teamwork** (P09)	Cognitive domain – level 1	☐ CA ☒ Project presentation ☐ Assignment ☒ Project paper ☒ Oral Presentation

Assessment:
25 Marks (35% Internal Examiner, 35% External Examiner, 30% Presentation and Oral).

4th Year (Even Semester)

CSE 4211: Machine Learning
Credits: 3 **Contact Hours:** 39
Year: Four **Semester:** Even

Prerequisite: MATH2241: Linear Algebra
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation This course is offered to provide an introduction to several fundamental concepts and methods for machine learning.

Course Objective:
The objective is to familiarize the students with some basic learning algorithms and techniques and their applications, as well as general questions related to analyzing and handling large data sets.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understand** a wide variety of learning algorithms	**Design/development of solutions:** (PO3)	Cognitive domain – level 5	☒Lecture Note ☒Text Book ☐Audio/Video ☐Web Material ☐Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **apply** the algorithms to a real-world problem	**Problem analysis:** (PO2)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Basic machine learning concepts and examples. Basic probability notions.

Bayesian inference. Nearest-neighbor algorithms. On-line learning (Halving, Weighted Majority, Perceptron, Winnow).

Support vector machines. Kernel methods. Decision trees. Ensemble methods (Boosting, Bagging).

Logistic regression.

Density estimation, ML, MAP, Maxent models. Multi-class classification (Conditional Maxent models, binary classifiers and error-correction codes).

Regression (linear regression, Kernel Ridge Regression, Lasso, neural networks). Clustering (K-means, DT clustering).

Dimensionality reduction (PCA, KPCA). Introduction to reinforcement learning. Elements of learning theory.

Text Book:
1. Ethem Alpaydin : **Introduction to Machine Learning,** *Phi*

Books Recommended:
1. Stephen Marsland : **Machine Learning: An Algorithmic Perspective,** *Chapman and Hall*

CSE4212: Machine Learning Lab
Credits: 1 **Contact Hours:** 26
Year: Fourth **Semester:** Odd

Prerequisite: MATH2241: Linear Algebra
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation This course is offered for the students to make understand the implementation procedures for the machine learning algorithms.

Course Objective:
To introduce students to give practical experience on use of data sets in implementing the machine learning algorithms and implement the machine learning concepts and algorithms.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **implement** machine learning algorithms	**Design/development of solutions:** (PO3)	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	**To** apply appropriate data sets to the machine learning algorithms	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
2. Write a program to implement the naïve Bayesian classifier for a sample training data set. Compute the accuracy of the classifier, considering few test data sets.
3. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Calculate the accuracy, precision, and recall for your data set.
4. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.
5. Apply EM algorithm to cluster a set of data. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.
6. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Find out both correct and wrong predictions.
7. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
8. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs
9. For a given set of training data examples, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

CSE4221: Computer Graphics
Credits: 3 **Contact Hours:** 39
Year: Third Semester: Even

Prerequisite: MATH1221 Co-ordinate Geometry, Vector analysis and Complex Variable, MATH2241Linear Algebra

Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Motivation To study how computer, draw and display graphics, and to design 2D/3D graphical user interface.

Course Objective:
The main objective of this course is to provide necessary knowledge on the structure of modern computer graphics systems, basic principles of implementing computer graphics primitives, modelling and rendering graphical data, write basic graphics application programs including animation, synthesize designs, shading and texture mapping algorithms and modern 3D computer graphics.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **Explain** the structure of modern computer graphics systems, basic principles of implementing computer graphics primitives	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation
CO2	To **Identify** and apply geometric view and projection models and transformations of homogeneous coordinates in computer graphics	**Problem analysis:** (PO2)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation
CO3	To **Apply** curves and hidden surfaces concepts	**Design/Development of solutions:** (PO3)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Introduction to Computer Graphics and Graphics systems: Overview of computer graphics, representing pictures, preparing, presenting and interacting with pictures for presentations; Visualization and image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active and Passive graphics devices; Computer graphics software.

Scan conversion: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

2D transformation and viewing: Basic transformations: translation, rotation, scaling; Matrix representations and homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines. Viewing pipeline, Window to view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse.

3D transformation and viewing: 3D transformations: translation, rotation, scaling and other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, view port clipping, 3D viewing.

Curves: Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic Bspline curves, rational B-spline curves.

Hidden surfaces: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Printer's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal - geometry.

Color and shading models: Light & color model; interpolative shading model; Texture.

Text Book:

1. Donald Hearn and M. Pauline Baker : **Computer Graphics,** *Prentice Hall.*
2. Steven Harrington : **Computer Graphics: A Programming Approach,** *McGraw-Hill College.*

Books Recommended:

1 F. S. Hill : **Fundamentals of Computer** *Graphics,Prentice Hall.*
2 Plastock and Kalley : **Computer Graphics,** *Mcgraw-hill.*
3 Zhigang Xiang & Roy Plastock **Computer Graphics,** *Mcgraw-hill.*
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CSE4222: Computer Graphics Lab
Credits: 1 **Contact Hours:** 26
Year: Third Semester: Even

Prerequisite: MATH1221 Co-ordinate Geometry, Vector analysis and Complex Variable, MATH2241Linear Algebra
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To study how computer, draw and display graphics, and to design 2D/3D graphical user interface.

