# Bangladesh Agricultural University


## Curricula and Course Profile

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## Bachelor of Science in Bioinformatics Engineering

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## Faculty of Agricultural Engineering and Technology

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# General Information

**Vision**

To produce graduates in the field of Bioinformatics engineering to serve the country and abroad towards excellence in computer science and biological research by empowering ICT in agriculture and by supporting advancement in mechanization of agricultural processes, ensuring food safety and security, drug discovery, reducing mortality rate, cutting-edge disease control and molecular level research.

**Mission**

To produce world class Bioinformatics engineers through quality teaching, research and technopreneurship.

**Program Educational Objectives**

- A strong foundation in computer science and engineering and biological science in readiness for a future professional development.
- Skills in the use and application of relevant tools and techniques.
- Effective interpersonal and communication skills.
- Awareness of professional and social responsibilities.

**Program Outcomes (PO)**

Engineering graduates develop a range of skills and attributes with the capability in applying the knowledge at different situations:

**PO-1:** Students understand the nature, practice and apply the science and engineering knowledge acquired in at least one specialized area of science and engineering in an advanced level.

**PO-2:** Students acquire disciplines from personality development to individuality in their career option.

**PO-3:** Effective communication would be developed in both oral and visual presentations as well as basic mannerism in behavior with the society would be developed.

**PO-4:** Capable to collect, organize, analyze and interpret data in a meaningful way and potentiality to develop an efficient and quantitative literacy.

**PO-5:** Proficient in using a range of sources in order to attain the desired information and be clever in evaluating the quality of information obtained to enhance the work.

**PO-6:** Critical thinking of a student would be developed and their intelligence quotient (IQ) will be expanded therefore to apply the acquired knowledge in analyzing, facing challenges posed and even to find effective solutions.

**PO-7:** Awareness in regard to ethical, social, occupational, health and safety issues will be developed and build up a strong intellect in appreciating the role of science in society.

**PO-8:** Skills for self-esteem in their own performance and managing ability to carry out a task in collaborations, in individual efficiency as well as in team.

**Program Learning Outcomes (PLO)**

**PLO-1:** The primary goal is to make the students to understand the basics of computer, information and communication technology (ICT), and the principles of programming languages.

**PLO-2:** To acquire knowledge on basic biological concepts.

**PLO-3:** To gain knowledge on mathematical and statistical methodologies for modeling and solving real world bioinformatics problems.

**PLO-4:** To understand the levels of programming language and its application in various fields of biology.

**PLO-5:** To be well versed in handling the biological data from the different database available online at present.

**PLO-6:** To obtain the knowledge on basics in designing the webpage for a database as well as online tools and software.

**PLO-7:** To obtain a basic knowledge about various fields of science and engineering.

**PLO-8:** To understand the professional, ethical and social responsibilities.

**PLO-9:** To develop effective communication skills.

**PLO-10:** To design, implement, and evaluate a computer-based system, process, component, or program for modeling and solving real world bioinformatics problems.

# Curriculum Structure

**Table 1: Course Distribution for B.Sc. Bioinformatics Engineering Degree Program**

| Course Types | Theory | Lab | Total |
|---|---|---|---|
| Core | 46 | 32 | 78 |
| Elective | 8 | 5 | 13 |
| **Total** | **54** | **37** | **91** |

**Table 2: Semester wise Courses and Credits Distribution Summary**

| Level | Semester | Theory courses (credits) | Lab courses (credits) | Total Courses (Credits) |
|---|---|---|---|---|
| 1 | 1 | 8 (16) | 3 (3) | 11 (19) |
| | 2 | 7 (16) | 4 (4) | 11 (20) |
| 2 | 1 | 7 (14) | 4 (4) | 11 (18) |
| | 2 | 7 (15) | 3 (3) | 10 (18) |
| 3 | 1 | 8 (16) | 5 (5) | 13 (21) |
| | 2 | 7 (14) | 5 (5) | 12 (19) |
| 4 | 1 | 6 (12) | 6 (6) | 12 (18) |
| | 2 | 4 (8) | 7 (9) | 11 (17) |
| **Total** | | **54 (111)** | **37 (39)** | **91 (150)** |

**Table 3: Domain Wise Credit distribution**

| Domains | Theory | Lab | Total | % |
|---|---|---|---|---|
| Computer Science & Engineering | 34 | 17 | 51 | 34% |
| Agricultural Science | 18 | 6 | 24 | 16% |
| Basic Science | 24 | 1 | 25 | 17% |
| Other Engineering | 12 | 4 | 16 | 11% |
| Humanities | 8 | 0 | 8 | 5% |
| Elective Courses | 15 | 6 | 21 | 14% |
| Project and Training | - | 5 | 5 | 3% |
| **Total** | 111 | 39 | 150 | 100% |

**Table 4: Faculty Wise Credit Distribution**

| Faculty/ Elective | Compulsory | Elective |
|---|---|---|
| Veterinary Science (DVM) | 5 | 3 |
| Agriculture (Ag) | 26 | 14 |
| Agricultural Economics & Rural Sociology (AERS) | 10 | 2 |
| Agricultural Engineering & Technology (AET) | 88 | 55 |
| Fisheries (Fish) | 0 | 4 |
| Elective | 21 | 0 |

**Table 5: Department Wise Credit Distribution**

| Faculty | Department | Area | Compulsory | Elective |
|---|---|---|---|---|
| DVM | Microbiology & Hygiene (VMH) | | 3 | |
| | Physiology (VPHY) | | | 3 |
| | Pharmacology (VPHA) | | 2 | |
| Ag | Agronomy (AGRON) | | | 2 |
| | Soil Science (SS) | | | 2 |
| | Crop Botany (CBOT) | | 3 | |
| | Genetics & Plant Breeding (GPB) | | 6 | 2 |
| | Agricultural Chemistry (ACHEM) | | 2 | |
| | Biochemistry & Molecular Biology (BMB) | | 6 | 4 |
| | Physics (PHY) | | 3 | |
| | Languages (LAN) | | 2 | |
| | Biotechnology (BTECH) | | 4 | 3 |
| AERS | Agricultural Economics (AE) | | 4 | |
| | Agricultural Statistics (STAT) | | 4 | |
| | Agribusiness and Marketing (AM) | | | 2 |
| | Rural Sociology (RS) | | 2 | |
| AET | Farm Structure & Environmental Engineering (FSEE) | | 4 | 2 |
| | Farm Power & Machinery (FPM) | | 5 | 3 |
| | Irrigation & Water Management (IWM) | | 5 | 3 |
| | Food Technology & Rural Industries (FTRI) | | 2 | 4 |
| | Computer Science & Mathematics (CSM) | CSE* | 51 | 43 |
| | | Mathematics | 16 | |
| | | Project & training | 5 | |
| Fish | Fisheries Biology and Genetics (FBG) | | | 2 |
| | Aquaculture (AQ) | | | 2 |
| | | Elective | 21 | |
| | | **Total** | **150** | |

* Computer Science and Engineering

**Marks Distribution**

Each course, theoretical or practical, irrespective of credit hours shall be evaluated on 100 marks in assigning letter grade and grade points.

Marks for class attendance shall be on percentage as:

| Marks Distribution | |
|---|---|
| (i) Class attendance | 10 |
| (ii) Class test(s) | 20 |
| (iii) Final examination | 70 |
| **Total** | **100** |

| Class attendance | Marks |
|---|---|
| 100% | 10 |
| 90% to 99% | 9 |
| 80% to 89% | 8 |
| 70% to 79% | 7 |
| 60% to 69% | 6 |
| Less than 60% | 0 |

**Grading of Result**

| Numerical Grade | Letter Grade | | Grade Point |
|---|---|---|---|
| 80% and above | A+ | (A Plus) | 4.00 |
| 75% to less than 80% | A | (A regular) | 3.75 |
| 70% to less than 75% | A- | (A minus) | 3.50 |
| 65% to less than 70% | B+ | (B Plus) | 3.25 |
| 60% to less than 65% | B | (B regular) | 3.00 |
| 55% to less than 60% | B- | (B minus) | 2.75 |
| 50% to less than 55% | C+ | (C plus) | 2.50 |
| 45% to less than 50% | C | (C regular) | 2.25 |
| 40% to less than 45% | D | | 2.00 |
| Less than 40% | F | (Fail) | 0.00 |

Finally, the results are shown on GPA and CGPA basis. The basis of GPA and CGPA are as follows:

Grade Point Average, GPA = $\frac{\sum C_i G_i}{\sum C_i}$

Cumulative Grade Point Average, CGPA = $\frac{\sum (GPA_i \times TC_i)}{\sum TC_i}$

Where,

$C_i$=Credit earned of respective courses

$G_i$=Grade Point obtained in individual courses

$GPA_i$= Grade Point Average obtained in individual courses(s) passed/completed semesters earned

$TC_i$=Total credit earned in respective semesters

$\sum$ = Sum of

**Academic Calendar**

Academic calendar followed in a Semester for B.Sc. Bioinformatics Engineering Degree Program

| Level | Semester | Activities | Schedule |
|---|---|---|---|
| 1 | 1 | Fresher's orientation | 1st week, Day-1 |
| | | Commencement of Class | 1st week, Day-2 |
| | | Dropping out due to absence | 3rd week, Day-1 |
| | | Class test | 10th week |
| | | Class suspension | At the end of 16th week |
| | | Preparatory recess | 16-17th week |
| | | Final Examination | 19- 22th week * |
| | | Publication of result | At the end of 24th week |
| 1 | 2 | Commencement of Class | 1st week, Day-1 |
| 2 | 1 & 2 | Class test | As in Level-1, Semester-1 |
| 3 | 1 & 2 | Class suspension | |
| 4 | 1 & 2 | Preparatory recess | |
| | | Final Examination | |
| | | Publication of result | |
| | | Study Tour** | |

*Decided by the Faculty Committee

**Any suitable time as decided by the Dean, usually in first semester in Level-4

**Study Tour**

At level-3, semester-2 or level-4, semester-1, the students are required to go for a study tour in different areas or locations of Bangladesh for a period of two weeks. During the tour, the students are facilitated to visit different institutes, industries and historical places with the guidance of senior teachers of the faculty. Apart from this, there are also provisions for visits in different semesters as a part of syllabus of individual courses. These programmes vary in length and time depending upon the decisions taken by the course offering department(s).

**ICT Industrial Attachment**

The students undertake practical training in different local and/or foreign at home and/or abroad ICT industries (or ICT based industries) for a period of 45 days in software developing on real world problems assigned by the concerned ICT industries (or ICT based industries). Students are required to submit reports after completion of the training in the ICT industries (or ICT based industries).

**Dean's List and Award**

Names of students having GPA of Top 3 percent (decimal will be considered as full number) amongst the students passed in a level (academic year) will be included in the Dean's list published every year in recognition of their outstanding performances with provisions of free studentships and special merit scholarships tenable for twelve months. A student with record of "repeat" results and misconduct will not be considered for this merit award.

# Curricula Layout for B. Sc. in Bioinformatics Engineering

## Level-1, Semester-1

| Course No. | Course Title | Credits | Contact Hours | PLO Mapping |
|---|---|---|---|---|
| ACHEM 1109 | Chemistry | 2 | 2 | 2,7 |
| AE 1107 | History of the Emergence of Independent Bangladesh | 2 | 2 | 8,9 |
| BMB 1105 | Biochemistry and Molecular Biology | 2 | 2 | 2,7 |
| BMB 1106 | Biochemistry and Molecular Biology | 1 | 2 | 2,7 |
| CSM 1121 | Introduction to Computer Systems | 2 | 2 | 1,6,10 |
| CSM 1122 | Introduction to Computer Systems | 1 | 2 | 1,6,10 |
| CSM 1123 | Structured Programming Language | 2 | 2 | 1,3,4,10 |
| CSM 1124 | Structured Programming Language | 1 | 2 | 1,3,4,10 |
| CSM 1125 | Coordinate Geometry and Vector | 3 | 3 | 3,7,10 |
| GPB 1101 | Cell Biology and Genetics | 2 | 2 | 2,7 |
| LAN 1105 | Communicative English | 1 | 1 | 8,9 |
| | **Total** | **19** | **22** | |

## Level-1, Semester-2

| Course No. | Course Title | Credits | Contact Hours | PLO Mapping |
|---|---|---|---|---|
| CSM 1221 | Object Oriented Programming Language | 2 | 2 | 1,3,4,10 |
| CSM 1222 | Object Oriented Programming Language | 1 | 2 | 1,3,4,10 |
| CSM 1223 | Calculus and Matrices | 3 | 3 | 3,7 |
| FPM 1261 | Electrical and Electronics Engineering | 2 | 2 | 3,7,10 |
| FPM 1262 | Electrical and Electronics Engineering | 1 | 2 | 3,7,10, |
| FSEE 1206 | Engineering Drawing | 1 | 2 | 7 |
| FTRI 1203 | Biochemical Engineering | 2 | 2 | 2,3,7 |
| GPB 1201 | Molecular Genetics | 2 | 2 | 2,7 |
| LAN 1206 | Communicative English | 1 | 2 | 8,9 |
| PHY 1201 | Physics | 3 | 3 | 7 |
| | Total | **18** | **22** | |

## Level-2, Semester-1

| Course No. | Course Title | Credits | Contact Hours | PLO Mapping |
|---|---|---|---|---|
| CSM 2121 | Data Structures | 2 | 2 | 1,3,4,5,10 |
| CSM 2122 | Data Structures | 1 | 2 | 1,3,4,5,10 |
| CSM 2123 | Digital Logic Design | 2 | 2 | 1,7,10 |
| CSM 2124 | Digital Logic Design | 1 | 2 | 1,7,10 |
| CSM 2125 | Database Management System | 2 | 2 | 1,5,6,10 |
| CSM 2126 | Database Management System | 1 | 2 | 1,5,6,10 |
| CSM 2127 | Discrete Mathematics | 2 | 2 | 1,3,7,10 |
| CSM 2129 | Differential Equations | 2 | 2 | 3,7 |
| RS 2101 | Sociology of Technology and Innovation | 2 | 2 | 7,8,9 |
| VMH 2103 | Basic Microbiology and Immunology | 2 | 2 | 2,4,7 |
| VMH 2104 | Basic Microbiology and Immunology | 1 | 2 | 2,4,7 |
| | **Total** | **18** | **23** | |

## Level-2, Semester-2

| Course No. | Course Title | Credits | Contact Hours | PLO Mapping |
|---|---|---|---|---|
| AAS 2207 | Biostatistics | 3 | 3 | 3,5,7,8 |
| AAS 2208 | Biostatistics | 1 | 2 | 3,5,7,8 |
| AE 2205 | Introductory Economics | 2 | 2 | 7,8,9 |
| CSM 2221 | Bioinformatics Algorithms | 2 | 2 | 1,3,4,6,10 |
| CSM 2222 | Bioinformatics Algorithms | 1 | 2 | 1,3,4,6,10 |
| CSM 2224 | Internet Programming | 1 | 2 | 1,6,10 |
| CSM 2225 | Numerical Methods | 2 | 2 | 3,7 |
| CSM 2229 | Linear Algebra and Complex Variables | 2 | 2 | 3,7 |
| CSM 2231 | Computer Architecture | 2 | 2 | 1,10 |
| GPB 2203 | Genomics and Proteomics | 2 | 2 | 2,7 |
| IWM 2203 | Agricultural Meteorology | 2 | 2 | 2,5,7,10 |
| | **Total** | **20** | **23** | |

## Level-3, Semester-1

| Course No. | Course Title | Credits | Contact Hours | PLO Mapping |
|---|---|---|---|---|
| CBOT 3101 | System Biology | 2 | 2 | 2,7 |
| CBOT 3102 | System Biology | 1 | 2 | 2,7 |
| CSM 3121 | Systems and Software Engineering | 2 | 2 | 1,3,6,10 |
| CSM 3122 | Systems and Software Engineering | 1 | 2 | 1,3,6,10 |
| CSM 3123 | Computer Graphics | 2 | 2 | 1,4,6,10 |
| CSM 3124 | Computer Graphics | 1 | 2 | 1,4,6,10 |
| CSM 3125 | Theory of Computation | 2 | 2 | 1,3,4,10 |
| CSM 3127 | Laplace Transformation and Fourier Series | 2 | 2 | 3,7 |
| FSEE 3107 | Environmental Impact Assessment | 2 | 2 | 2,8 |
| FSEE 3108 | Environmental Impact Assessment | 1 | 2 | 2,8 |
| VPHA 3103 | Molecular Modeling and Drug Designing | 2 | 2 | 2,7 |
| | 3 credits from the following elective courses | 3 | 4 | |
| | **Total** | **21** | **26** | |

## Elective Courses

| Course No. | Course Title | Credits | Contact Hours | PLO Mapping |
|---|---|---|---|---|
| AQ 3107 | Applied Aquaculture | 2 | 2 | 2,7 |
| CSM 3129 | Network and Telecommunication | 2 | 2 | 1,6,10 |
| CSM 3130 | Network and Telecommunication | 1 | 2 | 1,6,10 |
| CSM 3132 | Python Programming | 1 | 2 | 1,3,4,10 |
| FBG 3105 | Fish Genetics and Informatics | 2 | 2 | 2,7 |
| VPHY 3109 | Animal Cell Physiology | 2 | 2 | 2,7 |
| VPHY 3110 | Animal Cell Physiology | 1 | 2 | 2,7 |