Course Objective:
Computer graphics is one of the most exciting and rapidly growing computer fields and has many applications, including user interfaces, data visualization, computer-aided design, motion pictures and image processing. This unit concentrates on the hands-on experience of the fundamentals of computer graphics which are essential for computing professionals.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **identify** graphics programming and graphics tool	**Modern tool usage** (PO5)	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **analyze** 2D and 3D graphical scenes using open graphics library suits	**Design/Development of solutions** (PO3)	Cognitive domain – level 3	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Implementation of Algorithms for drawing 2D Primitives – Line
2. All slopes Circle (Midpoint)
3. Implementation of Line, Circle and ellipse attributes.
4. 2D Geometric transformations –Translation, Rotation, Scaling
5. Creating two dimensional objects
6. 3D Transformations – Translation, Rotation, Scaling

Text Book:

1. Donald Hearn and M. Pauline Baker : **Computer Graphics,** *Prentice Hall.*
2. Steven Harrington : **Computer Graphics: A Programming Approach,** *McGraw-Hill College.*

Books Recommended:

1. F. S. Hill : **Fundamentals of Computer** *Graphics,Prentice Hall.*
2. Plastock and Kalley : **Computer Graphics,** *Mcgraw-hill.*
3. Zhigang Xiang & Roy Plastock **Computer Graphics,** *Mcgraw-hill.*

CSE 4231: Cryptography and Network Security
Credits: 3 **Contact Hours:** 39
Year: Fourth Semester: Even

Prerequisite: ICE3161 Communication Engineering, CSE 3251 Computer Networks
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To know basic of cryptography and network security, different secure protocol, network security issues.

Course Objective:

The main objective of this course is to completely understand what ICT security is and how real scenarios can be affected by the lack of security. Students will learn how cryptography can support security and why this is not sufficient, needing to be embodied into shared standards. The course provides also an overview on other tools used for guaranteeing the security of networks, applications, and systems. Students will become familiar with the main attack techniques and will be able to choose and use secure protocols and other tools/systems for security that are indispensable for network administration and design of secure applications.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **illustrate** various Public key and Symmetric key cryptographic techniques.	**Engineering knowledge:** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO2	To **analyze** the vulnerabilities in any computing system and hence be able to design a security solution.	**Design/development of solutions:** (PO4)	Cognitive domain – level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation

CO3	To **evaluate** authentication protocols and requirements.	**The engineer and society**: (PO6)	Cognitive domain – level 2	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Overview: Cryptography Overview and Terminologies.

Symmetric Ciphers: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography, Simplified DES, Block Cipher Principles, The Data Encryption Standard, The Strength of DES, Block Cipher Design Principles, Evaluation Criteria for AES, The AES Cipher, Triple DES, Blowfish, RC5, Characteristics of Advanced Symmetric Block Ciphers, RC4 Stream Cipher, Placement of Encryption Function, Traffic Confidentiality, Key Distribution.

Number theory: Fields, algebraic closures, Integers - divisibility, primes, testing primes, factorization, Euclidean algorithm

Public-Key Encryption: Principles of Public-Key Cryptosystems, The RSA Algorithm, Key Management.

Network Security:

Message Authentication: Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, MD5 Message Digest Algorithm, Secure Hash Algorithm, Digital Signatures, Authentication Protocols.

Network Security Practice: Kerberos, Pretty Good Privacy, S/Mime, IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Web Security Considerations, Secure Socket Layer and Transport Layer Security.

System Security: Intruders, Intrusion Detection, Password Management, Viruses and Related Threats, Virus Countermeasures, Firewalls.

Text Book:

1. Bruce Schneier : **Applied Cryptography**, *John Wiley & Sons.*
2. W. Stallings **Cryptography and Network Security Principles and Practice**, *Prentice Hall.*

Books Recommended:

1. Dieter Gollmann : **Computer Security**, *John Wiley and Son.*
2. E. Biham and A. Shamir : **Differential Crypt Analysis of the Data Encryption Standard**, *Springer Verlag.*

CSE 4232: Cryptography and Network Security Lab
Credits: 1 Contact Hours: 26
Year: Fourth Semester: Even

Prerequisite: CSE 1221: Object Oriented Programming Java
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To know basic of cryptography and network security, different secure protocol, network security issues.

Course Objective:
The main objective of this Lab course is to develop computer program based on theory course CSE4231 (Cryptography and Network Security) in C or C++ or Java language.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	**To implement** elementary algorithms such as Caesar cipher, Transposition cipher, DES, RSA, MD5, SHA	**Design/development of solutions:** (PO3)	Cognitive domain – level 2	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	**To apply** Cryptographic algorithms to solve real world problems.	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

12. Suppose you are given a line of text as a plaintext, find out the corresponding Caesar Cipher (i.e. character three to the right modulo 26). Then perform the reverse operation to get original plaintext.
13. Find out the Polygram Substitution Cipher of a given plaintext (Consider the block size of 3). Then perform the reverse operation to get original plaintext.
14. Consider the plaintext “DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLY UNIVERSITY OF RAJSHAHI BANGLADESH”, find out the corresponding Transposition Cipher (Take width as input). Then perform the reverse operation to get original plaintext.
15. Find out corresponding double Transposition Cipher of the above plaintext. Then perform the reverse operation to get original plaintext.
16. You are supplied a file of large nonrepeating set of truly random key letter. Your job is to encrypt the plaintext using ONE TIME PAD technique. Then perform the reverse operation to get original plaintext.
17. Use the Lehmann algorithm to check whether the given number P is prime or not?
18. Use the Robin-Miller algorithm to check whether the given number P is prime or not?
19. Write a program to implement MD5 one way hash function.
20. Write a program to implement Secured Hash Algorithm (SHA) one way hash function.
21. Encrypt the plaintext message using RSA algorithm. Then perform the reverse operation to get original plaintext.
22. Write a program to implement Diffie-Hellman Key Exchange.

CSE4241: Multimedia System
Credits: 3 Contact Hours: 39
Year: Four Semester: Even

Prerequisite: CSE4161:Digital Image Processing, CSE3251;Computer Networks
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To know the issues of multimedia data format, properties and applications.

Course Objective:
The objective of this course is to acquire knowledge and skills required to plan, design and implement multimedia systems and technologies. This course teaches the principles and current technologies of multimedia systems, describes the ways in which multimedia information is captured, processed, and rendered and the major steps in some of the image, video and audio compression standards. It also introduces multimedia quality of service (QoS) and analyses the ways in which multimedia data is transmitted across networks. Privacy and copyright issues in the context of multimedia are discussed.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **define and describe** the different media and technologies of Multimedia system	**Engineering knowledge** (PO1)	Cognitive domain – level 6	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation
CO2	To **explain** data formats and standards of different media, protocol and issues in multimedia operating systems and multimedia networking.	**Problem analysis** (PO2)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation
CO3	**Analyze** media (image, video, audio) in the frequency domain for encoding	**Problem analysis** (PO2) **Investigation** (PO4)	Cognitive domain – level 4 & level 3	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:
Class tests + Assignments due in different times of the semester (20%), A class participation mark (10%).
A comprehensive final exam (70%), Total Time: 3 hours.

Course Contents:

Multimedia systems: Introduction to multimedia, components of multimedia, key properties of multimedia system, multimedia software tools, Multimedia authoring; Digitization of sound, SNR and SQNR, Linear and Nonlinear quantization, MIDI concept, MIDI messages;Image representation, Dithering, Color Lookup Tables, Image file formats; Light, color models, spectral sensitivity of the eye, Camera systems; color models in video, Types of video signals, Analog video transmission, Digital video, Chroma subsampling, HDTV;

Coding and compression: Compression ratio, Types of compression, PCM, PCM in speech compression, Differential coding, lossless predictive coding, DPCM, DM, ADPCM, Basics of information theory, Run-length coding, Variable-length coding (Shannon- Fano Algorithm, Huffman coding, Extended Huffman coding, Adaptive Huffman coding), Dictionary-Based Coding (LZW), Arithmetic coding, Distortion measure, Quantization in lossy scheme (Uniform scalar quantization, Nonuniform scalar quantization and vector quantization), Transform coding (1D DCT, 2D DCT), JPEG standard (Main steps in JPEG standard, JPEG Modes, JPEG bitstream, features of JPEG2000 standards); Types of frame in video, motion estimation and motion compensation in video compression;

Operating systems issues in multimedia: Real-time OS issues, Real time process scheduling (RMF and EDF), Multimedia file system paradigm, Multimedia file placement in disk, disk scheduling.

Networking issues in multimedia: Switching technologies (Circuit switching, Packet switching, Frame relay and cell relay), Asynchronous Transfer Mode, Quality-of-service parameters, Multimedia service class, IP-Multicast, RTP, RTCP, RSVP, RTSP, Internet telephony- H.323, SIP;

Security issues in multimedia: Digital water-marking; Multimedia applications: Audio and video conferencing, video on demand, voice over IP;

Text Book:
1. Ze-Nian Li and Mark S. Drew : **Fundamentals of Multimedia**, *Pearson*

Books Recommended:
1. John Villamil-Casanova and Louis Molina : **Fundamentals of Multimedia**, *Pearson*
2. Tay Vaughan : **Multimedia: An Introduction**, Prentice Hall India.