## Level-3, Semester-2

| Course No. | Course Title | Credits | Contact Hours | PLO Mapping |
|---|---|---|---|---|
| BMB 3203 | Biological Informatics | 2 | 2 | 2,3,4,7 |
| BMB 3204 | Biological Informatics | 1 | 2 | 2,3,4,7 |
| CSM 3221 | Compiler | 2 | 2 | 1,4,10 |
| CSM 3222 | Compiler | 1 | 2 | 1,4,10 |
| CSM 3223 | Artificial Intelligence | 2 | 2 | 1,3,4,10 |
| CSM 3224 | Artificial Intelligence | 1 | 2 | 1,3,4,10 |
| CSM 3225 | Microprocessor and Embedded System | 2 | 2 | 1,3,10 |
| CSM 3226 | Microprocessor and Embedded System | 1 | 2 | 1,3,10 |
| CSM 3227 | Digital Image Processing | 2 | 2 | 1,4,5,10 |
| CSM 3228 | Digital Image Processing | 1 | 2 | 1,4,5,10 |
| | 4 credits from the following elective courses | 4 | 4 | |
| | **Total** | **19** | **24** | |

| Elective Courses | | | | |
|---|---|---|---|---|
| **Course No.** | **Course Title** | **Credits** | **Contact Hours** | **PLO Mapping** |
| AGRON 3205 | Field Crop Production | 2 | 2 | 2,7 |
| BMB 3201 | Enzymes and Metabolism | 2 | 2 | 2,3,7 |
| CSM 3229 | Parallel and Distributed Systems | 2 | 2 | 1,3,4,10 |
| CSM 3231 | E-commerce | 2 | 2 | 1,3,4,10 |
| CSM 3233 | Computer Peripherals and Interfacing | 2 | 2 | 1,3,4,10 |
| CSM 3235 | Internet of Things | 2 | 2 | 1,3,4,10 |
| CSM 3237 | Operating Systems | 2 | 2 | 1,3,4,10 |
| CSM 3239 | Computer and Network Security | 2 | 2 | 1,3,4,10 |
| CSM 3242 | Apps Development | 1 | 2 | 1,3,4,10 |
| FSEE 3213 | Surveying | 1 | 1 | 7 |
| FSEE 3214 | Surveying | 1 | 2 | 7 |
| FTRI 3213 | Food Science and Nutrition | 2 | 2 | 2 |
| FTRI 3215 | Computation in Food Quality and Safety | 2 | 2 | 2,5 |
| GPB 3203 | Organism and Evolutionary Biology | 2 | 2 | 2,7 |
| IWM 3223 | Fluid Mechanics | 2 | 2 | 2,7 |
| IWM 3224 | Fluid Mechanics | 1 | 2 | 2,7 |
| SS 3203 | Soil Informatics | 2 | 2 | 2,7 |
| SS 3204 | Soil Informatics | 1 | 2 | 2,7 |

## Level-4, Semester-1

| Course No. | Course Title | Credits | Contact Hours | PLO Mapping |
|---|---|---|---|---|
| BTECH 4101 | Bioinformatics Methods and Applications | 2 | 2 | 2,5,7,9,10 |
| BTECH 4102 | Bioinformatics Methods and Applications | 1 | 2 | 2,5,7,9,10 |
| CSM 4121 | Machine Learning | 2 | 2 | 1,3,4,5,10 |
| CSM 4122 | Machine Learning | 1 | 2 | 1,3,4,5,10 |
| CSM 4124 | Computer Aided Design | 1 | 2 | 1,10 |
| CSM 4130 | Proposal Writing and Seminar | 1 | 2 | 1,8,9,10 |
| FPM 4161 | Engineering Management | 2 | 2 | 8,9 |
| IWM 4119 | GIS and Remote Sensing | 2 | 2 | 1,3,5,7,10 |
| IWM 4120 | GIS and Remote Sensing | 1 | 2 | 1,3,5,7,10 |
| | 5 credits from the following elective courses | 5 | 6 | |
| | **Total** | **18** | **24** | |

| Elective courses | | | | |
|---|---|---|---|---|
| **Course No.** | **Course Title** | **Credits** | **Contact Hours** | **PLO Mapping** |
| AM 4123 | Financial and Managerial Accounting | 2 | 2 | 7,8,9 |
| BMB 4103 | Recombinant DNA Technology | 2 | 2 | 2,7 |
| BTECH 4103 | Genetic Engineering and Biotechnology | 2 | 2 | 2,7 |
| BTECH 4104 | Genetic Engineering and Biotechnology | 1 | 2 | 2,7 |
| CSM 4125 | Wireless Networks | 2 | 2 | 1,10 |
| CSM 4127 | Human Computer Interaction | 2 | 2 | 1,10 |
| CSM 4131 | Neural Networks and Fuzzy Systems | 2 | 2 | 1,4,10 |
| CSM 4134 | R Programming | 1 | 2 | 1,4,10 |
| CSM 4136 | Assembly Language Programming | 1 | 2 | 1,4,5,10 |
| CSM 4137 | Bioinformatics Databases | 2 | 2 | 3,5,6 |
| CSM 4138 | Bioinformatics Databases | 1 | 2 | 3,5,6 |

## Level-4, Semester-2

| Course No. | Course Title | Credits | Contact Hours | PLO Mapping |
|---|---|---|---|---|
| BTECH 4202 | Biological Sequence Analysis | 1 | 2 | 2,5,7,10 |
| CSM 4221 | Big Data Mining | 2 | 2 | 1,3,4,10 |
| CSM 4222 | Big Data Mining | 1 | 2 | 1,3,4,10 |
| CSM 4230 | Project Work and Report | 3 | 6 | 1,8,9,10 |
| CSM 4232 | ICT Industrial Attachment | 1 | - | 1,8,9,10 |
| | 9 credits from the following elective courses | 9 | 10 | |
| | **Total** | **17** | **22** | |

| Elective courses | | | | |
|---|---|---|---|---|
| **Course No.** | **Course Title** | **Credits** | **Contact Hours** | **PLO Mapping** |
| CSM 4223 | Robotics Systems | 2 | 2 | 1,4,10 |
| CSM 4224 | Robotics Systems | 1 | 2 | 1,4,10 |
| CSM 4225 | Object Oriented Design Patterns | 2 | 2 | 1,4,10 |
| CSM 4226 | Object Oriented Design Patterns | 1 | 2 | 1,4,10 |
| CSM 4228 | Perl, BioPerl and CGI Programming | 1 | 2 | 1,4,10 |
| CSM 4233 | Cloud Computing | 2 | 2 | 1,4,10 |
| CSM 4234 | Cloud Computing | 1 | 2 | 1,4,10 |
| CSM 4235 | Cyber Law and Information Security | 2 | 2 | 8,9 |
| CSM 4237 | Pattern Recognition | 2 | 2 | 1,4,10 |
| CSM 4238 | Pattern Recognition | 1 | 2 | 1,4,10 |
| FPM 4219 | Machine Vision | 2 | 2 | 1,4,6 |
| FPM 4220 | Machine Vision | 1 | 2 | 1,4,6 |

## Total number of credits required for the degree: 150

**Note: The odd and even numeric figures in the course code indicate theory courses and practical courses, respectively.**

# Detailed Syllabus

## Level- 1, Semester- 1

**Department of Agricultural Chemistry**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **ACHEM 1009 Chemistry** |
| Level & Semester | L-1, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course is designed to impart knowledge and skills on analytical, physical and organic chemistry.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Describe solubility products and solve electrochemical problems.
*CLO 2:* Explain pH, EC, buffer solutions, units of concentration, standard solutions and colloids.
*CLO 3:* Describe volumetric and instrumental methods for chemical analysis.
*CLO 4:* Explain nature, formation and mechanisms of chemical bonding and chemical reactions in organic compounds.
*CLO 5:* Illustrate stereochemistry, optical activity, racemic modification, specific rotation and application of organic compounds.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Electrochemistry:** Electrolytes and non-electrolytes, strong and weak electrolytes, electrolytic dissociation and conductance; ionic equilibrium, Ostwald's dilution law, solubility of electrolyte and non-electrolyte; solubility product; principles of precipitation; common ion effect. | CLO 1 | 3 |
| pH and buffer solution and its preparation. | CLO 2 | 1 |
| **Properties of solution:** Colligative properties, elevation of boiling point, depression of freezing point, osmosis and Raoult's law. | CLO 2 | 3 |
| **Colloids:** Preparation, properties, types and application of colloids. | CLO 2 | 4 |
| **Volumetric methods of analysis:** Types of substances; units of concentrations; preparation and properties of standard solution; types of reactions in volumetric analysis, acid-base and redox titrations; indicators - selection and theories. | CLO 3 | 3 |
| **Instrumental methods of analysis:** Principle, instrumentation and application of colorimetry and spectrophotometry, flame emission and atomic absorption spectrophotometry, mass spectrometry and chromatography. | CLO 3 | 3 |
| **Chemical bonding:** Bonding in organic compounds, polarity, formation and cleavage of covalent bonds. | CLO 4 | 3 |
| **Reaction mechanism:** Electrophilic and nucleophilic additions and substitutions, Cannizzaro reactions, aldol and Parkin condensation. | CLO 5 | 4 |
| **Stereochemistry:** Configuration and confirmation, optical and geometrical isomerism, cause of optical activity, racemic modification and specific rotation. Ring structure, mutarotation, epimer, anomer, inversion and conformation of organic compounds. | CLO 5 | 4 |
| **Chemistry and application of organic compounds:** Aromatic, heterocyclic, carbohydrate, organometallic and polynuclear compounds; carboxylic acid and their derivatives. | CLO 5 | 3 |
| **Class test** | | 1 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Bahl, B.S.; Tuli, G.D. and Bahl, A. 2010. Essentials of Physical Chemistry. S. Chand & Company Ltd., New Delhi. India.
- Bansal, R.K. 2016. A Textbook of Organic Chemistry. Revised 6$^{th}$edn., New Age International (P) Ltd., New Delhi. India.
- Christian G.D.;Dasgupta, P.K. and Schug, K.A. 2014. Analytical Chemistry 7$^{th}$edn., John Wiley & Sons, Inc.
- Morison, R.T. and Boyd, R.N. 2014. A Text Book of Organic Chemistry. 7$^{th}$edn., Dorling Kindersley (India) Pvt. Ltd., New Delhi, India.
- Skoog, D.A.; West, D.M.; Holler, F.J. and Crouch S.R. 2014. Fundamentals of Analytical Chemistry. 9$^{th}$edn., Harcourt Asia Pvt. Ltd., Singapore.
- Stanforth, S. 2006. Natural Product Chemistry at a Glance. Blackwell Publishers, USA.
- Vollhardt, K.P.C. and Schore, N.E. 2014. Organic Chemistry: Structure and Function 7$^{th}$edn., W.H. Freeman and Company. New York.

**Department of Agricultural Economics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **AE 1107 History of the Emergence of Independent Bangladesh** |
| Level & Semester | L-1, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

This course has been designed to help the students in obtaining comprehensive idea about the history, culture and heritage of Bangladesh. It will introduce students with economy, society, politics, diplomacy and foreign policy of Bangladesh. Students will learn about the challenges and potentials of Bangladesh in shaping its peaceful and sustainable future. It will also assist the students in assessing roles and contribution of Bangladesh in the regional and international bodies which are dedicated to establish world peace.

**Course Learning Outcome (CLO)**

Upon completion of this course, the student will be able to:

*CLO 1:* Demonstrate a basic knowledge of rich history, culture and heritage of Bangladesh.
*CLO 2:* Gain in-depth knowledge on the major political events that shaped Bangladesh as an independent sovereign state.
*CLO 3:* Understand political, economic, social and technological development of Bangladesh.
*CLO 4:* Think critically and comprehensively about foreign policy of Bangladesh, its relationship with other countries.
*CLO 5:* Understand the challenges and potentials of Bangladesh in shaping its peaceful and sustainable development.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | | √ | √ | |
| *CLO 2* | | | | | | | | √ | √ | |
| *CLO 3* | | | | | | | | √ | √ | |
| *CLO 4* | | | | | | | | √ | √ | |
| *CLO 5* | | | | | | | | √ | √ | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Ancient Period and Muslim Period of Bengal; British Period; Pakistan Period. | CLO 1<br>CLO 2 | 6 |
| The Problem of National Integration Under Ayub Regime; Elite in Crisis During Pakistan Rule; Nation-Building in the New State; The Ideals and Philosophy of Constitution-Making of Bangladesh. | CLO 1<br>CLO 2 | 10 |
| Sectoral Contribution of Bangladesh Economic Development: Agriculture, Industry, Service sector; The Role of ICT in economic development in Bangladesh. | CLO 3<br>CLO 5 | 4 |
| Internal Trade and External Trade; Good Governance and contemporary Issues of Governance in Bangladesh. | CLO 3<br>CLO 4<br>CLO 5 | 4 |
| Environmental Hazards; Environmental Challenges of Bangladesh; mitigation and adaptation steps of the Fragile Environment of Bangladesh for Agricultural development. | CLO 3<br>CLO 4<br>CLO 5 | 4 |
| Bangladesh Foreign Policy: Realities and Challenges; Foreign Policy-Decision-Making Process in Bangladesh. | CLO 4 | 4 |

**Teaching Strategy**

Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**

Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- M. Shamsul Huq (1995): “Bangladesh in International Politics”. University Press Limited, Bangladesh.
- Rounaq Jahan (2005): “Bangladesh Politics: Problems and Issues”. University Press Limited, Bangladesh.
- Md. Abdul Halim (2010): “Constitution, Constitutional Law and Politics: Bangladesh Perspective”. CCB Foundation, Dhaka-1000.
- Dr. Mohammad Johurul Islam and Syed Sarfaraj Hamid: “Alleviating Corruption in Bangladesh: An Agenda for Good Governance”. Human Rights and Corruption, Empowerment through Law of the People (ELCOP), Dhaka-1205.
- A M A Muhith (1999): “Bangladesh in the Twenty-First Century: Towards an Industrial Society”. the University Press Limited, Dhaka-1000, Bangladesh.
- Haroun er Rashid (2005): “Economic Geography of Bangladesh”. University Press Limited, Bangladesh.
- Abul Barkat (2013): “Political Economy of Fundamentalism in Bangladesh”.
- Bertil Litner (2003): “The Plight of Ethnic and Religious Minorities and the Rise of Islamic Extremism in Bangladesh”. Asia Pacific Media Service.
- Tariq Karim and C. Christine Fair (2007): “Bangladesh at the Crossroads”. US Institute of Peace.
- G.H. Peiris (1998): “Political Conflict in Bangladesh”. Ethnic Studies Report, Vol. XVI, No. 1.
- K. B. Sajjadur Rashid (2008): “Bangladesh: Resources and Environmental Profile”. Dhaka-1205.
- Zaglul Haider (2008): “The Changing Pattern of Bangladesh Foreign Policy: A Comparative Study of Mujib and Zia Regimes”. The University Press Limited, Dhaka-1000, Bangladesh.
- Bayes Abdul (2012): “Bangladesh at 40: Changes and Challenges”, A H Development Publishing House, Dhaka, Bangladesh

**Department of Biochemistry and Molecular Biology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **BMB 1105 Biochemistry and Molecular Biology** |
| Level & Semester | L-1, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The students need to have a proper knowledge on the physical, chemical and molecular aspects of biomolecules for understanding molecular interplays in living systems.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

CLO1: Describe scope and importance of biochemistry and molecular biology in bioinformatics engineering.
CLO2: Explain biological functions, physical and chemical properties of biomolecules.
CLO3: Compare, contrast and interaction among various biomolecules in living system.
CLO4: Construct the structures of various biomolecules
CLO5: Construct recombinant DNA and clones for development of new variety.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Cell & Tissue:** Cell: Cell theory, Prokaryotic cells & Eukaryotic cells, Structure and functions of subcellular orgenelles. Membrane phenomena. Tissue: Types, structure and functions of animal tissues (Connective tissue, Muscle tissue, Nervous tissue, epithelial tissue, Mineralized tissue), plant tissues (Meristematic tissues & Permanent tissues). | CLO1 | 2 |
| **Carbohydrates & Nucleic acids:** Carbohydrates: Definition, classification, structure, properties, occurrence and biological importance of Monosaccharides, Disaccharides, Oligosaccharides, And Polysaccharides.<br>Nucleic acids: Types, structure, properties and function of nucleic acids, Deviation from Watson-Crick model, DNA as genetic material. concept of rDNA technology | CLO2, CLO3, CLO4, CLO5 | 8 |
| **Proteins & Amino Acids:** Amino acids: Definition, composition, structure, properties, stability and biological importance of Amino Acid, Formation of Peptide bond, Identification of C and N terminal residues of amino acids<br>Protein: Definition, classification, composition, structure, properties, occurrence and biological importance of Protein.<br>**Techniques for separation, isolation and characterization of proteins:** Electrophoresis – Basic techniques of Electrophoresis, Types, Working & Application, Advantages and disadvantages. Centrifugation - Basic principles, Types, Molecular weight determination & Application, Advantages and disadvantages. Chromatography- Overview of Centrifugation, Types, Principles, Working & Application, Advantages and disadvantages. | CLO2, CLO3, CLO4 | 6 |
| **Lipids:** classification and function. Lipids as membrane constituent. | CLO2, CLO3, CLO4 | 6 |
| **Vitamins and Minerals:** Source, classification and biochemical function. | CLO2, CLO3, CLO4 | 4 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- B. Albert, A. Johnson, J. Lewis, M. Raff, D. Bray, K. Hopkin, K. Roberts and P. Walter (2003): "Essential Cell Biology", 2nd edition or later. Taylor & Francis Group, USA.
- T.M. Devlin (2002): "Textbook of Biochemistry", 5th edition or later. John Wiley and Sons, Inc. USA.
- H. Lodish, A. Berk, C. A. Kaiser, M. Krieger, A. Bretscher, H. Ploegh and K. C. Martin (2016): "Molecular Cell Biology", 8th edition or later. W. H. Freeman and company, New York.
- D. L. Nelson and M. M. Michael (2017): "Lehninger Principles of Biochemistry", 7th edition or later. W. H. freeman and company. New York.
- L. Stryer (1995): "Biochemistry", 4th edition or later. W. H. freeman and company. New York.
- D. Voet and J. G. Voet, J.G. (1995): Biochemistry, 2nd edition or later. John Wiley and Sons, New York.

**Department of Biochemistry and Molecular Biology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **BMB 1106 Biochemistry and Molecular Biology** |
| Level & Semester | L-1, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course will develop the practical skill on various biochemical methods so that the students can use their acquired lab skill for various biochemical researches.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

CLO1: Prepare various types of solutions
CLO2: Identify biomolecules from biological samples
CLO3: Analyze moisture, fat, crude fiber and ash from biological samples
CLO4: Extract and estimate starch vitamin, and DNA.
CLO5: Explore sophisticated biochemical techniques in different laboratories.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Preparation of solutions and their standardization | CLO1 | 1 |
| Qualitative analysis of carbohydrates and proteins | CLO1 | 4 |
| Quantification of carbohydrates and proteins | CLO2 | 3 |
| Quantitative analysis of enzymatic and non-enzymatic antioxidants | CLO4 | 2 |
| Extraction and estimation of DNA | CLO4 | 1 |
| Proximate analysis: Moisture, fat, crude fibre and ash | CLO3 | 1 |
| Biochemical and molecular laboratory visit | CLO5 | 1 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- An introduction to practical Biochemistry. Davit T. Plummer. Tata McGraw-Hill Publishing Company Limited, New Delhi, 1995.
- Biochemistry Laboratory Manual. F. M. Strong. WM.C. Brown Company Publishers, USA, 1965.
- Biochemistry Laboratory Techniques. Sterling Chaykin. Wiley Eastern Private Limited, New Delhi, 1970.
- Biochemical Calculations. How to Solve Mathematical Problem in General Biochemistry. Irwin H. Segel. John Wiley and Sons, Inc. New York, 1968.
- Experimental Biochemistry. A Laboratory Manual. Gerald Litwack. John Liley and Sons. Inc, New York, 1960.
- Official Methods of Analysis. Association of Official Analytical Chemists (AOAC), Washington D.C., 1990.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 1121 Introduction to Computer Systems** |
| Level & Semester | L-1, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to familiarize students with computer and its basic parts, different hardware devices, programming languages and web technologies. Acquaint the students with the usage of application and system software for document preparation, presentation and spreadsheet analysis. Prepare students for knowing both advantage and disadvantage of current programming languages and also make them familiar with web technologies.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire basic knowledge on history of computers and generations, basic parts of computers and its uses, and computer hardware.
- *CLO 2:* Understand the usage of number systems and their conversions.
- *CLO 3:* Use different types of software for document preparation, presentation and spreadsheet analysis.
- *CLO 4:* Compare and categorize different types of programming languages.
- *CLO 5:* Develop a website using various web technologies.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | √ |
| *CLO 2* | √ | | | | | √ | | | | √ |
| *CLO 3* | √ | | | | | √ | | | | √ |
| *CLO 4* | √ | | | | | √ | | | | √ |
| *CLO 5* | √ | | | | | √ | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to Computers:**<br>From a Key Press to Display, Hardware, Software, Operating System, Microprocessor, Memory Overview, File and File System. Input-Output Devices. | CLO 1 | 4 |
| **Computer Hardware and Software:**<br>Hardware – Types – Working methods, Introduction to Computer Memory – RAM, ROM, Storage Types, Cache and Register.<br>Software – System software and application software – Basic Text Editor (gedit, Notepad), Document Processing, Spreadsheet, Presentation, Database, Mathematical Analysis, Simulation, Image and Video Editing, Games etc. | CLO 1, CLO 3 | 6 |
| **Number System:**<br>Concept of Bit, Electronic Representation of Bits. Bit- Array: Byte, Word, Double Word. Binary – to- Decimal Conversion, Binary Arithmetic, Bit- Shifting, Logic Representation (1-Bit, Bit- Array). Hexadecimal Arithmetic up to 32- Bit Array Representation. Conversion between Binary, Hexadecimal and Octal Numbers. Representation of Characters by Bit- Array: ASCII and UTF-8. Character Arithmetic: Case and Language Mapping and Changing. | CLO 2 | 6 |
| **Introduction to Programming:**<br>Different types of programming languages, programming designing tools, different types of errors in programming, system modeling and flow chart. | CLO 4 | 10 |
| **Web Technologies:**<br>Different types web technologies and their applications. HTML, JavaScript, CSS. Basic web page design, Web and Internet, Dynamic Website. | CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Peter Norton (2000): "Introduction to Computers", 6th edition or later. Glencoe/McGraw-Hill.
- Yale Patt and Sanjay Patel (2003): "Introduction to computing systems". McGraw-Hill Higher Education.
- Paul Wang and Sanda Katila (2004): "An Introduction to Web Design and Programming". Thomson/Brooks/Cole.
- George Spooner and Richard Mentzer (1968): "Introduction to number systems". Prentice-Hall.
- Anita Goel (2010): "Computer Fundamentals". Pearson.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 1122 Introduction to Computer Systems** |
| Level & Semester | L-1, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of the course is to familiarize students with practical knowledge on computer and its basic parts, different hardware devices, programming languages and web technologies. Acquaint the students with the usage of application and system software for document preparation, presentation and spreadsheet analysis. Prepare students for knowing both advantage and disadvantage of current programming languages and also make them familiar with web technologies.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire basic practical knowledge on computer and its hardware.
- *CLO 2:* Understand the mode of surfing internet and search engines options, and the usage of email and the various options.
- *CLO 3:* Use different types of software for document preparation, presentation and spreadsheet analysis.
- *CLO 4:* Identify different types of programming tools and their usages.
- *CLO 5:* Develop a website by using advance tags of HTML.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | √ |
| *CLO 2* | √ | | | | | √ | | | | √ |
| *CLO 3* | √ | | | | | √ | | | | √ |
| *CLO 4* | √ | | | | | √ | | | | √ |
| *CLO 5* | √ | | | | | √ | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Hands-On experience:** From a Key Press to Display, Hardware, Microprocessor, Memory Overview, File and File System. Input-Output Devices. | CLO 1 | 2 |
| **Computer Software:** Regular Usage – Utilities of Windows (XP) – Browsers (I.E., Chrome, Mozilla Firefox) – Surfing the Internet – Search Engines – E-Mail (Sending and Receiving mail, attaching folders on mail). Downloading and installing software/plug-ins on Windows – Searching / Surfing on the WWW. Basic Text Editor (gedit, Notepad), Document Processing, Spreadsheet, Presentation, Database, Mathematical Analysis, Simulation, Image and Video Editing, Games etc. | CLO 2 | 3 |
| **Application Software:** Different types of application software. Document processing, spreadsheet analysis and presentation preparation. | CLO 3 | 3 |
| **Introduction to Programming tools:** Different types of programming languages, programming designing tools, different types of errors in programming, system modeling and flow chart. | CLO 4 | 5 |
| **Web Technologies:** Creating Sample HTML page using Editors, Basic, Elements, Attributes, Headings and Paragraphs. Creating Sample HTML page using Styles, Formatting, Quotations and Comments. Creating Sample HTML page using Links, Images, Tables and Lists. | CLO 5 | 3 |

**Teaching Strategy**

Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Peter Norton (2000): "Introduction to Computers", 6th edition or later. Glencoe/McGraw-Hill.
- Yale Patt and Sanjay Patel (2003): "Introduction to computing systems". McGraw-Hill Higher Education.
- Paul Wang and Sanda Katila (2004): "An Introduction to Web Design and Programming". Thomson/Brooks/Cole.
- George Spooner and Richard Mentzer (1968): "Introduction to number systems". Prentice-Hall.
- Anita Goel (2010): "Computer Fundamentals". Pearson.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 1123 Structured Programming Language** |
| Level & Semester | L-1, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of the course is to familiarize students with program readability/understanding including program style/formatting and self-documenting code. Stimulate interest of students in researching and learning new method, new tools, or new way of applying existing rules, in terms of programming languages. Prepare students for knowing both advantage and disadvantage of current programming languages and also make them familiar with debugging process.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire fundamental knowledge on structured programming language.
- *CLO 2:* Understand the basic terminology used in computer programming.
- *CLO 3:* Use different data types and operators in a computer program.
- *CLO 4:* Design programs involving decision statements, loops, functions, arrays, structures and unions, pointers and file data structure.
- *CLO 5:* Compare and choose the loops and decision-making statements to solve the problem.
- *CLO 6:* Create and update data files.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | √ | √ | | | | | | √ |
| *CLO 6* | √ | | √ | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Fundamentals of Structured Programming Language:** History of structured programming language, programming structures and building blocks. **Fundamentals:** Character set, Tokens, Keywords, Identifiers, Data Types, Variables, Constant, Comments. | CLO 1, CLO 2, CLO 3 | 4 |
| **Operators and Expression:**<br>Operators and Build in Functions: Arithmetic, Unary, Relational and logical, Assignment and Conditional Operators, precedence and Associative - Library functions - Data input and output functions. Writing Programs: Declarations - Expressions – Statements – Simple programs. | CLO 3 | 6 |
| **Control Structures:**<br>Control Structures: Flow of control –Decision making, loop control - if, if-else, while, do-while, for loop, Nested control structures – switch, break and continue, go to statements – comma operator.<br>Solving Problems: Problem solving concepts and techniques - Steps in problem solving - Algorithms and flowcharts – Examples. | CLO 4, CLO 5 | 6 |
| **Functions, Arrays, Structures and Unions:**<br>**Functions:** Basic types of function, Declaration and definition, Function call, Types of function, Parameter passing, call by value, Call by reference, Scope of variable, Storage classes, Recursion. **Arrays:** Arrays- Defining and processing- Passing arrays to functions- Multi Dimensional Arrays- Arrays and Strings. **Structures and Unions:** User Defined data types-Passing structures to functions- Unions- Bit wise operations. | CLO 4, CLO 5 | 10 |
| **Pointers and Files: Pointers:** Declarations, Pointer Variables, Passing Pointers to functions- Operation on Pointers-Pointer and Arrays- Arrays of Pointers- Pointer Structures.<br>**Files:** File Input / Output - Creating,<br>Reading and Writing files, processing, opening and closing file data. | CLO 4, CLO 5, CLO 6 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- E. Balagurusamy (2015): "Programming in ANSI C", 6th Edition or later. Tata Mc-Graw Hill.
- Y. Kanetkar (1999): "Let us C". BPB Publication, New Delhi.
- H. Schildt (2000): "C, The Complete Reference", 4th Edition or later. TMH Edition.
- Ashok N. Kamthane (2006): "Programming with ANSI and Turbo C". Pearson Education.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 1124 Structured Programming Language** |
| Level & Semester | L-1, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to provide hands on experience on program writing to students. Stimulate interest of students in researching and learning new method, new tools, or new way of applying existing rules, in terms of programming languages. Prepare students for solving real world problems using structured programming language.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire practical knowledge on structured programming language.
- *CLO 2:* Understand the basic terminology used in computer programming.
- *CLO 3:* Use different data types and operators in a computer program.
- *CLO 4:* Implement different operations using decision statements, loops, functions, arrays, structures and unions, pointers and file data structure.
- *CLO 5:* Apply problems solving techniques to real world problems.
- *CLO 6:* Create and update data files.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | √ | √ | | | | | | √ |
| *CLO 6* | √ | | √ | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Design control flow mechanism for simple, decision making and looping programs. | CLO 1, CLO 2, CLO 3, CLO 4 | 2 |
| Program to process data types, format input and output. Program to evaluate an expression. | CLO 3 | 3 |
| Create programs using decision making statements, loops and arrays. | CLO 4, CLO 5 | 3 |
| Create programs using string, function, file, pointer and user defined data types. | CLO 4, CLO 5, CLO 6 | 5 |
| Create Animation/ Gaming /Application using structured programming tools. | CLO 4, CLO 5, CLO 6 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- E. Balagurusamy (2015): "Programming in ANSI C", 6th Edition or later. Tata Mc-Graw Hill.
- Y. Kanetkar (1999): "Let us C". BPB Publication, New Delhi.
- H. Schildt (2000): "C, The Complete Reference", 4th Edition or later. TMH Edition.
- Ashok N. Kamthane (2006): "Programming with ANSI and Turbo C". Pearson Education.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 1125 Coordinate Geometry and Vector** |
| Level & Semester | L-1, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 03 |
| Contact hours | 03 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to familiarize students with 2D and 3D geometrical problem solving, to explain the basic properties of lines and curves, to evaluate volume and surface integrations and to apply different techniques for solving real-world problems.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* State and apply the formulas and general equations of 2D and 3D.
- *CLO 2:* Explain the basic properties of lines and curves.
- *CLO 3:* Understand the basic properties of vectors.
- *CLO 4:* Evaluate volume and surface integrations.
- *CLO 5:* Apply vector analysis techniques for solving real-world problems.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | √ | | | | √ | | | |
| *CLO 2* | | | √ | | | | √ | | | |
| *CLO 3* | | | √ | | | | √ | | | √ |
| *CLO 4* | | | √ | | | | √ | | | √ |
| *CLO 5* | | | √ | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Two-dimensional geometry:** Coordinate system, straight line in a plane, distance of two lines, slope of a line, tangent and normal on a curve, pair of straight lines, basic properties of circle, parabola, ellipse and hyperbola; change of coordinate axes, general equation of second degree. | CLO 1 | 8 |
| **Three-dimensional geometry**: Different systems of coordinates and transformations of coordinates, direction cosines and direction ratios, planes and straight lines in three dimensions, general equation of second degree in three variables, reduction to standard forms and identification of ellipsoid, paraboloid, hyperboloid, sphere, cylinder and cone. | CLO 1, CLO 2 | 10 |
| **Introduction of vector analysis:** Operations with vectors, Scalar and vector product of three vectors, Product of four vectors, Reciprocal vectors, Theorems of Green, Gauss, Stokes, and problems based on these. | CLO 3 | 10 |
| **Vector differentiation:** Vector and scalar fields, vector operator, directional derivatives, gradient, divergence, and curl. | CLO 4 | 10 |
| **Vector integration:** Path, line, surface and volume integrals; Line integrals of linear differential forms, integration of total differentials, conservative fields, the fundamental theorem on exact differentials, conditions for line integrals to depend only on the endpoints. | CLO 4, CLO 5 | 10 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- J. G. Chakraborty and P. R. Ghosh (2000): "Analytical Geometry and Vector Analysis", 20th or later edition. U. N. DHUR & SONS private ltd.
- P.K. Jain (2005): "A Textbook of Analytical Geometry", 3rd or later edition. New Age International.
- J. T. Bell (2015): "Elementary Treatise on Coordinate Geometry". Macmillan and Company Limited.
- Howard Anton and Chris Rorres (2013): "Elementary Linear Algebra: Applications Version", 11th or later edition. Wiley.

- Murray R. Spiegel (1974): "Schaum's Outline of Theory and Problems of Vector Analysis". McGraw-Hill Publishing Co.

**Department of Genetics and Plant Breeding**

Bangladesh Agricultural University, Mymensingh

**Course Profile**

| | |
|---|---|
| Course No. & Title | **GPB 1101 Cell Biology and Genetics** |
| Level & Semester | L-1, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

This course describes cell structure and function, diversity and complexity of cellular functions. It will also discuss the molecular composition of cellular components and organelles, and how these molecules and their interactions ultimately dictate cell structure and function.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

CLO1: Discuss chemical bonds, interactions and forces that hold molecules, molecules of life

CLO2: Explain basic knowledge of the different eukaryotic cellular organelles

CLO3: Relate the structure and function of the DNA, RNA and protein molecule

CLO4: Interpret mutations in DNA, flow of genetic information from DNA to proteins

CLO5: Illustrate how information generated by genome sequencing projects can be used to discover practical knowledge about gene expression and relationships between species

CLO6: Apply the Hardy-Weinberg Law in analyzing population genetics for gene frequency, sex linkage, equilibrium, and heterozygote frequency

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 | PLO 8 | PLO 9 | PLO 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| CLO 1 | | ✓ | | | | | ✓ | | | |
| CLO 2 | | ✓ | | | | | ✓ | | | |
| CLO 3 | | ✓ | | | | | ✓ | | | |
| CLO 4 | | ✓ | | | | | ✓ | | | |
| CLO 5 | | ✓ | | | | | ✓ | | | |
| CLO 6 | | ✓ | | | | | ✓ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to Cell Biology:** Brief history of the cell theory & emergence of modern cell biology; bricks & mortar of cells (molecules & bonds) ; fundamental properties of water; the 4 types of biological molecules | CLO 1 | 3 |
| **Protein Structure and Function:** What are proteins and what don't they do? amino acids; primary, secondary, tertiary, quaternary protein structures<br>**Membrane Structure and Function:** Membrane models; constituents of the membranes; fluid & dynamic membrane; movement across membranes | CLO 2 | 4 |
| **Chemotrophic Energy Metabolism:** Bioenergetics; glycolysis; tricarboxylic acid cycle (Kreb's cycle, citric acid cycle); electron transport chain & oxidative phosphorylation<br>**Intracellular Compartments:** Endomembrane System; overview; protein synthesis | CLO | 4 |
| **Cellular Communication:** Overview; extracellular matrix (ECM) molecules & interactions (integrins); cell-cell recognition & adhesion; cell signaling & signal transduction<br>**Cell Mobility:** Cytoskeletal structural elements; microtubule-based movement & motors; actin-based movement (non-muscular) | CLO 2 | 5 |
| **Structure and Biochemistry of DNA:** DNA - the Genetic Code; Structure, Mutation of DNA; | CLO 3, | 6 |

| | | |
|---|---|---|
| Transcription and Translation<br>**Transmission Genetics:** Basic and Advanced Principles of Heredity; The Chromosomal Basis of Heredity | CLO 4 | |
| **Linkage, Mapping, and Chromosomes:** Gene Linkage and Genetic Mapping; Human Karyotypes and Chromosome Behavior<br>**Prokaryotic Genetics:** The Genetics of Bacteria and Viruses; Molecular Mechanisms of Prokaryotic Gene Regulation and RNA Interference in Eukaryotes | CLO 4,<br>CLO 5 | 5 |
| **Advanced Topics:** Genetic Engineering and Genomics; Gene editing; Cancer; The Basics of Population Genetics | CLO 6 | 5 |

**Teaching Strategy**

Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**

Written examination, Assignment, Quiz, and Observation

**Recommended Books**


- Karp, G. (2013), "Cell and Molecular Biology: Concepts and Experiments", Wiley and Sons.
- W.H. Freeman and Company (2003), "Molecular Cell Biology", 5th Ed. New York, NY: ISBN: 9780716743668.
- Hartl, D L. (2014), "Essential Genetics, a Genomics Perspective", 6th Ed. Sudbury, MA: Jones and Bartlett Publishers, ISBN: 978-1-4496-8688-8
- Roger L. Miesfeld (1999), "Applied Molecular Genetics", Latest Ed, Elsevier.