CSE4242: Multimedia System Lab
Credits: 1**Contact Hours:** 26
Year: Fourth **Semester:** Even

Prerequisite: CSE4161:Digital Image Processing, CSE3251;Computer Networks
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To learn the data format, standards and transformation techniques of multimedia data.

Course Objective:
Multimedia System Lab is an introduction to implement of different data compression standards and analyze the different media with various transformation technique.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **understand** Detail knowledge of the lossless and lossy data compression standards	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **apply** multimedia data and techniques on a practical application.	**Problem analysis** (PO2) **Investigation** (PO4) **Modern tool usages** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Encoding and decoding with RLE method of text and image file.
2. Encoding and decoding with LZW method of text and image file.
3. Encoding and decoding with Arithmetic coding method of a text file.
4. Encoding and decoding with Huffman coding method of a text image file.
5. Encoding and decoding of an image file with the DCT transformation

Text Book:
1. Ze-Nian Li and Mark S. Drew : **Fundamentals of Multimedia**, *Pearson*

CSE4251: Distributed Database Management System
Credits: 3 **Contact Hours:** 39
Year: Four **Semester:** Even

Prerequisite: CSE3121 Database Management Systems, CSE 3251 Computer Networks
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To accrue adequate knowledge about the distributed environment, distributed file and database management system.

Course Objective:
Gigantic amount of data is generated in our daily life. And the volume is increasing day by day. Conventional DBMS are not sufficient to manage and process these enormous amounts of data. Distributed database management systems are different from conventional DBMS. To be able to manage and process these huge amounts of data CS graduates must have a clear understanding of DDBMS..

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **explain** the different terminologies and techniques related to distributed database management system (DDBMS).	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO2	To **demonstrate** different architectures of DDBMS.	**Engineering knowledge** (PO1)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☐ Presentation
CO3	To **design**, **deploy** and maintain DDBMS.	**Engineering knowledge** (PO1)	Cognitive domain – level 2	☒ Lecture Note ☒ Text Book ☐ Audio/Video ☐ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Introduction: Distributed Data processing, Distributed database system (DDBMSS), Promises of DDBMSs, Complicating factors and Problem areas in DDBMSs, Overview Of Relational DBMS Relational Database concepts, Normalization, Integrity rules, Relational Data Languages, Relational DBMS

Distributed DBMS Architecture: DBMS Standardization, Architectural models for Distributed DBMS, Distributed DBMS Architecture Distributed Database Design: Alternative design Strategies, Distribution design issues, Fragmentation, Allocation. Semantic Data Control: View Management, Data security, Semantic Integrity Control

Overview of Query Processing: Query processing problem, Objectives of Query Processing, Complexity of Relational Algebra operations, characterization of Query processors, Layers of Query Processing Introduction To Transaction Management: Definition of Transaction, Properties of transaction, types of transaction

Distributed Concurrency Control: Serializability theory, Taxonomy of concurrency control mechanisms, locking bases concurrency control algorithms. Parallel Database Systems: Database servers, Parallel architecture, Parallel DBMS techniques, Parallel execution problems, Parallel execution for hierarchical architecture.

Distributed Object Database Management systems: Fundamental Object concepts and Object models, Object distribution design. Architectural issues, Object management, Distributed object storage, Object query processing. Transaction management. Database Interoperability: Database Integration, Query processing.

Text Book:

1. M.T. Ozsu and P. Valduriez : **Principles of Distributed Database Systems**, *Pearson.*

Books Recommended:

1. S. Ceri and G. Pelagatti : **Distributed Databases principles and systems**, *Tata McGraw Hill*
2. Andrew S. Tanenbaum : **Distributed Database**, *Pearson*.

CSE4252: Distributed Database Management System Lab
Credits: 1 **Contact Hours:** 26
Year: Fourth **Semester:** Even

Prerequisite: CSE3121 Database Management Systems, CSE 3251 Computer Networks
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation To develop practical knowledge on designing and maintaining distributed database management system.

Course Objective:
This lab course is designed for the students to achieve a hands-on experience in designing, using as well as maintaining DDBMSs. The idea is to give them practical experience in retrieving information from a distributed database system efficiently and effectively. Theoretical lectures are completed by lab practice where theoretical knowledge is applied.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **demonstrate** the basic operation of DDBMS.	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☐ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☐ Assignment ☒ Note book ☐ Presentation
CO2	To **apply** the concept of efficient query processing in DDBMS environment.	**Problem analysis** (PO2)	Cognitive domain – level 3	☒ Lecture Note ☐ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☐ Final Exam ☐ Assignment ☒ Note book ☐ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

22. Understanding the (key,value) pair in distributed database system.
23. Creating HDFS.
24. Installing Hadoop framework
25. Query processing in HDFS.

CSE4261: Neural Networks and Deep Learning
Credits: 3 **Contact Hours:** 39
Year: Four **Semester:** Even

Prerequisite: CSE4131: Artificial Intelligence
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation If you want to break into cutting-edge AI, this course will help you do so. Deep learning is a new "superpower" that will let you build AI systems that just weren't possible a few years ago.