**Department of Languages**

Bangladesh Agricultural University, Mymensingh

**Course Profile**

| | |
|---|---|
| Course No. & Title | **LAN 1105 Communicative English** |
| Level & Semester | L-1, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 01 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**:

The course focuses mostly on the reading and writing skills of students exposing them to a holistic communicative environment in the classes where all the four skills of language learning – listening, speaking, reading and writing – are simultaneously taught to improve their language proficiencies for communicating effectively in English in academic, professional and everyday life.

**Course Learning Outcome (CLO)**

Upon completion of this course, the student will be able to:

CLO1: Understand and use a variety of English expressions related to their academic and everyday lives by participating in routine conversations, fulfilling a variety of speaking functions and making presentations in English

CLO2: Demonstrate a significant increase in word/ vocabulary knowledge

CLO3: Employ reading strategies for increasing confidence in reading and understanding texts

CLO4: Prepare organized writing with process and product writing techniques and proper syntax

CLO5: Communicate through professional and academic correspondence

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | | | √ | |
| *CLO 2* | | | | | | | | | √ | |
| *CLO 3* | | | | | | | | √ | √ | |
| *CLO 4* | | | | | | | | √ | √ | |
| *CLO 5* | | | | | | | | √ | √ | |

**Detailed Syllabus**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Introducing oneself and others<br>Social interaction (Making conversation, applying proper register to perform language functions in English)<br>Listening for practice & tests: monologues, dialogues, narratives, songs (Questions and exercises include WH & yes-no questions/synonyms-antonyms/sentence making with words/ fill in the blanks/matching/ MCQs/ True-false/ given-not given/ flow chart etc.) | CLO 1, CLO 2 | 2 |
| Verb Tenses (syntax, sentence correction, right forms of verbs etc.)<br>Types of sentences<br>Transformation of sentences<br>Subject-verb agreement rules & exercises<br>Rules of punctuation & capitalization | CLO 2, CLO 4 | 3 |
| Making effective presentations<br>Situation based role playing & simulations<br>Extempore speech<br>Public speaking | CLO 1, CLO 2 | 2 |
| Reading passages for comprehension with follow-up questions (WH & yes-no questions/synonyms-antonyms/sentence making with words/ fill in the blanks/matching/MCQs/ True-false -not given/ flow chart etc.) | CLO 3, CLO 4 | 2 |
| Academic & professional correspondence<br>**Academic**: Application for stipend, scholarship, certificate, mark sheet etc./research motivation letter<br>**Professional**: Job application/Job offer acceptance or joining letter/ Resignation letter/ Memo writing/ Report writing/ Proposal writing<br>CV & Resume preparation | CLO 4, CLO 5 | 4 |

| | | |
|---|---|---|
| Use of linking devices<br>Paraphrasing & summary writing<br>Paragraph writing<br>Describing graphs, charts and tables | CLO 2,<br>CLO 3,<br>CLO 4 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Speaking Naturally (Audio CD) Communication Skills in American English by Bruce Tillitt and Mary Newton Bruder, 1985, 2005. CUP
- Speaking Effectively - Developing Speaking Skills For Business English, Comfort Rogerson Stott & Utley, 1994 CUP.
- High School English Grammar and Composition, by Wren and Martin. 1980. S. Chand & Company, India.
- Guide to Patterns and Usage in English, by Hornby A. S. 1998. 2nd edition, Oxford University Press, Delhi.
- Accelerator (An Effective English Language Workbook), by Karim, Z. & Arifeen, M. S. 2016, Madhorse Publications, Dhaka.
- Writing Skills Handbook, by Wiener, B. 1988, 4th edition, Houghton Miffin Company, Boston and New York, USA.
- English Pronouncing Dictionary, by Jones, D. 1977. University of Cambridge, UK.

**Level- 1, Semester- 2**

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 1221 Object Oriented Programming Language** |
| Level & Semester | L-1, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of this course is to give students the necessary knowledge on the programming of computer and Internet systems using object oriented programming language. The course introduces the fundamentals of analyzing a problem and then implementing a solution as a computer software system using an object oriented language. Students learn about problem solving strategies, top-down program development and programming style. The course provides a basic introduction to data abstraction and object-oriented analysis and design. Emphasis is placed on programming and testing.

**Course Learning Outcome (CLO)**

Upon completion of this course, the student will be able to:

*CLO 1:* Acquire fundamental knowledge on object oriented programming language.
*CLO 2:* Understand the basic concepts of data encapsulation, inheritance, and polymorphism to large-scale software.
*CLO 3:* Write object oriented programs with collection framework, package, thread, generics and complicated exception handling facilities.
*CLO 4:* Design applications with an event-driven graphical user interface.
*CLO 5:* Apply the object-oriented design principles to complex software systems.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | √ | | | | | | √ |
| *CLO 2* | √ | | √ | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | √ | | | | | | √ |
| *CLO 5* | √ | | √ | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to Object Oriented Concepts:** Procedural Programming vs. Object-Oriented Programming, Abstract Data Types (ADTs), Basics of Object Oriented Programming language, Introduction to UML. | CLO 1 | 4 |
| **Classes and Objects:** Classes & Objects, Attributes and functions, constructors and destructors, functions or methods, overloading methods, access control, special considerations in different Languages. I/O: Stream and files. | CLO 1 | 6 |
| **Object Design and Programming:** Abstraction, inheritance: Superclass and Subclass, multiple inheritance, polymorphism, method overriding, associations, delegation, dynamic binding, interface. | CLO 2 | 6 |
| **Exception Handling & Generics or Templates:** Exception handling fundamentals, exception types, chained exception, creating own exception subclasses. Special considerations in different languages. Package/Namespace: Understanding and implementing package/ namespace. | CLO 3 | 5 |
| **GUI Development, Thread and Collections:** GUI: AWT Graphical Components, Event Handling, Anonymous Classes. Thread: Thread Lifecycle, Thread Synchronization, Critical Sections. Collection: Collections Framework, List, Map, Set, Iterating through Collections. | CLO 3, CLO 4 | 6 |
| **Object-oriented Design Principles and Examples:** Introduction to object-oriented design principles and examples, introduction to object-oriented design. Case Study using Object Oriented Programming. | CLO 5 | 5 |

**Teaching Strategy**

Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- H. M. Deitel and P. J. Deitel (2007): "Java How to Program", 7th edition. Prentice Hall.
- M. Priestley (2003): "Practical Object-Oriented Design with UML", 2nd edition. McGraw-Hill.
- T. Budd (2001): "An Introduction to Object-oriented Programming", 3rd edition. Addison-Wesley.
- Herbert Scheldt (2009): "Java: The Complete Reference", 9th edition. Tata McGraw Hill.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 1222 Object Oriented Programming Language** |
| Level & Semester | L-1, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to provide hands on experience on object oriented program writing to students. Stimulate interest of students in researching and learning new method, new tools, or new way of applying existing rules, in terms of object oriented programming languages. Prepare students for designing real world problems using object oriented design principle and solving using object oriented programming language.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire fundamental knowledge on object oriented programming language.
- *CLO 2:* Understand the basic concepts of data encapsulation, inheritance, and polymorphism to large-scale software.
- *CLO 3:* Write object oriented programs with collection framework, package, thread, generics and complicated exception handling facilities.
- *CLO 4:* Design applications with an event-driven graphical user interface.
- *CLO 5:* Apply the object-oriented design principles to complex software systems

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | √ | | | | | | √ |
| *CLO 2* | √ | | √ | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | √ | | | | | | √ |
| *CLO 5* | √ | | √ | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Create programs using class, attributes and functions, constructors and destructors, functions or methods, overloading methods, access control. | CLO 1, CLO 2 | 3 |
| Create programs using abstraction, inheritance: Superclass and Subclass, multiple inheritance, polymorphism, method overriding, associations, delegation, dynamic binding, and interface. | CLO 1, CLO 2 | 3 |
| Create programs using collection framework, package, and complicated exception handling facilities | CLO 3 | 3 |
| Create programs using thread, generics. | CLO 3 | 4 |
| Create Graphical User Interface using object oriented programming language tools. | CLO 4, CLO 5 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- H. M. Deitel and P. J. Deitel (2007): "Java How to Program", 7th edition. Prentice Hall.
- M. Priestley (2003): "Practical Object-Oriented Design with UML", 2nd edition. McGraw-Hill.
- T. Budd (2001): "An Introduction to Object-oriented Programming", 3rd edition. Addison-Wesley.
- Herbert Scheldt (2009): "Java: The Complete Reference", 9th edition. Tata McGraw Hill.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 1223 Calculus and Matrices** |
| Level & Semester | L-1, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 03 |
| Contact hours | 03 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to familiarize with the applications of differential and integral calculus. To apply advanced matrix knowledge to Engineering problems and equip themselves familiar with the concepts of differential calculus. Acquaint the students to identify the appropriate theorem and use it to arrive at the given conclusion of our problems.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:
*CLO 1:* Acquire basic knowledge on the principles of mathematics and describe the basic parts of retention of terminology and its uses.
*CLO 2:* Understand the notion of linear independence and the notion of a fundamental set of solutions.
*CLO 3:* Use mathematical concepts in problem-solving through integration of new material and modeling.
*CLO 4:* Verify whether a given problem solved by use of the appropriate theorem.
*CLO 5:* Evaluate line integrals along simple closed contours on the plane.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | √ | | | | √ | | | |
| *CLO 2* | | | √ | | | | √ | | | |
| *CLO 3* | | | √ | | | | √ | | | |
| *CLO 4* | | | √ | | | | √ | | | |
| *CLO 5* | | | √ | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction of Calculus:** The real line and its geometrical representation, Properties of limit and classification of discontinuities, properties of continuous functions, differentiability and differentials. | CLO 1 | 6 |
| **Differential Calculus:** Successive differentiation, Leibnitz's theorem, Rolle's theorem, Mean value theorem, Taylor's theorem, indeterminate forms, maxima and minima of functions. | CLO 2 | 10 |
| **Integral Calculus:** Integration by substitution and by parts, Standard integrals, Definite integrals, Fundamental theorem, rectification, quadrature, surface areas and volumes of revolution. | CLO 3 | 10 |
| **Applications:** Asymptotes, concavity, convexity, and points of inflection, plane curves, tangent and normal in parametric form, quadrature, rectification, length of a curve, volumes and surface areas of solids of revolution. | LO-4 | 15 |
| **Matrices:** Definition, examples and properties of matrices, Adjoint, inverse and rank of a matrix, Echelon, normal and canonical forms, Elementary transformation of matrices, System of linear equation, Cayley-Hamilton theorem, Eigenvalues and Eigen vectors, Crammer's rule. | CLO 5 | 5 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Fuzhen Zhang (2011): "Matrix Theory: Basic Results and Techniques". Springer.
- Denis Serre (2010): "Matrices: Theory and Applications". Springer.
- B.C. Das and B.N. Mukherjee (2007): "Differential and Integral Calculus". U. N. DHUR & SONS private ltd.
- Howard Anton and Irl C. Bivens (2005): "Calculus". Wiley.

**Department of Farm Power and Machinery**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FPM 1261 Electrical and Electronics Engineering** |
| Level & Semester | L-1, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
To enable the students with necessary theoretical and practical knowledge in understanding the basic of Electrical and Electronics Engineering.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

CLO 1: Understanding fundamental of current and voltage
CLO 2: Able to differentiate between DC and AC and able to comprehend power, cycles, frequency, ohm's law and Kirchhoff's voltage and current law
CLO 3: To design and solve DC and AC series and parallel circuits
CLO 4: Able to find the complex circuit's equivalent resistance, impedance and power factor of AC circuit
CLO 5: To learn the basics of electronics, integrated circuits

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | | | | ✓ |
| *CLO 2* | | | | | | | ✓ | | | |
| *CLO 3* | | | ✓ | | | | | | | ✓ |
| *CLO 4* | | | | | | | ✓ | | | |
| *CLO 5* | | | ✓ | | | | | | | ✓ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Fundamental of Current, voltages and their units | CLO 1 | 4 |
| Instantaneous Current, voltage, power, cycles, frequency, ohm's law, Kirchoff's current law, Kirchoff's voltage law, phase difference and power factor. | CLO 2 | 3 |
| Solving dc series circuits, solving dc parallel circuits, ac series circuits, ac parallel circuits. | CLO 3 | 4 |
| Wye-delta transformation, delta-wye transformation, R-branch, L-brach, C-branch, RL-brtanch, RC-branch, RLC-branch. | CLO 3 | 4 |
| RMS value, Average value, vector diagram of ac circuit, mesh analysis theory, problem solving by applying mesh analysis | CLO 4 | 3 |
| Cartesian, exponential and polar forms of representation. Operators, addition, subtraction, multiplication and division. | CLO 4 | 4 |
| Nodal analysis, Thevenin theorem, superposition theorem related theory and problem solving | CLO 4 | 4 |
| Atomic structure and energy bands in solids. Transport phenomenon in semiconductor, junction diode characteristics and diode circuits. P-n-p and n-p-n transistors circuits, signal power amplifiers, filtering. | CLO 5 | 3 |
| Feedback amplifier and Oscillators. Switching control and control circuits. Control applications in instrumentation and agriculture. | CLO 3, CLO 5 | 4 |

**Teaching Strategy:**
Lectures, Discussion, Demonstration by video, Question & answer (QA), Self-Study, Case Studies, Practice, Group Studies.

**Assessment Strategy:**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Introduction to Electrical Engineering Ward, R.P. Prentice Hall.
- Alternating Current Circuits Kerchner, Russel M. and Corcoran, George F. John Wiley.
- Millman, Jacob and Halkias, Christos C. Electronic Devices and Circuits. Tata Mcgraw Hill.
- Electronics: Principles and Techniques. S. Ramabhadran.

**Department of Farm Power and Machinery**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FPM 1262 Electrical and Electronics Engineering** |
| Level & Semester | L-1, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
To enable the students with necessary practical knowledge in understanding the basic of Electrical and Electronics Engineering.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

CLO 1: Understanding fundamental of current and voltage
CLO 2: Able to differentiate between DC and AC and able to comprehend power, cycles, frequency, ohm's law and Kirchhoff's voltage and current law
CLO 3: To design and solve DC and AC series and parallel circuits
CLO 4: Able to find the complex circuit's equivalent resistance, impedance and power factor of AC circuit
CLO 5: To learn the basics of electronics, integrated circuits

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | | | | ✓ |
| *CLO 2* | | | | | | | ✓ | | | |
| *CLO 3* | | | ✓ | | | | | | | ✓ |
| *CLO 4* | | | | | | | ✓ | | | |
| *CLO 5* | | | ✓ | | | | | | | ✓ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Elementary circuit and wiring. | CLO 1 | 1 |
| Use of voltmeter, ammeter and multi meter. | CLO 2 | 3 |
| Series and parallel circuits. | CLO 3 | 1 |
| Electric power distribution. | CLO 4 | 2 |
| Use of wattmeter and energy meter. | CLO 4 | 2 |
| Verification of superposition theorem | CLO 5 | 1 |
| Verification of Thevenin's theorem | CLO 5 | 1 |
| Study of RLC circuit. | CLO 4 | 1 |
| Nonlinear circuits: diodes and analog multipliers | CLO 4 | 1 |
| Comparators, positive feedback, and relaxation oscillators | CLO 4 | 1 |
| Transistors as amplifiers and switches | CLO 4 | 1 |

**Teaching Strategy:**
Lectures, Discussion, Demonstration by video, Question & answer (QA), Self-Study, Case Studies, Practice, Group Studies.

**Assessment Strategy:**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Introduction to Electrical Engineering Ward, R.P. Prentice Hall.
- Alternating Current Circuits Kerchner, Russel M. and Corcoran, George F. John Wiley.
- Millman, Jacob and Halkias, Christos C. Electronic Devices and Circuits. Tata Mcgraw Hill.
- Electronics: Principles and Techniques. S. Ramabhadran.

**Department of Farm Structure and Environmental Engineering**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FSEE 1206 Engineering Drawing** |
| Level & Semester | L-1, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
To enable the student with necessary knowledge and skills on different drawing technique so that they will be used in drawing: different views, building sections, building components, orthographic view of machine components, plans and maps in the field of Bioinformatics Engineering.