Course Objective:
This course teaches you how Deep Learning actually works, rather than presenting only a cursory or surface-level description. So, after completing it, students will be able to apply deep learning to your own applications. If they are looking for a job in AI, after this course you will also be able to answer basic interview questions.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	Understand the major technology trends driving Deep Learning	**Engineering knowledge** (PO1)	Cognitive domain – level 5	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☒ Presentation
CO2	Build, train and apply fully connected deep neural networks	**Design/development of solutions** (PO3)	Cognitive domain – level 4	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☐ Presentation
CO3	Implement efficient (vectorized) neural networks	**Design/development of solutions** (PO3)	Cognitive domain – level 2	☒ Lecture Note ☒ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☐ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Multilayer Perceptron.
Deep Feedforward Networks: Gradient-Based Learning, Back-propagation and other differential algorithms. Techniques to improve neural networks: regularization and optimizations, hyperparameter tuning and deep learning frameworks.

Concepts and mathematical formalization of Deep Belief Networks, stacks of restricted Boltzman Machines. Autoencoders: Undercomplete, Regularized, and Denoising Autoencoders. Learning Manifold with Autoencoder.
Convolutional Neural Networks (CNNs): The convolution operation and Pooling. Application of CNNs on computer vision.

Recurrent Neural Networks (RNNS): Bidirectional RNNs, Deep Neural Networks, e Long short-term memory and other gated RNNS, Applications of RNNs on natural language processing, and speech recognition.
Advanced topics: Generative Adversarial Networks, Deep Reinforcement Learning, Adversarial Attacks.

Text Book:
1. Ian Goodfellow and Yoshua Bengio and Aaron Courville : **Deep Learning,** *An MIT Press book*

Books Recommended:
1. Michael Nielsen : **Neural Networks and Deep Learning**

CSE4262: Neural Networks and Deep Learning Lab
Credits: 1 Contact Hours: 26
Year: Fourth **Semester:** Even

Prerequisite: MATH 1121 Differential and Integral Calculus, MATH2241Linear Algebra
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation This course is offered for the students to make understand the applications and implementation procedures for the deep learning algorithms.

Course Objective:
To introduce students to give practical experience on the use of data sets in implementing the deep learning algorithms and implement the deep learning concepts and algorithms.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **implement** Neural network and deep learning algorithms	**Design/development of solutions:** (PO3)	Cognitive domain – level 5	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	**To** apply appropriate data sets to the deep learning algorithms	**Modern tool usage:** (PO5)	Cognitive domain – level 4	☐ Lecture Note ☒ Text Book ☐ Audio/Video ☒ Web Material ☒ Lab Manual	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:
Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

1. Implement an Multilayer Perceptron algorithm without regularization to classify IRIS dataset. Update the weights using gradient descent optimizer by implementing the Back propagation algorithm.
2. Built the same Multilayer Perceptron in 1 now with regularization and show the difference by plotting accuracy curve obtained during model training.
3. Classify hand written digits from MNIST datasets by deep belief networks.
4. Classify hand written digits from MNIST datasets by restricted boltzman machine.
5. Build a 5 layers autoencoder to reconstruct two digits in MNIST dataset. Calculate the PCA on the outputs of the nodes in 3rd layers and scatter plot the first two PCs for each digit. By observing the plots, do you thinks the outputs of the nodes in 3rd layers can be used as features for digits classification?
6. Build a convolution neural network to classify cat and dog using the Kaggle cats and dogs dataset. Take the output of the networks from just before the flatten layers and plot the output and explain about the distinguishability of the features calculated in the convolutional layers.
7. Implement a recurrent neural network to recognize specific words from speech signal.

CSE 4271: Big Data
Credits: 3 **Contact Hours:** 39
Year: Fourth Semester: Even

Prerequisite: CSE4131: Artificial Intelligence

Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce

Motivation Drive better business decisions with an overview of how big data is organized, analyzed, and interpreted. Apply your insights to real-world problems and questions.

Course Objective:

Do you need to understand big data and how it will impact your business? This Specialization is for you. You will gain an understanding of what insights big data can provide through hands-on experience with the tools and systems used by big data scientists and engineers. Previous programming experience is not required! You will be guided through the basics of using Hadoop with MapReduce, Spark, Pig and Hive. By following along with provided code, you will experience how one can perform predictive modeling and leverage graph analytics to model problems. This specialization will prepare you to ask the right questions about data, communicate effectively with data scientists, and do basic exploration of large, complex datasets. In the final Capstone Project, developed in partnership with data software company Splunk, you'll apply the skills you learned to do basic analyses of big data.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **descri**be the Big Data landscape including examples of real-world big data	**Engineering knowledge (PO1)**	Cognitive domain – level 5	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☒ Assignment ☐ Participation ☐ Presentation
CO2	To **identify** big data problems and be able to recast problems as data science questions.	**Design/development of solutions (PO3), Modern tool usage (PO5)**	Cognitive domain – level 4	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☒ Participation ☐ Presentation
CO2	To **summarize t**he features and significance of the HDFS file system .	**Engineering knowledge (PO1)**	Cognitive domain – level 4	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☒ Final Exam ☐ Assignment ☐ Participation ☒ Presentation

Assessment and Marks Distribution:

Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:

Big Data: Why and Where: Big Data era, Applications, Example, Big Data Source, Machine-Generated Data, Advantages, Generated By People, Organization-Generated Data, Benefits, Integrating Diverse Data. Characteristics of Big Data and Dimensions of Scalability: Volume, Variety, Velocity, Veracity, Valence, The Sixth V: Value

Data Science: Getting Value out of Big Data: Building a Big Data Strategy, How does big data science happen? Five Components of Data Science, Asking the Right Questions, Steps in the Data Science Process. Foundations for Big Data Systems and Programming: Distributed File System, Scalable Computing over the Internet, Programming Models for Big Data

Systems: Hadoop: Hadoop: Why, Where and Who? The Hadoop Ecosystem The Hadoop Distributed File System: A Storage System for Big Data, YARN: A Resource Manager for Hadoop, MapReduce: Simple Programming for Big Results, Reconsider Hadoop? Cloud Computing: An Important Big Data Enabler, Cloud

Service Models: An Exploration of Choices, Value From Hadoop and Pre-built Hadoop Images, Copy your data into the Hadoop Distributed File System (HDFS). Big Data Modeling and Management: Data Ingestion, Data Storage, Data Quality, Data Operations, Data Scalability and Security, Energy Data Management Challenges at ConEd,

Big Data Modeling: Introduction to Data Models, Data Model Structures, Operations, Constraints, CSV Data, Relational Data Model? Semistructured Data Model? Relational Data Model of CSV Files, Semistructured Data Model of JSON data, Array Data Model of an Image, Sensor Data, Vector Space Model, Graph Data Model, Other Data Models, Lucene Search Engine's Vector Data Model, Graph Data Models with Gephi

Working With Data Models: Data Model vs. Data Format, Data Stream, Streaming Data different, Data Lakes, Streaming Sensor Data. Big Data Management: The "M" in DBMS: DBMS-based and non-DBMS-based Approaches to Big Data, DBMS to BDMS, Redis, Aerospike, AsterixDB, Solr, Vertica.

Retrieving Big Data: Data Retrieval, Querying Two Relations, Subqueries, Querying Relational Data with Postgres, Querying JSON Data with MongoDB, Aggregation Functions. Querying Aerospike, Querying Documents in MongoDB, Pandas DataFrames. Big Data Integration: Integration Scenario, Integration for Multichannel Customer Analytics, Big Data Management and Processing Using Splunk and Datameer.

Processing Big Data: Big Data Processing Pipelines, High-Level Processing Operations in Big Data Pipelines, Aggregation Operations, Typical Analytical Operations in Big Data Pipelines, Big Data Processing Systems, The Integration and Processing Layer, Apache Spark.

Introduction to Graphs: Graph, Why Graphs, Example 1: Social Networking, Example 2: Biological Networks, Example 3: Human Information Network Analytics, Example 4: Smart Cities, Purpose of Analytics, Impact of Big Data's V's on Graphs

Text Book:

1. Michael Z. Zgurovsky, Yuriy P. Zaychenko : **Big Data: Conceptual Analysis and Applications**, *Springer*

Books Recommended:

1. Thi Thi Zin, Jerry Chun-Wei Lin : **Big Data Analysis and Deep Learning Applications**, *Springer*

CSE 4272: Big Data Lab
Credits: 1 **Contact Hours:** 26
Year: Fourth Semester: Even

Prerequisite: CSE4132: Artificial Intelligence Lab

Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce

Motivation Drive better business decisions with an overview of how big data is organized, analyzed, and interpreted. Apply your insights to real-world problems and questions.

Course Objective:

Do you need to understand big data and how it will impact your business? This Specialization is for you. You will gain an understanding of what insights big data can provide through hands-on experience with the tools and systems used by big data scientists and engineers. Previous programming experience is not required! You will be guided through the basics of using Hadoop with MapReduce, Spark, Pig and Hive. By following along with provided code, you will experience how one can perform predictive modeling and leverage graph analytics to model problems. This specialization will prepare you to ask the right questions about data, communicate effectively with data scientists, and do basic exploration of large, complex datasets. In the final Capstone Project, developed in partnership with data software company Splunk, you'll apply the skills you learned to do basic analyses of big data.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **describe** the Big Data landscape.	**Engineering knowledge (PO1)**	Cognitive domain – level 5	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **identify** big data problems	**Design/development of solutions (PO3), Modern tool usage (PO5)**	Cognitive domain – level 4	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **summarize** the features and significance of the HDFS file system	**Engineering knowledge (PO1)**	Cognitive domain – level 4	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Lab Course Contents/List of Experiments:

Experiment 1:
Step 0: Store the dataset across 4 partitions in HDFS.
Step 1: Map the data.
Step 2: Sort and Shuffle.
Step 3: Reduce to calculate the final counts.