**Course Learning Outcome (CLO)**

*CLO 1:* Explain the different types of drawing instruments and drawing techniques.
*CLO 2:* Construct scale in different view, plan and maps.
*CLO 3:* Discuss the techniques of isometric, oblique, orthographic views of machine components, building components and sections.
*CLO 4:* Design a plan of building and maps.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | √ | | | |
| *CLO 2* | | | | | | | √ | | | |
| *CLO 3* | | | | | | | √ | | | |
| *CLO 4* | | | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction:** History, Applications, Instruments, Lines, Arrows, Dimensions and Symbols. | CLO 1 | 2 |
| **Lettering:** Definition, Types, uses, single and double stroke lettering. | CLO 1, CLO 2 | 3 |
| **Scale:** Definition, Types, Uses, Plane and Diagonal Scale Construction. | CLO 1, CLO 2 | 2 |
| **Views:** Definition, Types and Uses. | CLO 1, CLO 3 | 2 |
| **Orthographic view:** Definition, principles, Surfaces of solid Sections, drawing procedure and uses. Orthographic view of machine components. | CLO 1, CLO 3 | 3 |
| **Isometric View:** Definition, drawing of solids, Orthographic views from isometric view and uses. | CLO 1, CLO 3 | 2 |
| **Building drawing:** Foundation, Superstructure, lintel with sunshade, Beam, roof Staircase, construction plans and layouts of farm house and Storage Structure. | CLO 1, CLO 4 | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**
- Civil Engineering Drawing – G. Singh and S. C. Sharma, Standard Publishers Distributors, Delhi
- Civil Engineering Drawing and Design- D. N. Ghose, CBS Publishers and Distributors, Delhi
- The Fundamental of Engineering Drawing and Graphic Technology-T. E. French and C. J. Vierck, McGraw-Hill Book Co., London
- Engineering Drawing – L. Levant, Mir Publisher, Moscow
- Intermediate Engineering Drawing – A. C. Parkinson, Sir Isaack Pitman & Sons Ltd., London
- Prathamic Engineering Drawing – Hemonta Kumar Vattacharga, Somnath Book Agency, Kolkata
- Fundamentals of Engineering Drawing – Thomas E. French, McGraw-Hill Book Co., London

**Department of Food Technology and Rural Industries**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FTRI 1203 Biochemical Engineering** |
| Level & Semester | L-1, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
To enable the students with necessary theoretical and practical knowledge to handle the biochemical process for the production of bio-based foods and ingredients for the food industry.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

| | |
|---|---|
| *CLO-1* | Explain an ideal biochemical process and its components including metabolic pathways of glucose, protein and fat. |
| *CLO-2:* | Explain microbial growth and growth kinetics and growth systems |
| *CLO-3:* | Discuss the transport phenomena in the bioreactor systems. |
| *CLO-4:* | Identify downstream bio-processing need for any bioprocess industries. |
| *CLO-5* | Acquire knowledge on different aspects of bio-sensing technology and cutting edge bioengineering concepts |

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | | | | |
| *CLO 2* | | √ | | | | | | | | |
| *CLO 3* | | | | | | | √ | | | |
| *CLO 4* | | | √ | | | | √ | | | |
| *CLO 5* | | | √ | | | | | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Concept of biochemical engineering:** An ideal biochemical process and its components; Industrially important microorganisms, their characteristics and sources and techniques of improvement, molecular genetics and control systems | CLO 1 | 4 |
| **Overview on microbial metabolism:** important metabolic pathways for glucose, protein and fat, Synthesis of biomolecules | CLO 1 | 2 |
| **Microbial growth and growth kinetics:** batch and continuous; yield coefficients for biomass and product formation, rates of reaction, growth, limiting substrate concentrations, Monod's equation; monitoring microbial growth in culture, factors affecting growth of microbes | CLO 2 | 4 |
| **Fermentation systems:** fermenter design, cardinal rules, materials of construction and vessel size, bearing assemblies, motor drive, aseptic seals, aseptic operation, tangential flow filtration (TFF), piping and valves for biochemical engineering, pressure relief, cleaning and sterilization of process equipment | CLO 3 | 8 |
| **Mass transfer and transport phenomena in Bioreactor:** Aeration and agitation: mass transfer and microbial respiration, bubble aeration and mechanical agitation, factors influencing oxygen transfer coefficients. Media sterilization: batch and continuous, air sterilization, Scaling up of the lab process | CLO 3 | 4 |
| **Downstream bioprocessing:** Separation and recovery of purified product, Basic separation units, Protein Purification: IEX, HIC, Affinity | CLO 4 | 4 |
| **Biosensors:** Classifications, parts of biosensors, Transducing mechanism, Specialized equipment for biosensors, Cutting edge bioengineering concepts such as recombinant DNA technology, Intracellular signaling and so on | CLO 5 | 4 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Primrose, S.B. 1987. Modern Biotechnology. Blackwell Scientific Publications.
- Conn, E.E. and Strumpf, P.K. 1976. Outlines of Biochemistry. 4th Edn. John Wiley and Sons, Inc.
- Webb, F.C. 1976. Biochemical Engineering. Van Nostrand Co. Inc. London.
- Blakebrough, N. 1967. Biochemical and Biological Engineering Science. Academic Press, London.2001. Blackwell Science, UK
- Aiba, S., Humphery, A.E. and Mills, N.F. 1973. Biochemical Engineering. 2nd Edn. Academic Press Inc. New York and London.
- Industrial Microbiology: An Overview by Michael J. Waites, Neil L. Morgan, Gary Higton

**Department of Genetics and Plant Breeding**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **GPB 1201 Molecular Genetics** |
| Level & Semester | L-1, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course will provide the concept of the gene, transcription, translation, regulation of gene expression and replication and covers many of the latest methodologies used in genomics analysis.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

CLO 1: Describe molecular events of DNA replication, RNA and protein synthesis
CLO 2: Explain events of gene expression and regulation
CLO 3: Outline the concept and uses of molecular marker and genome mapping
CLO 4: Explain the significance of genomics and the –omics revolution to bioinformatics research and applications
CLO 5: Explain the methodology and principles behind genomic sequencing, interpretation, and analysis

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction :** Concept, scope of molecular genetics | CLO 1 | 2 |
| **DNA Replication:** Types of DNA replication, molecular basis, DNA unwinding, proteins involved in replication, polymerase | CLO 2 | 1 |
| **RNA:** Concept, types, nomenclature, coding and non-coding RNA, RNA splicing | CLO 2 | 2 |
| **Gene expression and regulation:** Transcription, translation, operon (*Lac* and *Trp*), protein-DNA binding motif | CLO 2 | 4 |
| **Molecular markers and map:** Concept, types, methods of mapping and types of map, mapping genomes, sequencing genomes | CLO 3 | 3 |
| **Genome:** Understanding a Genome Sequence and Genome functions, Eukaryotic Genomes, Prokaryotic and Organellar Genomes | CLO 4 | 2 |
| **Genome assembly:** Accessing the Genome, Assembly of the Transcription Complex, Regulation of Genome Activity, Genome Replication | CLO 4, CLO 5 | 2 |
| **Protein:** Concept, types, synthesis and processing of the protein, folding and structure modeling | CLO 5 | 1 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Marjorie A. Hoy (2013), "Insect Molecular Genetics: An Introduction to Principles and Applications," 3rd or Latest Ed, Elsevier.
- Tom Strachan and Andrew Read (2018), "Human Molecular Genetics," 5th Ed. or later, Garland Science
- Alfred Pühler, Kenneth N. Timmis (2012), "Advanced Molecular Genetics", Latest Ed, Springer
- Roger L. Miesfeld (1999), "Applied Molecular Genetics", Latest Ed, Elsevier.

**Department of Languages**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **LAN 1206 Communicative English** |
| Level & Semester | L-1, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**:
The course focuses mostly on the listening and speaking kills of students with a view to improving their language proficiencies to communicate effectively in English in academic, professional and everyday lives.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

CLO1: Understand and use a variety of English expressions related to their academic and everyday lives by participating in routine conversations and fulfilling a variety of speaking functions
CLO2: Apply appropriate pronunciation in speaking
CLO3: Perform listening tasks through audio-visual tape scripts
CLO4: Show confidence in making presentations and facing interviews in English
CLO5: Communicate through professional and academic correspondence

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | | √ | √ | |
| *CLO 2* | | | | | | | | | √ | |
| *CLO 3* | | | | | | | | √ | | |
| *CLO 4* | | | | | | | | √ | √ | |
| *CLO 5* | | | | | | | | | √ | |

**Detailed Syllabus**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Introducing oneself and others<br>Making accurate sentences in English | CLO 1 | 2 |
| Dialogue making and role-plays | CLO 1,<br>CLO 2 | 3 |
| Discussing habits/activities/past events/ neighborhoods | CLO 2 | 3 |
| Listening to songs and understanding lyrics | CLO 1 | 3 |
| Making appointments/Attending phone calls/Taking messages | CLO 2 | 3 |
| Audio-visual exercises: animated stories | CLO 2 | 3 |
| Using modal verbs for various functions, Talking about holidays/vacations, Giving and asking for directions | CLO 1 | 3 |
| Audio-visual exercises: Mind your Language, Episode-1<br>Extempore speech | CLO 3 | 3 |
| Listening exercises: Dialogues and monologues<br>Making conversations based on cue cards | CLO 4 | 3 |
| Making Effective Presentations<br>Developing Interview Skills and Participating in Mock Interviews | CLO 5 | 3 |
| Audio-visual exercises: Mind your Language, Selections from other episodes<br>Short debate/ Group debate | CLO 3 | 3 |
| Listening exercises: Animated stories/fables<br>Story Telling/ Group Discussions | CLO 1,<br>CLO 2,<br>CLO 5 | 3 |
| Use of sentence connectors<br>Writing Cover letters<br>Report writing | CLO- 1 | 3 |
| Presenting graphs, charts and tables | CLO 2,<br>CLO 4,<br>CLO 5 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Speaking Naturally (Audio CD) Communication Skills in American English by Bruce Tillitt and Mary Newton Bruder, 1985, 2005. CUP
- Speaking Effectively - Developing Speaking Skills For Business English, Comfort Rogerson Stott & Utley, 1994 CUP
- Communicative English (A practical workbook designed by the Department of Languages) by Arifeen, M. S., Karim, Z., Jamila, M. & Pathan, A. K., 2019, Madhorse Publications, Dhaka.
- Accelerator (An Effective English Language Workbook), by Karim, Z. & Arifeen, M. S. 2016, Madhorse Publications, Dhaka.
- A communicative Grammar in English, by Leech, G. and Svartvik, J. 1995. 2nd edition, Longman, London and NY.
- Guide to Patterns and Usage in English, by Hornby A. S. 1998. 2nd edition, Oxford University Press, Delhi.
- Oxford Advanced Learner's Dictionary of Current English, by Hornby, A.S. 1996 edition, J. Crowler, 5th edition, Oxford University Press, London.
- English Pronouncing Dictionary, by Jones, D. 1977. University of Cambridge, UK.

**Department of Physics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **PHY 1201 Physics** |
| Level & Semester | L-1, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 03 |
| Contact hours | 03 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of this course is to provide basic knowledge of classification of solids, crystal structure, elastic properties, flow of fluid, heat, first law of thermodynamics, second law of thermodynamics, electricity and magnetism, induction, nuclear Physics, radiation and electrical circuits and electronics. Topics covered heat, thermodynamics, electricity and magnetism, nuclear physics, radioactivity and electronics.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Describe the classification of solids and crystal structures.
*CLO 2:* Describe properties of matter and flow of fluid.
*CLO 3:* Differentiate between heat and thermodynamics
*CLO 4:* Describe electricity and magnetism.
*CLO 5:* Analyze nuclear fission and fusion.
*CLO 6* Describe the laws of radiation of heat, black body and body and radiation,
*CLO 7* Describe semiconductors, transistors and integrated circuit and their uses.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | √ | | | |
| *CLO 2* | | | | | | | √ | | | |
| *CLO 3* | | | | | | | √ | | | |
| *CLO 4* | | | | | | | √ | | | |
| *CLO 5* | | | | | | | √ | | | |
| *CLO 6* | | | | | | | √ | | | |
| *CLO 7* | | | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Structure of matter: Classification of solids; amorphous, crystalline, binding energy and atomic separation in equilibrium in solid, different types of bonds in crystals, lattice, basis, crystal, unit cell, packing fraction of sc, bcc crystals, X-ray diffraction, Bragg's law. | CLO 1 | 5 |
| General Properties of matter: Elasticity, fluid mechanics, viscosity and surface tension. | CLO 2 | 5 |
| Heat and Thermodynamics: First law of thermodynamics and its applications, different kinds of thermo- dynamical changes, interrelation between pressure, volume and temperature Second law of thermodynamics; reversible and irreversible processes, heat engine and Carnot's cycle. | CLO 3 | 8 |
| Electricity and Magnetism: Current and resistance, Kirchhoff's laws on distribution ofcurrent. Magnetic induction due to current, Ampere's law, Biot-Savart law, Electromagnetic induction, Henry- Faraday's law, inductance, L-R circuits. | CLO 4 | 8 |
| Nuclear physics- Atomic and nuclear structure, radioactivity, decay law, half life. Nuclear fission and fusion, use of radio isotopes. | CLO 5 | 6 |
| Radiation of heat, black body and body and radiation, laws of radiation, planck's constant. | CLO 6 | 8 |
| Electronics- Semiconductors, transistors and integrated circuit and their uses. | CLO 7 | 8 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Karl F. Kuhn (1996): “Basic Physics: A Self-Teaching Guide”, 2nd edition. Wiley.
- Steven H. Simon (2013): “The Oxford Solid State Basics”, 5th edition. Oxford University Pres.
- Steven Holzner (2016): “Physics I For Dummies”. Paperback.
- Donald A. Neamen (2011): “Semiconductor Physics and Devices: Basic Principles”. McGraw-Hill Higher Education.

**Level- 2, Semester- 1**

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 2121 Data Structure** |
| Level & Semester | L-2, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of the course is to teach the students how to select and design data structures and algorithms that are appropriate for problems that they might encounter. This course is also about showing the correctness of algorithms and studying their computational complexities. This course offers the students a mixture of theoretical knowledge and practical experience. Topics covered in this course include: analysis of algorithms, trees, binary search trees, multi-way search trees, dictionaries, hash tables, graphs, graph traversals, graph algorithms, sorting.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Describe the properties, interfaces, and behaviors of basic abstract data types, such as array, linked list, stack, and queue.
- *CLO 2:* State the asymptotic time complexity of the fundamental operations associated with a variety of data structures, linked list, tree, and heap.
- *CLO 3:* Acquire the basic Knowledge of and ability to implement sorting algorithms and compare their performance analytically and empirically
- *CLO 4:* Implement and use search structures and algorithms including binary search, search trees, and hash tables.
- *CLO 5:* Compare and contrast the operation of common data structures (such as linear structures, priority queues, tree structures, hash tables, maps, and graphs) in terms of time complexity, space utilization, and the abstract data types they implement

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | √ | | | | | √ |
| *CLO 2* | √ | | | √ | √ | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to Data Structure:** Arrays and Strings, Algorithm Development, Complexity analysis, Recursion, Links Lists Operation-creations, insertions, deletions, circular list, doubly linked list. Application of linked list-polynomial, sparse matrix. | CLO 1, CLO 2 | 4 |
| **Linear Data Structure:** Stack, Queue, Circular queue, priority queue creations and operations using linked list and array. Stack application- Recursion, polish notation. Queue application- Johnsons algorithm, simulation. | CLO 1 | 6 |
| **Non-Linear Data Structure:** Basic tree concept, Binary tree representation, operation and traversal, thread binary tree, The Huffman algorithm, Expression tree, Introduction to multiday search tree and its creation(AVL,B-tree, B+ tree) | CLO 2, CLO 3, CLO 4 | 6 |
| **Sorting Methods:** Sort concept, shell sort, radix sort, insertion sort, quick sort, merge sort, head sort, bubble sort, tree sorting, bucket sort | CLO 3 | 4 |
| **Graph Algorithms:** Definition and Representation of graphs, graph traversal (BFS, DFS), Topological sort, Shortest Path Algorithms, Network flow problems, Minimum Spanning Tree, Application of BFS and DFS. | CLO 5 | 6 |
| **Searching:** List search, linear index search, tree searching sequential search, hashed list search, hashing methods, collision resolution. | CLO 4, CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- John R. Hubbard (2000): “Data Structures with C++”. Schaum's Outline Series.
- Yedidyah Langsam, Moshe J. Augenstein and Aaron M. Tanenbaum (2018): “Data Structures Using C”, 1st edition. Pearson.
- Sartaj Sahni and Dinesh Mehta Ellis Horowitz (2008): “Fundamentals of Data Structures in C”, 2nd edition or later.
- Alfred V. Aho, Jeffrey D. Ullman and John E. Hopcroft (1983): “Data Structures and Algorithms”, 1st edition or later. Pearson.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 2122 Data Structure** |
| Level & Semester | L-2, S-1 (January-June) |
| Pre-requisite course | CSM 1123, CSM 2121 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to provide practical knowledge in application of data structures. It also helps to develop skills to design and analyze simple linear and nonlinear data structures. It strengthens the ability to the students to identify and apply the suitable data structure for the given real world problem.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Write programs using basic abstract data types, such as array, linked list, stack, and queue.
*CLO 2:* Analyze the asymptotic time complexity of the fundamental operations associated with a variety of data structures, linked list, tree, and heap.
*CLO 3:* Acquire the basic Knowledge of and ability to implement sorting algorithms and compare their performance analytically and empirically
*CLO 4:* Implement and use search structures and algorithms including binary search, search trees, and hash tables.
*CLO 5:* Compare and contrast the operation of common data structures (such as linear structures, priority queues, tree structures, hash tables, maps, and graphs) in terms of time complexity, space utilization, and the abstract data types for solving real-life problems

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | √ | | | | | √ |
| *CLO 2* | √ | | | √ | √ | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| • Implementations of Linked Lists menu driven program.<br>• Implementation of different operations on linked list – copy, concatenate, split, reverse, count no. of nodes etc<br>• Representation of Sparse matrix using multilinked structure. Implementation of sparse matrix multiplication.<br>• Implementation of polynomials operations (addition, subtraction) using Linked List.<br>• Implementations of Linked Lists menu driven program (stack and queue)<br>• Implementations of Double ended queue using Linked Lists.<br>• Implementation of Priority queue program using Linked List | CLO 1, CLO 2 | 2 |
| • Implementations of stack menu driven program<br>• Implementation of multistack in one array.<br>• Implementations of Infix to Postfix Transformation and its evaluation program.<br>• Implementations of Infix to Prefix Transformation and its evaluation program.<br>• Simulation of recursion<br>• Implementations of circular queue menu driven program<br>• Implementations of double ended queue menu driven program<br>• Implementations of queue menu driven program<br>• Implementation of Priority queue program using array.<br>• Implementation of Johnsons Algorithm<br>• Implementation of Simulation Problem | CLO 1 | 3 |
| • Implementations of Binary Tree menu driven program<br>• Implementation of Binary Tree Traversal program.<br>• Implementation of construction of expression tree using postfix expression.<br>• Implementations of Huffman code construction | CLO 2, CLO 3, CLO 4 | 3 |

| | | |
|---|---|---|
| • Implementations of BST program<br>• Implementation of various operations on tree like – copying tree, mirroring a tree, counting the number of nodes in the tree, counting only leaf nodes in the tree.<br>• Implementations of B-tree menu driven program<br>• Implementations of B+ tree program<br>• Implementation of Preorder traversal of a threaded binary tree.<br>• Implementations of AVL Tree menu driven program | | |
| • Implementations of Shell sort, Radix sort and Insertion sort menu driven program<br>• Implementations of Quick Sort, Merge sort and Heap Sort menu driven program | CLO 3 | 2 |
| • Implementations of Graph menu driven program | CLO 5 | 3 |
| • Implementations of searching methods (Index Sequential, Interpolation Search) menu driven program<br>• Implementation of hashing functions with different collision resolution techniques | CLO 4,<br>CLO 5 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- John R. Hubbard (2000): "Data Structures with C++". Schaum's Outline Series.
- Yedidyah Langsam, Moshe J. Augenstein and Aaron M. Tanenbaum (2018): "Data Structures Using C", 1st edition. Pearson.
- Sartaj Sahni and Dinesh Mehta Ellis Horowitz (2008): "Fundamentals of Data Structures in C", 2nd edition or later.
- Alfred V. Aho, Jeffrey D. Ullman and John E. Hopcroft (1983): "Data Structures and Algorithms", 1st edition or later. Pearson.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 2123 Digital Logic Design** |
| Level & Semester | L-2, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of the course is to provide a modern introduction to logic design and the basic building blocks used in digital systems, in particular digital computers. It starts with a discussion of combinational logic: logic gates, minimization techniques, arithmetic circuits, and modern logic devices such as field programmable logic gates and then deals with sequential circuits: flip-flops, synthesis of sequential circuits, and case studies, including counters, registers, and random access memories. State machines will then be discussed and illustrated through case studies of more complex systems using programmable logic devices. Different representations including truth table, logic gate, timing diagram, switch representation, and state diagram will be discussed.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

*CLO 1:* Acquire basic knowledge on how to derive digital circuits from optimized Boolean equations and compute the Boolean equations of a digital circuit.