Experiment 2:
1. Filter rows in a spreadsheet
2. Perform aggregate operations such as average and sum

Experiment 3:
1. Display the nested structure of a JSON file.
2. Extract data from a JSON file.

Experiment 4:
1. Identify the major components in semi-structured data from a weather station
2. Create plots of weather station data

Experiment 5:
1. Import and query text documents with Lucene
2. Perform weighted queries to see how rankings change
3. View the Term Frequency-Inverse Document Frequency (TF-IDF)

Experiment 6:
1. Import a CSV file into Gephi
2. Perform statistical operations and layout algorithms on graph data in Gephi

Experiment 7:
1. View semi-structured data streaming in real-time from a weather station
2. Create plots of streaming weather station data

Experiment 8:
1. View the text of Twitter data streaming in real-time containing specific words.
2. Create plots of the frequency of streaming Twitter data to see how popular a word is.

Text Book:

1. Michael Z. Zgurovsky, Yuriy P. Zaychenko : **Big Data: Conceptual Analysis and Applications**, *Springer*

Books Recommended:

1. Thi Thi Zin, Jerry Chun-Wei Lin : **Big Data Analysis and Deep Learning Applications**, *Springer*

CSE4281: Systems Biology
Credits: 3 **Contact Hours:** 39
Year: Four **Semester:** Even

Prerequisite: None
Course Type ☒ Theory ☐ Laboratory work ☐ Project work ☐ Viva Voce
Motivation Design systems-level experiments using appropriate cutting-edge techniques, collect big data, and analyze and interpret small and big data sets quantitatively.

Course Objective:
The Systems Biology course covers the concepts and methodologies used in systems-level analysis of biomedical systems. Students will learn how to use experimental, computational and mathematical methods in systems biology and how to design practical systems-level frameworks to address questions in a variety of biomedical fields.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	Design, execution and interpretation of multivariable experiments that produce large data sets; quantitative reasoning, models and simulations.	**Design/development of solutions** (PO3)	Cognitive domain – level 5	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☐ Class Test ☒ Final Exam ☒ Assignment ☒ Participation ☐ Presentation
CO2	Demonstrate "how" cell- level functions arise and "why" mechanistic knowledge allows us to predict cellular behaviors leading to disease states and drug responses.	**Design/development of solutions** (PO3)	Cognitive domain – level 4	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ Class Test ☐ Final Exam ☐ Assignment ☒ Participation ☒ Presentation

Assessment and Marks Distribution:
Students will be assessed on the basis of their overall performance in all the exams, class tests, assignments, and class participation. Final numeric reward will be the compilation of:

Class tests + Assignments due in different times of the semester (20%)
A comprehensive final exam (70%), Total Time: 3 hours.
A class participation mark (10%).

Course Contents:
Systems Level Reasoning: Overview of Systems Level Reasoning & Molecules to Pathways, Systems Level Reasoning, Molecules to Pathways - cAMP and G Protein Pathways

Pathways to Networks | Physical Forces and Electrical Activity in Cell Biology: Pathways to Networks - MAP-kinase Pathways/Network, Mechanical Forces in Cell Biology, Electrical Activity in Cell Biology. Mathematical Representations of Cell Biological Systems | Simulations of Cell Biological Systems: Mathematical Representations of Cell Biological Systems, Simulations of Cell Biological Systems

Experimental Technologies | Network Building and Analysis: Experimental Technologies, Analyzing Large Data Sets, Network Building/Analysis and Data Organization, Building Networks. Analysis of Networks | Topology to Function: Analysis of Networks, From Topology to Function: Directed Sign Specified Graphs

Strengths and Limitations of Different Types of Models | Identifying Emergent Properties: Strengths and Limitations of Different Types of Models, Identifying Emergent Properties: Biostability

Emergent Properties: Ultrasensitivity and Robustness | Case Studies: Ultrasensitivity, Robustness and Scaffolds Case Studies | Systems Biomedicine | Systems Pharmacology and Therapeutics | Perspective: Systems

Biomedicine, Systems Pharmacology and Therapeutics, Perspective

Experimental Methods in Systems Biology: Scope and Overview, Biological Model Systems, Experimental Perturbations, Measuring Nucleic Acids, Measuring Protein and Protein States. Deep mRNA Sequencing: History of Sequencing, 2nd and 3rd Generation Sequencing, Illumina-Based mRNA Sequencing, mRNA Sequencing Data Analysis

Mass Spectrometry-Based Proteomics: Basics of Mass Spectrometry, Quantification in Proteomics, Proteomics Flow and Mass Cytometry for Single Cell Protein Levels and Cell Fate: Flow Cytometry, Mass Cytometry, Cytometry Data Analysis

Live-cell Imaging for Single Cell Protein Dynamics: Fluorescence Microscopy, Types of Imaging, Visualizing Molecules in Living Cells: Fluorescent Tools, Quantification. Integrating and Interpreting Datasets with Network Models and Dynamical Models: Omics data and Network Model Analyses, Single Cell Time Course Data and Dynamical Model Analyses, Dynamical Model Case Study

Text Book:

1. Mariano Bizzarri : **Systems Biology,** *Humana Press*

Books Recommended:

1. Uri Alon : **An Introduction to Systems Biology: Design Principles of Biological Circuits**, *CRC Press*
2.. Fabricio Alves Barbosa da Silva, Nicolas Carels, Floriano Paes Silva Junior **Theoretical and Applied Aspects of Systems Biology**, *Springer International Publishing*
3. Tao Huang **Computational Systems Biology,** *Springer New York;Humana Press*

CSE4282: Systems Biology Lab
Credits: 1 **Contact Hours:** 26
Year: Four **Semester:** Even

Prerequisite: None
Course Type ☐ Theory ☒ Laboratory work ☐ Project work ☐ Viva Voce
Motivation Gain practical systems-level experiments using appropriate cutting-edge techniques, collect big data, and analyze and interpret small and big data sets quantitatively.

Course Objective:
The Systems Biology lab covers implementation of the concepts and methodologies used in systems-level analysis of biomedical systems. Students will learn how to use experimental, computational and mathematical methods in systems biology and how to design practical systems-level frameworks to address questions in a variety of biomedical fields.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Delivery methods and activities	Assessment tools
CO1	To **design**, execution and interpretation of multivariable experiments that produce large data sets	**Design/development of solutions** (PO3)	Cognitive domain – level 5	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation
CO2	To **demonstrate** "how" cell- level functions arise and "why" mechanistic knowledge allows us to predict cellular behaviors	**Design/development of solutions** (PO3)	Cognitive domain – level 4	☒ Lecture Note ☐ Text Book ☒ Audio/Video ☒ Web Material ☐ Journal paper	☒ CA ☒ Final Exam ☒ Assignment ☒ Note book ☒ Presentation

Assessment and Marks Distribution:

Continuous Assessments (CA) (20%)
A comprehensive final exam + Lab note book (70%)
A class participation mark (10%).

Course Contents:

1. Mathematical Representations of Cell Biological Systems | Simulations of Cell Biological Systems
2. Experimental Technologies | Network Building and Analysis
3. Emergent Properties: Ultrasensitivity and Robustness | Case Studies
4. mRNA Sequencing Data Analysis
5. Proteomics Analysis
6. Flow Cytometry – Acquisition, Analysis
7. Mass Cytometry
8. Genes2Networks and Network Visualization
9. Functional Association Networks with Sets2Networks
10. Functional Association Networks with Genes2FANs
11. The Fisher Exact Test and Enrichr
12. Gene Set Enrichment Analysis (GSEA)
13. Principal Angle Enrichment Analysis (PAEA)
14. GATE and Network2Canvas
15. RNA-seq STAR

CSE 4280: Board Viva-Voce

Credits: 2
Year: Fourth **Semester:** Even

Prerequisite: None
Course Type ☐ Theory ☐ Laboratory work ☐ Project work ☒ Viva Voce
Motivation To develop practical oral presentation skills to face viva voce.

Course Objective:

This lab course is designed for the students to achieve their skills about to face viva voce to produce their academic knowledge in their professional life. The students will be able to communicate effectively complex computer science and engineering activities with the engineering community and with society at large in oral form.

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Assessment tools
CO1	To **communicate** effectively in professional life.	**Communication** (P10)	Viva voce

Assessment :

The Board viva-voce will be conducted by the Examination Committee.

CSE4292: Thesis/Project (Part-II)

Credits: 2 Contact **Hours: 52**
Year: Fourth **Semester:** Even

Prerequisite: None
Course Type ☐ Theory ☐ Laboratory work ☒ Project work ☒ Viva Voce
Motivation To design a develop a project from their knowledge they have acquired from their undergraduate program

Course Objective:

This course is a continuation of the course CSE 4192 (Part- I) from the odd semester Part- IV. A student has to complete the defended project proposal, submit it by the end of the semester and make an oral defense of the project., this course is designed for the students to achieve their skills function effectively as an individual and as a member or leader of diverse teams and in multidisciplinary settings

Course Outcomes (COs), Program Outcomes (POs) and Assessment:

CO No.	CO Statement	Corresponding PO	Domain / level of learning taxonomy	Assessment tools
CO1	To **Construct** a real world project based on their acquired knowledge	**Individual work and teamwork** (P09)	Cognitive domain – level 1	☐ CA ☒ Project presentation ☐ Assignment ☒ Project paper ☒ Oral Presentation

Assessment:

50 Marks (35% Internal Examiner, 35% External Examiner, 30% Presentation and Oral).