*CLO 2* Understand the principles and methodology of digital logic design at the gate and switch level, including both combinational and sequential logic elements.

*CLO 3:* Use Karnaugh maps to optimize combinatorial logic, including incompletely specified logic and also able to calculate and interpret costs and timing delay in combinational and sequential logic circuits.

*CLO 4:* Understand how to analyze and design combinational and sequential digital systems and use standard combinational and sequential digital building blocks including adders, multiplexers, decoders, encoders, and registers.

*CLO 5:* Analyze characteristic tables and equations and timing diagram of latches and flip-flops and also able to create state diagram from sequential circuits and design sequential circuits from state diagrams.

*CLO 6:* Design and verify by simulation a finite state machine satisfying given criteria.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | √ | | | |
| *CLO 2* | √ | | | | | | √ | | | |
| *CLO 3* | √ | | | | | | √ | | | |
| *CLO 4* | | | | | | | √ | | | √ |
| *CLO 5* | | | | | | | √ | | | √ |
| *CLO 6* | | | | | | | √ | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to Logic Design:** Number systems, logic gates and their truth tables, Combinational Circuits, Standard/Canonical form, Boolean algebra, De Morgan's Theorems, Algebraic simplification, the Karnaugh map method, Quine-McCluskey method. | CLO 1, CLO 2, CLO 3 | 4 |
| **Arithmetic Circuits:** Adder circuit. Carry propagation, carry look-ahead adder. IC parallel adder. The 2's complement addition and subtraction system. The BCD adder. Binary multiplier | CLO 3, CLO 4 | 6 |
| **MSI Logic Circuits:** Decoders, BCD-to-decimal decoders, BCD-to-7-segment decoder/driver. Encoders. Multiplexers and multiplexer applications. Demultiplexers. | CLO 4 | 6 |
| **Sequential Circuits:** Flip-flops: SR, JK, D and T flip-flops. The D latch. Master-slave FF. Flip-Flop applications. Edge triggering; FF synchronization. | CLO 5 | 4 |
| **Counters and Registers:** Asynchronous counter, Ripple counter, mod counters, Propagation delay, Synchronous up/down counters. Cascading counters. Registers; Counter and Register applications. | CLO 5 | 6 |
| **Finite State Machines:** Finite State machine models. Mealy machine, Moore machines. Machine minimization. | CLO 6 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- M. Moris Mano and Michael D. Ciletti (2007): Digital Design, 4th edition, Prentice Hall.
- T. L. Floyd (2009): "Digital Fundamentals", 10th Edition, Prentice Hall, USA.
- R. J. Tocci, N. S. Widmer and G. L. Moss (2011): "Digital Systems", 11th Edition. Prentice Hall, USA.
- C. Roth (2014): "Fundamental of Logic Design", 7th Edition. Thomson Brooks, USA.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

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|---|---|
| Course No. & Title | **CSM 2124 Digital Logic Design** |
| Level & Semester | L-2, S-1 (January-June) |
| Pre-requisite course | **CSM 2123** |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to provide a practical knowledge on digital logic design in digital systems, in particular digital computers. It starts with a discussion of combinational logic: logic gates, minimization techniques, arithmetic circuits, and modern logic devices such as field programmable logic gates and then deals with sequential circuits: flip-flops, synthesis of sequential circuits, and case studies, including counters, registers, and random access memories.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Demonstrate about logic gates.
*CLO 2* Use multiplexer in real time study.
*CLO 3:* Develop binary counter.
*CLO 4:* Apply flip flop in real life.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | √ | | | |
| *CLO 2* | √ | | | | | | √ | | | |
| *CLO 3* | √ | | | | | | √ | | | |
| *CLO 4* | | | | | | | √ | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Demonstrating the operation and characteristics of a TTL logic gate (NAND gate-7400) and implementing the three basic logic functions using NAND gate. | CLO 1, CLO 3 | 2 |
| Demonstrating the operation and characteristics of a CMOS logic gate (NOR gate-4001) and implementing the three basic logic functions using NOR gate | CLO 2 | 3 |
| TTL and CMOS, NAND, NOR, and XOR gates are used to implement any logic functions and implementing the Boolean algebra to reducing logic circuits to their minimum configuration. | CLO 4 | 1 |
| Implementing and investigating the operation of a 2-bit full adder, 4-bit full adder, and 4-bit full subtractors from basic combinational 74LS logic. | CLO 2 | 3 |
| Testing the operation of 74x138 decoder, and using it as demultiplexer. Implement the Boolean functions using 74x138 decode and 74151 multiplexers. | CLO 3 | 3 |
| Demonstrating the operations and characteristics of D-type flip-flop and JK-type flip-flop. Verify that the flip-flop is a bistable multivibrator (has two stable state). And it has two complementary output states. | CLO 4 | 2 |
| Demonstrating the operations and characteristics of a binary counter (up counter /down counter). | CLO 4 | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- M. Moris Mano and Michael D. Ciletti (2007): Digital Design, 4th edition, Prentice Hall.
- T. L. Floyd (2009): "Digital Fundamentals", 10th Edition, Prentice Hall, USA.
- R. J. Tocci, N. S. Widmer and G. L. Moss (2011): "Digital Systems", 11th Edition. Prentice Hall, USA.
- C. Roth (2014): "Fundamental of Logic Design", 7th Edition. Thomson Brooks, USA.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

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|---|---|
| Course No. & Title | **CSM 2125 Database Management System** |
| Level & Semester | L-2, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of the course is for students to become well-grounded in basic concepts necessary for understanding database and their users, DBMS concepts, architecture , the concepts of the Entity Relationship(ER) model, the data abstraction and semantic modeling concepts leading to ER data model, describe the basic relational model, its integrity constraints and update operations, and the operation of relational algebra, describe relational schema design, and it covers the normalization and functional dependency algorithm.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Understand, appreciate and effectively explain the underlying concepts of database technologies and also database administration.
- *CLO 2* Able to model an application's data requirements using ER diagrams
- *CLO 3:* Transform an E-R model into a relational database schema and to use a data definition language and/or utilities to implement the schema using a DBMS.
- *CLO 4:* Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
- *CLO 5:* Write SQL commands to create tables and indexes, insert/update/delete data, and query data in a relational DBMS.
- *CLO 6:* Transform biological sequence data into databases.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | √ | √ | | | | √ |
| *CLO 2* | √ | | | | √ | √ | | | | √ |
| *CLO 3* | √ | | | | √ | √ | | | | √ |
| *CLO 4* | √ | | | | √ | √ | | | | √ |
| *CLO 5* | √ | | | | √ | √ | | | | √ |
| *CLO 6* | √ | | | | √ | √ | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction:** Database, System Applications, Purpose of Database Systems, View of Data, Database Languages, Introduction to Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Database Users and Administrators, History of Database Systems. | CLO 1 | 4 |
| **Database Design and E-R Model:** Overview of the Design Process, The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams, Reduction to Relational Schemas, Entity-Relationship Design Issues, Extended ER Features, Alternative Notations for Modeling Data, Other Aspects of Database Design. | CLO 2 | 6 |
| **Relational Model and Its Design Techniques:** Introduction to the Relational model: Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, Relational Operations. Relational Database Design: Features of Good Relational Designs, Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies, Functional-Dependency Theory, Algorithms for Decomposition, Decomposition Using Multivalued Dependencies, More Normal Forms, Database- Design Process, Modeling Temporal Data. | CLO 3, CLO 4 | 4 |
| **Structured Query Language:** Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Subqueries, Modification of the Database. | CLO 5 | 6 |
| **Database Administration:** Transaction Management, Concurrency Control Object, Distributed and | CLO 1 | 6 |

| | | |
|---|---|---|
| Cloud Databases, Recovery management, Security system. | | |
| **Biological Database Management:** Introduction to Biological Data Integration , specifications, Challenges Faced in the Integration of Biological Information: -Nature of Biological data, Data sources in Life Sciences, Challenges in information integration, Data management in Bioinformatics, Dimensions -Describing the Space of Integration Solutions. | CLO 6 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Silberschatz (2016): "Database System Concepts", 6th Edition or later. McGraw Hill.
- Raghu Ramakrishnan, Johannes Gehrke (2003): "Database Management System", 3rd Edition or later. McGraw Hill.
- Elmashri and Navathe (2000): "Fundamentals of Database System", 3rd Edition or later. Addison-Wesley Publishing.
- C. J. Date (2001): "An Introduction to Database", 7th Edition or later. Addison-Wesley Pub Co.
- Jeffrey D. Ullman, Jennifer Widom (2001): "A First Course in Database System", 1st Edition or later. Prentice Hall, AWL.
- Peter Rob, Carlos Coronel (2001): "Database Systems - Design, Implementation, and Management", 4th Edition or later. Thomson Learning.
- Zoe Lacroix and Terence Critchlow (2003): "Bioinformatics: Managing Scientific Data". Morgan Kaufmann Publishers.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 2126 Database Management System** |
| Level & Semester | L-2, S-1 (January-June) |
| Pre-requisite course | CSM 2125 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of this course is to provide hands on experience on how to represent data in a database for a given application and how to manage and use a database management system. Emphasis is on data definition, data manipulation, and data control statements, normalization, object oriented model and structured XML data model.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Design and implement a database schema for a given problem domain
- *CLO 2* Create and maintain tables using PL/SQL
- *CLO 3:* Populate and query a database
- *CLO 4:* Apply Normalization techniques to normalize a database
- *CLO 5:* Application development using PL/SQL & front end tools

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | √ | √ | | | | √ |
| *CLO 2* | √ | | | | √ | √ | | | | √ |
| *CLO 3* | √ | | | | √ | √ | | | | √ |
| *CLO 4* | √ | | | | √ | √ | | | | √ |
| *CLO 5* | √ | | | | √ | √ | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Basics about RDBMS, Environment Set Up<br>Design an application using E-R diagram | CLO 1 | 2 |
| Implementing a sample database using DDL<br>Basics of DML(Insertion, Deletion, Update)<br>Basic Search Queries, Boolean Expressions, Pattern Matching in String | CLO 2,<br>CLO 3 | 3 |
| Introduction to SQL Joining(Cross Join, Inner Join, Natural Join, Outer Join), Aggregate Functions, Sub Query, Grouping in Query, Use of Having in Query) | CLO 4 | 3 |
| Normal forms and normalization, Functional dependencies, Schema refinement in database design, Object-oriented model, Semi-structured XML data model | CLO 4 | 5 |
| Mini project (Implementation of Inventory Control System, Hospital Management System, Railway Reservation System, Personal Information System, Time table Management system and Hotel management system, etc.) | CLO 5 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Silberschatz (2016): "Database System Concepts", 6th Edition or later. McGraw Hill.
- Raghu Ramakrishnan, Johannes Gehrke (2003): "Database Management System", 3rd Edition or later. McGraw Hill.
- Elmashri and Navathe (2000): "Fundamentals of Database System", 3rd Edition or later. Addison-Wesley Publishing.
- C. J. Date (2001): "An Introduction to Database", 7th Edition or later. Addison-Wesley Pub Co.
- Jeffrey D. Ullman, Jennifer Widom (2001): "A First Course in Database System", 1st Edition or later. Prentice Hall, AWL.
- Peter Rob, Carlos Coronel (2001): "Database Systems - Design, Implementation, and Management", 4th Edition or later. Thomson Learning.
- Zoe Lacroix and Terence Critchlow (2003): "Bioinformatics: Managing Scientific Data". Morgan Kaufmann Publishers.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 2127 Discrete Mathematics** |
| Level & Semester | L-2, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to familiarize the students with propositional and predicate calculus, quantification, mathematical induction, sets, sequences, relations and functions, as well as fundamental ideas about combinatorial analysis, recurrence relations, graphs, and tree theory.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire the basic knowledge on logics, sets, functions, relations.
- *CLO 2:* Construct proofs using direct proof, proof by contradiction, and proof by cases, or mathematical induction.
- *CLO 3:* Solve problems using counting techniques and combinatory.
- *CLO 4:* Know essential concepts in graph theory and related algorithms
- *CLO 5:* Apply algorithms and use definitions to solve problems to proof statements in elementary number theory.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | | | | √ | | | |
| *CLO 2* | √ | | √ | | | | √ | | | √ |
| *CLO 3* | √ | | √ | | | | √ | | | √ |
| *CLO 4* | √ | | √ | | | | √ | | | |
| *CLO 5* | √ | | √ | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Logics and Sets:** Propositional logic, logical equivalence, predicates & quantifiers, and logical reasoning. Sets, Operations on sets, Binary Relations, Equivalence Relations, Partial Orders. | CLO 1 | 4 |
| **Functions and Relations:** Domain, Range, One-to-One, Onto, Inverses and Composition, One-to-One Correspondence and the Cardinality of a Set. Properties of relation, Combining relations, Closures, Equivalence, partial ordering | CLO 1 | 6 |
| **Integers, Sequence and Summation:** Prime numbers and divisibility, Fundamental Theorem of Arithmetic, Euclidean Algorithm, Modular Arithmetic, Solving Linear Congruence's, Sequences, sums and products. | CLO 5 | 6 |
| **Induction and Recursion:** Mathematical Induction, Recursively Defined Sequences, Solving Recurrence Relations: The Characteristic Polynomial, Generating Functions. | CLO 2 | 5 |
| **Counting and Probability:** basic rules, Pigeon hall principle, Permutations and combinations, Binomial coefficients and Pascal triangle. Discrete probability. Expected values and variance. | CLO 3, CLO 5 | 6 |
| **Graphs:** Basic terminology, simple graphs, Kn. Directed graphs. Subgraphs, complementary graphs. Degree, the Handshaking Theorem, Bipartite graphs, $K_{m,n}$., Adjacency and incidence matrices, Isomorphism, isomorphism invariants. Walks, paths and circuits, Euler and Hamilton paths, Connected graphs, connected components. Planar graphs, Euler's formula, Dual graphs, Necessary conditions for planarity, Kuratowski's Theorem, Trees, spanning trees. Weighted graphs, Minimal spanning trees, Kruskal and Dijkstra algorithm. | CLO 4 | 5 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Kenneth Rosen (2012): “Discrete Mathematics and Its Applications”, 7th Edition. McGraw Hill Publishing Co.
- Goodaire and Parmenter (2006): “Discrete Mathematics with Graph Theory”, 2nd edition. Pearson
- Richard Johnsonbaugh (2007): "Discrete Mathematics", 7th edition. Pearson.
  Susanna Epp (2010): "Discrete Mathematics with Applications", 4th edition. Brooks Cole.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 2129 Differential Equations** |
| Level & Semester | L-2, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of the course is to familiarize with the applications of differential equation and series solutions. To apply advanced applications knowledge to Engineering problems and equip themselves familiar with the concepts of differential equation. Acquaint the students to identify the appropriate theorem and use it to solve most of ODE and PDE problems that involves calculations.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

*CLO 1:* Acquire basic knowledge on the principles of mathematics and describe the basic parts of retention of terminology and its uses.
*CLO 2:* Identify a general method for constructing solutions to inhomogeneous linear constant-coefficient second-order equations.
*CLO 3:* Use the operator method to solve linear systems with constant coefficients.
*CLO 4:* Able to solve first and higher order ordinary differential equations.
*CLO 5:* Evaluate the initial and boundary conditions to obtain particular values of constants in the general solution of second-order differential equations.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | √ | | | | √ | | | |
| *CLO 2* | | | √ | | | | √ | | | |
| *CLO 3* | | | √ | | | | √ | | | |
| *CLO 4* | | | √ | | | | √ | | | |
| *CLO 5* | | | √ | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to differential equations:** Formation of a differential equation, Degree and order of a differential equation, Solutions: General, particular, and singular; Homogeneous and Non-homogeneous differential equations, Initial and boundary conditions. | CLO 1 | 4 |
| **First order and first degree differential equations:** Equations in which the variable are separable, Homogeneous equations, Linear equations and equations reducible to linear form, First order higher degree equations solvable for x, y, p; Clairaut's form and singular solutions, Orthogonal trajectories, Linear differential equations with constant coefficients, Homogeneous linear ordinary differential equations. | CLO 2 | 6 |
| **Higher order differential equations:** Linear differential equations of second and higher order with constant coefficients, Operator method, Method of variation of parameters, Undetermined coefficients, Cauchy Euler equations. | CLO 3 | 6 |
| **Partial differential equations:** Formation of PDEs, Types of solutions, PDEs of the first order, Some special types of equations, Charpit's and Jacobi's general method, PDEs of second and higher order, Classification of linear partial differential equations, PDEs reducible to equations with constant coefficients, Monge's methods. | LO-4 | 10 |
| **Series solutions of differential equations:** Power series method, Bessel, Legendre and Hypergeometric functions and their properties; recurrence and generating relations, Orthogonality of functions, Sturra-Liouville problem, Orthogonality of eigen functions and eigenvalues. Orthogonality of Bessel functions and Legendre polynomials. | CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Shepley L. Ross (2008): "Differential Equations", 3rd or later Edition. John Wiley & Sons.
- C. Henry Edwards and David E. Penney (2014): "Differential Equations: Computing and Modeling". Pearson.
- B.D. Sharma (2003): "Differential Equations". Kedar Nath Ram Nath, New Delhi.
- Boyce and Diprima (1965): "Elementary Differential Equations and Boundary Value Problems". Wiley.
- M. Braun (1975): "Differential Equations and their Applications". Springer.

**Department of Rural Sociology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **RS 2101 Sociology of Technology and Innovation** |
| Level & Semester | L-2, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course provides engineering students with a comprehensive idea of sociology that will help them to apply sociological perspectives in analyzing social issues in their academic and professional career.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

CLO1: Discuss scientific perspectives in explaining social reality
CLO2: Explain the relationship between culture and socialization
CLO3: Synthesize social inequality and rural development; and achieve knowledge on technology and innovation
CLO4: Analyze the microsphere industry environment and macroeconomic society
CLO5: Apply skills in conducting social research

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | √ | | | |
| *CLO 2* | | | | | | | | √ | | |
| *CLO 3* | | | | | | | | √ | | |
| *CLO 4* | | | | | | | √ | | | |
| *CLO 5* | | | | | | | | | √ | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Scientific Study of Society:** Concept on society and sociology, Rural vs. urban sociology, Importance of sociology for the engineer, Role of the Sociologists in Agricultural Development | CLO 1 | 5 |
| **Culture and socialization:** Meaning, importance and elements of culture, Cultural variability, Cultural lag, Culture and technology, Globalization of culture, Socialization and personality development. | CLO 2 | 6 |
| **Social Inequality and Change:** Differentiation, stratification and inequality; Rural power structure; Technology and gender, Society, technology and social change; Social application of biotech and InfoTech, Knowledge-technology-innovation; Rural social policy and planning; Rural development. | CLO 3 | 5 |
| **Microspheres Industry:** Business and sociological understanding; Structure of company and workgroups; Industry, business and social environment; Socio-psychological dynamics of work; Social consequences of the division of labor; Humanization of work environment. | CLO 4 | 5 |
| **Macroeconomic Sociology:** Economic and social development of the modern world, Industrial revolution and social inequality, Modernization and its social consequences, Central and peripheral companies, Sustainable development, Economic development and social exclusion. | CLO 5 | 6 |
| **Methods and Techniques of Social Research:** Concept of research, Importance, Value judgment and ethical issues, Research process, Sampling, Mode of data collection, Analysis of social data | CLO 6 | 5 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Samantha Hillyard (2007): “The sociology of rural life”.
- Robert M. Moore (2001): “The Hidden America: Social Problems in Rural America for the Twenty-First Century”, Susquehanna University Press.
- Paul Milbourne (2004): “Rural Poverty: Marginalization and Exclusion in Britain and the United States”, Routledge.
- John B. Chitamber (1997): “Introductory Rural Sociology: A synopsis of concepts and principles".
- Ranjit Kumar (2005): "Research Methodology-A Step-by-Step Guide for Beginners", Singapore, Pearson Education.
- John M. Macionis (1999): "Sociology", London: Prentice-Hall.
- Giddens, Anthony (1998): "Sociology", 3rd edition, Polity Press: London.

**Department of Microbiology and Hygiene**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **VMH 2103 Basic Microbiology and Immunology** |
| Level & Semester | L-2, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

This course is designed for students with an engineering background to learn the fundamentals of microbiology and immunology. The course emphasizes conceptual appreciation relevant to microbial infection caused by microorganism also biological importance of cells that are responsible for immune system. Topics covered are: General concepts of microorganism, Microbial genetics and Microbial Bioinformatics, , cell and organs of immune system, antigens, antibodies, Genetic control of antibody production, T-cell & B- cell, immune system, its function and also the response to the foreign bodies.

**Course Learning Outcome (CLO)**

Upon completion of this course, the student will be able to:

*CLO-1:* Acquire knowledge relevant to Basic concepts of microorganism.
*CLO-2:* Acquire the basic information about Microbial genetics and Bioinformatics
*CLO-3:* Know the relationship between Host and Microorganisms.
*CLO-4:* Understand about different organs and cells involved in innate and adaptive immunity.
*CLO-5:* Describe about Antigen-Antibody interactions and hypersensitivity reactions.
*CLO-6:* Design primers and analyze sequences of different gene of microorganisms

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | | | | |
| *CLO 4* | | √ | | | | | | | | |
| *CLO 5* | | √ | | | | | √ | | | |
| *CLO 6* | | | | √ | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Introduction to Microbiology, General properties of different Microorganisms | CLO 1, CLO 2 | 2 |
| Bacterial Taxonomy, Bacterial structures, classification and growth, Bacterial Genetics. | CLO 1, CLO 2 | 2 |
| Fungal genetics and reproduction | CLO 1, CLO 2 | 6 |
| Virus structure and genetics, Host-virus relationship, Viral and Bacterial pathogenesis | CLO 1, CLO 2 CLO 3 | 4 |
| Introduction to cells, types and functions of cells, organs of the immune system | CLO 3, CLO 4 | 4 |
| Classification of immune system – innate and adaptive immunity. Antigen recognition by T-cells and B cells | CLO 4, CLO 5 | 4 |
| Antigens, Antibodies and their structure | CLO 4, CLO 5 | 4 |
| Genetic control of antibody production, production of monoclonal and polyclonal antibodies, Different types of hypersensitivity reactions. | CLO 3, CLO 4, CLO 5 | 3 |
| Primer design, Sequencing, Sequence and Genome analysis. | CLO 6 | 3 |

**Teaching Strategy**

Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**

Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Subhash Chandra Parija. "Textbook of Microbiology and Immunology" Paperback – Elsevier; Second edition 2012
- N Arumugam, Dulsy Fatima. "Immunology & Microbiology". Saras Publication (2013)
- Parija. "Textbook of Microbiology & Immunology" Elsevier India, 2009
- R. Vasanthakumari. "Textbook of Microbiology" BI Publications Pvt Ltd, 2007.
- Peter J. Delves, Seamus J. Martin, Dennis R. Burton and Ivan M. Roitt "Immunology" W. H. Freeman – Paperblack 5th edition 2002

**Department of Microbiology and Hygiene**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **VMH 2104 Basic Microbiology and Immunology** |
| Level & Semester | L-2, S-1 (January-June) |
| Pre-requisite course | VMH 2103 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

This course is designed for students with an engineering background to learn the fundamentals of microbiology and immunology. The course emphasizes conceptual appreciation relevant to microbial infection caused by microorganism and also biological importance of cells that are responsible for immune system. Topics covered are: General concepts of microorganism, Microbial genetics and Microbial Bioinformatics, cell and organs of immune system, antigens, antibodies, Genetic control of antibody production, T-cell & B- cell, immune system, its function and also the response to the foreign bodies.

**Course Learning Outcome (CLO)**

Upon completion of this course, the student will be able to:

*CLO-1:* Acquire knowledge to maintain basic safety protocol at laboratory
*CLO-2:* Apply Knowledge to isolate different microorganisms.
*CLO-3:* Identify different microorganisms using different techniques
*CLO-4:* Identify microorganisms using serological and molecular techniques
*CLO-5:* Design primers and analyze sequences of different gene of microorganisms

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | | | | |
| *CLO 4* | | √ | | | | | | | | |
| *CLO 5* | | √ | | √ | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Sterilization and disinfection, Culture of bacteria and fungi on different culture media, Identification of organisms by staining, biochemical tests, Antimicrobial sensitivity tests | CLO 1, CLO 2, CLO 3 | 3 |
| Cultivation and titration of virus in different host system | CLO 2, CLO 3 | 5 |
| Serological test for identification of antibody, microbial antigen and determination of immune status- agglutination test, precipitation test, AGIDT, ELISA and IFAT tests | CLO 3, CLO 4 | 3 |
| Molecular techniques for identification of microorganisms-PCR, RT-PCR, Gel electrophoresis and SDS-PAGE, Southern and Western blotting. | CLO 3, CLO 4 CLO 5 | 5 |

**Teaching Strategy**

Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**

Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Subhash Chandra Parija. "Textbook of Microbiology and Immunology" Paperback – Elsevier; Second edition 2012
- N Arumugam, Dulsy Fatima. "Immunology & Microbiology". Saras Publication (2013)
- Parija. "Textbook of Microbiology & Immunology" Elsevier India, 2009
- R. Vasanthakumari. "Textbook of Microbiology" BI Publications Pvt Ltd, 2007.
- Peter J. Delves, Seamus J. Martin, Dennis R. Burton and Ivan M. Roitt "Immunology"
- W. H. Freeman – Paperblack 5th edition 2002
- Sambrook, Fritch and Maniatis. "Molecular cloning, A laboratory manual". 4th edition, 2012.

**Level- 2, Semester- 2**

**Agricultural and Applied Statistics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **AAS 2207 Biostatistics** |
| Level & Semester | L-2, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 03 |
| Contact hours | 03 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
Students with necessary knowledge on statistics will be able to plan, design and execute experiment for making better decision.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

CLO 1: Describe the roles biostatistics serves in bioinformatics.
CLO 2 Numerical, tabular, and graphical descriptive techniques commonly used to characterize and summarize real world data.
CLO 3 Define basic terminology, laws and distributions of probability, sampling technique and distribution,
CLO 4: Measure linear relationship between two or more variables and test of hypotheses regarding the parameters of the population.
CLO 5: Evaluate computer output containing statistical procedures and graphics and interpret it in a biostatistics context.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | ✓ | | ✓ | | | | | |
| *CLO 2* | | | ✓ | | ✓ | | | | | |
| *CLO 3* | | | ✓ | | | | | | | |
| *CLO 4* | | | ✓ | | | | | | | |
| *CLO 5* | | | ✓ | | | | ✓ | ✓ | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Exploring Data:** Raw data, attributes and variables, frequency distribution and cumulative frequency distribution, Graphical presentation of frequency distribution, Central tendency and its measures, Dispersion and its measures, Measures of dispersion for comparison, Moments, Skewness and Kurtosis. | CLO 1, CLO 2 | 5 |
| **Probability:** Theory of probability, Deterministic and non-deterministic models, Random experiment, Sample spaces, Events, Probability, Theorems of probability, conditional probability, Bayes' theorem,<br>Random variable, Discrete and continuous Random variables, probability mass function, distribution function and its properties, probability density function, Distribution function for continuous random variable and its properties, Mathematical expectation its properties, mean and variance, theorems on expectation, Determination of median and mode. | CLO 3, CLO 5 | 7 |
| **Probability Distributions:** Uniform distribution, Bernoulli distribution, Binomial distribution, Geometric distribution, Poisson distribution and Normal distribution. | CLO 3, CLO 5 | 5 |
| **Correlation and Regression:** Bivariate data, scatter diagram, Correlation, positive correlation, negative correlation, zero correlation, Karl Pearson's coefficient of correlation (r), interpretation of r, coefficient of determination ($r^2$) and interpretation as strength of relation. Regression, Linear regression, Fitting of straight line using least squares method, Properties of regression coefficients, Non-linear regression models, Residual plot, mean residual sum of squares, Multiple and Partial Regression and Correlation. | CLO 4, CLO 5 | 7 |
| **Theory of Estimation and Test of Hypothesis:** Statistical inference methods, estimate population parameters, construct confidence intervals for means and proportions. Hypothesis, null and alternative hypotheses, type I error, type II error, level of significance. Basic steps for testing hypothesis. Statistical tests: a population mean is equal to a specified value, equality of two population means (independent & correlated), significance of correlation and regression coefficients, independence of attributes and ANOVA. | CLO 4, CLO 5 | 8 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Bernard Rosner, B. (2015). *Fundamentals of Biostatistics*, 8th edition. Brooks Cole.
- Geoffrey R. Norman and David L. Sreiner (2014*): Biostatistics: The Bare Essentials*, 4th edition or later. People's Medical Publishing House - USA, Ltd.
- Gomez, A. K. & A. A. Gomez (2010). *Statistical Procedures for Agricultural Research*. 2nd edition. Wiley-India.
- Gupta, S. C. and V. K. Kapur (2007). *Fundamentals of Mathematical Statistics*. 12th edition, Sultan Chand & Sons, New Delhi.
- Harvey Motulsky, H. (2015). *Essential Biostatistics: A Nonmathematical Approach*, 1st edition or later. Oxford University Press.
- Islam, M. N. (2011). *An Introduction to Statistics and Probability*, 3rd edition, Mullick & Brothers, Dhaka.
- Motulsky, H. (2013). *Intuitive Biostatistics: A Nonmathematical Guide to Statistical Thinking*, 3rd edition or later. Oxford University Press.
- Pagano, M. and Gauvreau, K. (2000). *Principles of Biostatistics*, 2nd edition or later. Cengage Learning.
- Steel, R. G. D. and J. H. Torrie (1980). *Principles and Procedures of Statistics*, McGraw-Hill International Book Company, New York.

**Agricultural and Applied Statistics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **AAS 2208 Biostatistics** |
| Level & Semester | L-2, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
Students with necessary knowledge on statistics will be able to analyzing experimental and biological survey data.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

CLO 1: Identify different types of variable and draw appropriate diagram.
CLO 2 Compute different measures of location, dispersion and shape characteristics of a frequency distribution.
CLO 3 Calculate and interpret the coefficients of correlation and regression.
CLO 4: Execute different statistical tests regarding the population parameters.
CLO 5: Analyze experimental data and analysis of variance.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | ✓ | | ✓ | | | | | |
| *CLO 2* | | | ✓ | | ✓ | | | | | |
| *CLO 3* | | | ✓ | | | | | | | |
| *CLO 4* | | | ✓ | | | | | | | |
| *CLO 5* | | | ✓ | | | | ✓ | ✓ | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Construction of frequency tables and their graphical representation. Measures of location and variation. Measures of moments, skewness and kurtosis | CLO 1, CLO 2 | 2 |
| Pearson's correlation coefficient. Fitting linear regression to observed data by the method of least squares. | CLO 3, CLO 4 | 3 |
| Statistical tests: A population mean is equal to a specified value, equality of two population means (for both independent & correlated samples), a population proportion is equal to a specified value, equality of two population proportions, independence of attributes, significance of correlation and regression coefficients. | CLO 4 | 6 |
| Analysis of variance for completely randomized design (CRD), randomized block design (RBD), latin square design (LSD) and split plot design. Multiple comparison tests. | CLO 5 | 5 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Islam, M. N. (2011): "An Introduction to Statistics and Probability". Mullick & Brothers, Dhaka. 3rd edition or later.
- Mood, A. M., Graybill, F. A. and D. C. Boes (1974): "Introduction to the Theory of Statistics". McGraw-Hill. 3rd edition or later.
- Rangaswamy, R. (2013): "A Textbook of Agricultural Statistics", New Age International (P) Limited, Publishers, India. 2nd edition or later.
- Montogomery, D. C. (2012): "Design and Analysis of Experiments", John Wiley & Sons. 8th edition or later.
- Steel, R. G. D. and J. H. Torrie (1980): "Principles and Procedures of Statistics", McGraw-Hill Int. Book Company, New York.
- Gomez, A. K. and A. A. Gomez (2010): "Statistical Procedures for Agricultural Research". Wiley-India. 2nd edition or later.
- Zaman, S. M. H., K. Rahim and M. Howlader (1982): "Simple Lessons from Biometry". Joydebpur, Bangladesh
- Bernard Rosner, B. (2015). Fundamentals of Biostatistics, 8th edition. Brooks Cole.

- Geoffrey R. Norman andDavid L. Sreiner (2014): Biostatistics: The Bare Essentials, 4th edition or later. People's Medical .USA, Ltd -e Publishing Hous

**Department of Agricultural Economics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **AE 2205 Introductory Economics** |
| Level & Semester | L-2, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course provides an introduction to supply and demand and the basic forces that determine an equilibrium in a market; a framework for learning about consumer behavior and analyzing consumer decisions; firms and their decisions about optimal production, and the impact of different market structures on firms' behavior; some of the more advanced topics that can be analyzed using microeconomic theory.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Understand consumer behavior.
*CLO 2:* Understand firm behavior.
*CLO 3:* Analyze different types of market structures (monopoly, oligopoly and a competitive market).
*CLO 4:* Understand how to apply economic principles to a range of policy questions.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | √ | √ | √ | |
| *CLO 2* | | | | | | | √ | √ | | |
| *CLO 3* | | | | | | | √ | √ | | |
| *CLO 4* | | | | | | | √ | √ | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Supply and Demand:** Introduction to microeconomics; Applying supply and demand; Elasticity. | CLO 1, CLO 2 | 6 |
| **Consumer Theory:** Preferences and utility; Budget constraints; Deriving demand curves; Applying consumer theory: Labor. | CLO 1, CLO 4 | 4 |
| **Producer Theory:** Introduction to Producer Theory; Productivity and Costs. | CLO 2 | 6 |
| **Markets:** Classification and characteristics of different market types: Perfect Competition, Monopolistic Competition, Monopoly and Oligopoly | CLO 3 | 4 |
| **Welfare Economics:** Competition; Principles of welfare economics. | CLO 4 | 6 |
| Factor markets; International trade; Uncertainty; Capital supply and markets; Equity and Efficiency. | CLO 4 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**
- Jeffrey M. Perloff (2017): "Microeconomics", 8th edition or later. Pearson.
- N. Gregory Mankiw (2014): "Principles of Microeconomics", 7th edition or later. South-Western College Pub.
- Paul Krugman and Robin Wells (2014): "Microeconomics", 4th edition or later. Worth Publishers.
- Robert Pindyck and Daniel Rubinfeld (2012): "Microeconomics", 8th edition or later. Pearson.
- R. Glenn Hubbard and Anthony Patrick O'Brien (2016): "Microeconomics", 6th edition or later. Pearson.
- David C Colander (2012): "Microeconomics", 9th edition or later. McGraw-Hill Education

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 2221 Bioinformatics Algorithms** |
| Level & Semester | L-2, S-2 (July-December) |
| Pre-requisite course | CSM 2121, CSM 2122 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of the course is to teach techniques for effective problem solving in computing. The use of different paradigms of problem solving will be used to illustrate clever and efficient ways to solve a given problem. In each case emphasis will be placed on rigorously proving correctness of the algorithm. In addition, the analysis of the algorithm will be used to show the efficiency of the algorithm over the naive techniques.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Understand the correctness of, and analyze the running times of, different algorithms.
- *CLO 2:* Use different algorithm-design techniques, including, but not limited to, greedy, divide-and-conquer, and dynamic programming techniques, to solve particular problems.
- *CLO 3:* Model real problems abstractly using the language of graphs and flows.
- *CLO 4:* Solve problems by reducing to other problems whose solution is known, and show that problems are hard by reducing from other problems.
- *CLO 5:* Develop intelligent decisions about alternative data structures and algorithmic techniques in the context of practical problems, choosing from existing data structures and algorithms or designing your own when necessary.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | √ | | √ | | | | √ |
| *CLO 2* | √ | | √ | √ | | √ | | | | √ |
| *CLO 3* | √ | | √ | √ | | √ | | | | √ |
| *CLO 4* | √ | | √ | √ | | √ | | | | √ |
| *CLO 5* | √ | | √ | √ | | √ | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction:** The Role of Algorithms in Computing, Growth of Functions, Asymptotic notation, Standard notations and common functions | CLO 1 | 4 |
| **Sorting:** Insertion sort, Bubble sort, Merge sort, Heap Sort, Selection sort.<br>**Greedy Algorithms:** An activity-selection problem, Elements of the greedy strategy, Huffman codes, Matroids and greedy methods, A task-scheduling problem as a matroid. | CLO 2 | 6 |
| **Dynamic Programming:** Rod cutting, Matrix-chain multiplication, Elements of dynamic programming, Longest common subsequence, Optimal binary search trees.<br>**Divide-and-Conquer:** The maximum-subarray problem, Strassen's algorithm for matrix multiplication, The substitution method for solving recurrences, The recursion-tree method for solving recurrences. | CLO 2 | 6 |
| **Graph Algorithms:** Representations of graphs, Breadth-first search, Depth-first search, Topological sort, Strongly connected components, Minimum Spanning Trees, Growing a minimum spanning tree, The algorithms of Kruskal and Prim, Single-Source Shortest Paths :The Bellman-Ford algorithm, Single-source shortest paths in directed acyclic graphs, Dijkstra's algorithm, All-Pairs Shortest Paths, Shortest paths and matrix multiplication, The Floyd-Warshall algorithm, Johnson's algorithm for sparse graphs, Maximum Flow:<br>Flow networks, The Ford-Fulkerson method, Maximum bipartite matching. | CLO 3 | 10 |
| **NP-Completeness:** Polynomial time, Polynomial-time verification, NP-completeness and reducibility, NP-completeness proofs, NP-complete problems.<br>**Approximation Algorithms:** The vertex-cover problem, The traveling-salesman problem, The set-covering problem, Randomization and linear programming. | CLO 4, CLO 5 | 6 |

**Teaching Strategy**

Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Cormen, Leiserson, Rivest, and Stein (2001): "Introduction to Algorithms", 2nd edition or later. MIT press.
- Dasgupta, Papadimitrou and Vazirani (2006): "Algorithms". McGraw-Hill Education.
- Horowitz, Sahni, and Rajasekaran (2007): "Computer Algorithms". Silicon Press.
- Kleinberg and Tardos (2005): "Algorithm Design". Pearson.
- Goodrich and Tamassia (2001): "Algorithm Design". Wiley.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 2222 Bioinformatics Algorithms** |
| Level & Semester | L-2, S-2 (July-December) |
| Pre-requisite course | CSM 2221 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

In this laboratory after completing experiments student has to learn how to analyze a problem & design the solution for the problem. In addition to that, solution must be optimum, i.e., time complexity & memory usage of the solution must be very low

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Know the appropriate algorithmic design technique to specific problems.
- *CLO 2:* Understand methods for analyzing the efficiency and correctness of algorithms (such as exchange arguments, recurrence, induction, and average case analysis)
- *CLO 3:* Design algorithms using the dynamic programming, greedy method, Backtracking, Branch and Bound strategy, and recite algorithms that employ this strategy
- *CLO 4:* Identify and analyze criteria and specifications appropriate to new problems.
- *CLO 5:* Develop the efficient algorithms for the new problem with suitable designing techniques.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | √ | | √ | | | | √ |
| *CLO 2* | √ | | √ | √ | | √ | | | | √ |
| *CLO 3* | √ | | √ | √ | | √ | | | | √ |
| *CLO 4* | √ | | √ | √ | | √ | | | | √ |
| *CLO 5* | √ | | √ | √ | | √ | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Consider the problem of eight queens on an (8x8) chessboard.<br>Two queens are said to attack each other if they are on the same row, column, or diagonal.<br>Write a program that implements backtracking algorithm to solve the problem i.e. place eight non-attacking queens on the board. | CLO 1,<br>CLO 3,<br>CLO 5 | 2 |
| Write a program to find the strongly connected components in a digraph.<br>Write programs to implement the following:<br>a) Prim's algorithm.<br>b) Kruskal's algorithm. | CLO 2,<br>CLO 5 | 3 |
| Write a program to implement dynamic programming algorithm to solve all pairs shortest path problem.<br>Write a program to implement file compression (and un-compression) using Huffman's algorithm. | CLO 2,<br>CLO 3,<br>CLO 5 | 3 |
| Write a program that uses dynamic programming algorithm to solve the optimal binary search tree problem.<br>Write a program to find optimal ordering of matrix multiplication.<br>Write a program to solve 0/1 knapsack problem using the following:<br>a) Greedy algorithm.<br>b) Dynamic programming algorithm.<br>c) Backtracking algorithm.<br>d) Branch and bound algorithm. | CLO 3,<br>CLO 5 | 5 |
| Write a program for solving traveling sales persons problem using the following:<br>a) Dynamic programming algorithm.<br>b) The back tracking algorithm.<br>c) Branch and Bound. | CLO 3,<br>CLO 4,<br>CLO 5 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Cormen, Leiserson, Rivest, and Stein (2001): "Introduction to Algorithms", 2nd edition or later. MIT press.
- Dasgupta, Papadimitrou and Vazirani (2006): "Algorithms". McGraw-Hill Education.
- Horowitz, Sahni, and Rajasekaran (2007): "Computer Algorithms". Silicon Press.
- Kleinberg and Tardos (2005): "Algorithm Design". Pearson.
- Goodrich and Tamassia (2001): "Algorithm Design". Wiley.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 2224 Internet programming** |
| Level & Semester | L-2, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of this course is to give real-world knowledge on the design and techniques for developing internet-based applications, mainly focusing on web programming. Topics include HTML, client-side scripting language (JavaScript), server-side programming (Servlets, JSP, and J2EE or PHP or asp.net), and XML/web services.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire fundamental knowledge on internet programming.
- *CLO 2:* Understand the architecture of the Internet and the organization and standards that make it the World Wide Web at both the underlying structure and the browser/server levels.
- *CLO 3:* Have a comprehensive knowledge of the semantics and syntax of HTML, Javascript, and Java applets, servlets, and JSP or any server side language.
- *CLO 4:* Compare and contrast competing web application architectures and list their advantages and disadvantages.
- *CLO 5:* Design and develop interactive, client-side, executable web applications

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | √ | | | | √ |
| *CLO 2* | √ | | | | | √ | | | | √ |
| *CLO 3* | √ | | | | | √ | | | | √ |
| *CLO 4* | √ | | | | | √ | | | | √ |
| *CLO 5* | √ | | | | | √ | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Internet Overview :**<br>• Networks, TCP-IP, Web Organization and Addressing<br>• Ports, Packets, Routers, and Routing<br>• Web Browsers and Web Servers<br>• Client/Server Architectures<br>• Security | CLO 1, CLO 2 | 2 |
| **Web Page Basics:**<br>• HTML, Javascript, and CGI scripts<br>• Designing a web presence<br>• Building dynamic applications | CLO 1, CLO 3 | 3 |
| **Web Applications:**<br>• Java and Applets (client side applications)<br>• CGI (server side applications)<br>• Servlets and JSP (server side applications)<br>• PHP or ASP.NET | CLO 1, CLO 3, CLO 4 | 3 |
| **Advanced Web Applications:**<br>• Crawlers and Search Engines<br>• Advanced Interactive Tools<br>• Distributed and Redundant Resources | CLO 3 | 5 |
| • Legal and Ethical Issues<br>• Clear and Technically Correct Page Contents<br>• project | CLO 3, CLO 4 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Larry Ullman (2017): "PHP and MySQL for Dynamic Web Sites: Visual QuickPro Guide", 5th edition or later. Peachpit Press.
- Steven M. Schafer (2010): "HTML, XHTML, and CSS Bible", 5th edition or later. Wiley Publishing.
- Deital and Deital, Goldberg (2004): "Internet & World Wide Web, How To Program", 3rd edition or later. Pearson Education.
- Paul Wilton and Jeremy McPeak (2009): "Beginning JavaScript", 4th edition or later. Wrox
- Adrian Kingsley-Hughes, Kathie Kingsley-Hughes, Daniel Read (2007): "VBScript Programmer's Reference", 3rd edition or later. Wrox.
- Vivek Chopra, Jon Eaves, Rupert Jones, Sing Li, John T. Bell (2005): "Beginning JavaServer Pages", 5th edition. Wrox.
- Macdonald Mathew (2002): "Asp.Net - The Complete Reference", 2nd edition. McGraw-Hill/ Osborne.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 2225 Numerical Methods** |
| Level & Semester | L-2, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for BSc in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to provide the student with numerical methods of solving the non-linear equations, interpolation, differentiation and integration. To improve the student's skills in numerical methods by using the numerical analysis software and computer facilities.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:
*CLO 1:* Knowledge of basic theorems and concepts in the different areas of mathematics.
*CLO 2:* Ability to understand the different math concepts and be able to implement them in our everyday problems.
*CLO 3:* Efficient use of computers, laboratories and soft wares to handle problems that are difficult to be solved manually.
*CLO 4:* Understanding of professional and ethical responsibilities.
*CLO 5:* Efficient use of the techniques, skills, and tools of modern mathematics.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | √ | | | | √ | | | |
| *CLO 2* | | | √ | | | | √ | | | |
| *CLO 3* | | | √ | | | | √ | | | |
| *CLO 4* | | | √ | | | | √ | | | |
| *CLO 5* | | | √ | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Numerical solutions of algebraic and transcendental equations:** Bisection method, Newton-Raphson method, False position method and Iteration method. | CLO 1 | 4 |
| **Finite difference:** Newton's forward differences, backward differences and Central Differences; Shifting operator, Relations between the operators. | CLO 2 | 6 |
| **Interpolation:** Newton-Gregory formulae for forward and backward interpolation with equal intervals, Divided differences, Lagrange's interpolation formulae for unequal intervals, Inverse interpolation. | CLO 3 | 6 |
| **Numerical differentiation and integration:** Newton's forward and backward differences formulae to compute first and higher order derivatives, Trapezoidal rule, Simpson's one third rule and three eighth rule. | CLO 4 | 10 |
| **Numerical solutions of ordinary differential equations:** Picard's method for successive approximation, Euler's method, Improved and modified Euler method, Runge-Kutta methods of fourth order formulae. | CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- S.S. Sastry (2012): "Introductory Methods of Numerical Analysis", 4th edition. Prentice Hall.
- F. B. Hildebrand (2013): "Introduction to Numerical Analysis", 2nd edition. MIT press.
- E. Balagurusamy (2000): "Computer Oriented Statistical and Numerical Methods", 2nd edition. Macmillan Publishers India Limited.
- Richard Hamming (2012): "Numerical Methods for Scientists and Engineers", 3rd edition. Dover Publication.
- M.K.Jain (1984): "Numerical Solution of Differential Equations", 2nd edition. Wiley.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 2229 Linear Algebra and Complex Variables** |
| Level & Semester | L-2, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The objective of this course is to introduce the fundamental ideas of linear algebra, functions of complex variables and developing a clear understanding of the fundamental concepts of Complex Analysis such as analytic functions, complex integrals and a range of skills which will allow students to work effectively with the concepts.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:
- *CLO 1:* Acquaint students with the basic concepts and properties of linear algebra and complex variables.
- *CLO 2:* Understand linear systems and mathematically transform signals between the time and frequency domains.
- *CLO 3:* Use transfer functions and frequency response to analyze and design filters.
- *CLO 4:* Apply linear algebra to solve problems.
- *CLO 5:* Apply theory on practical real-life algebraic and complex variable problems.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | √ | | | | √ | | | |
| *CLO 2* | | | √ | | | | √ | | | |
| *CLO 3* | | | √ | | | | √ | | | |
| *CLO 4* | | | √ | | | | √ | | | |
| *CLO 5* | | | √ | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Complex number system:** Complex number, polar form of complex number, Geometry of the complex plane, Limit, continuity and differentiability of functions of a complex variable. | CLO 1 | 4 |
| **Analytic functions:** Analytic functions and their properties, Derivation, Cauchy Riemann equations, Singular points, Orthogonal families of curves, Continuity and differentiability of complex functions, Harmonic functions. | CLO 2 | 6 |
| **Complex integration and Infinite series:** Cauchy's theorem for simple contours, Cauchy's integral formula, theorems of Liouville and Morera, fundamental theorem of algebra, singularities, poles and residues, Taylor's and Laurent's series, Cauchy's residue theorem, Conformal mappings, bilinear transformations and their properties. | CLO 3 | 6 |
| **Introduction to Linear Algebra:** Systems of linear equations, Gaussian elimination, Inverse of matrix, Eigen values and eigen vectors, Cayley-Hamilton theorem, matrix rank. | CLO 4 | 10 |
| **Linear Transformations:** Vector spaces and Subspaces, Sum and direct sum, Basis and dimension, Inner product spaces, orthogonality, Cross products and their geometric applications, Linear independence, Matrix diagonalization. | CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Gilbert Strang (2006): "Linear Algebra and Its Applications", 4th Edition. Elsevier.
- Frank Ayres Jr. (2011): "Schaum's Theory & Problems of Matrices". 6th edition. McGraw-Hill.
- Murray R. Spiegel, ?Seymour Lipschutz, ?John J. Schiller (2009): "Complex Variables", 2nd edition. McGraw-Hill.
- B.S. Tyagi (1981): "Functions of a Complex Variable", 2nd edition. Kedar Nath Ram Nath.
- H.K. Dass (2008): "Advanced Engineering Mathematics", 10th edition. S.Chand and Company Pvt Ltd.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 2231 Computer Architecture** |
| Level & Semester | L-2, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of this course is to teach about the architecture and design of some conventional and advanced processors. Returning to the subject "The structure of computers," it examines more advanced concepts in processor design. The content of the course discusses the design techniques that improve the performance of computer systems. Shows the evolution of the main innovations in architecture and computer technology and explains the incorporation of these advances in current processors, justifying its usefulness in terms of performance improvement.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Recognize the basic vocabulary of computer architecture.
- *CLO 2:* Understanding the limitations of pipelining and causes of loss of productivity.
- *CLO 3:* Recognize the need and utility of cache memories and the organization in fully associative, direct mapped and set associative.
- *CLO 4:* Recognize the key features of storage in disks and flash memory.
- *CLO 5:* Knowing the basics of superscalar processors: policies of instructions issued, renaming registers, reordering buffer, retirement unit.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | √ |
| *CLO 2* | √ | | | | | | | | | √ |
| *CLO 3* | √ | | | | | | | | | √ |
| *CLO 4* | √ | | | | | | | | | √ |
| *CLO 5* | √ | | | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Abstractions, Technology and Performance Computer:** introduction, Architecture of a computer system, Performance in a computer system, Perspective and evolution of technology | CLO 1 | 4 |
| **Segmented processors:** fundamentals of designing a processor, The instruction set, single cycle, Data path and control, The technique of segmentation (pipeline), ideal operation, Associated Concepts: Latency and Performance (Throughput), Design a processor with pipeline, Limitations of the pipelined instructions channel, Causes of performance loss due to stop of pipeline, Conflicts structural constraints, Conflicts over control risks, Data dependency conflicts, Techniques to avoid halts, Internal forwarding, Branch prediction | CLO 2 | 6 |
| **Memory Organization and Structure: caches and virtual memory:** Memory Hierarchy, Basic principles of the cache, Multi-level cache, Organizations: fully associative, direct mapped and set associative, Operating schemes. Write Through with assignment in writing (Fetch onwrite) and no assignment in writing. Post-write or writeback, Replacement algorithms, cache coherence, Examples of caches, Virtual Memory, Operation of virtual memory: paging, segmentation, paged segments, Translation of virtual addresses to physical or real addresses, Memory Management Unit (MMU), Translation Look-aside Buffer (TLB), Integration of the memory: the TLB and cache, Cache system with real or virtual cache | CLO 3 | 6 |
| **Storage and other aspects of the I / O:** Reliability and availability, Flash disk storage, Measures of performance in I / O, Parallelism and I / O | CLO 4 | 10 |
| **Advanced techniques of parallelism:** Instruction level parallelism (ILP), superscalar processors, Policies in Instruction Issue, Register renaming, Superscalar Implementation, reorder buffer, unit retirement, VLIW processors, Planning by the compiler, Comparison Superscalar vs. VLIW processor, Multicore, multiprocessors and clusters, The difficulty of parallel program, Shared memory multiprocessors, Clusters and other message-passing multiprocessor, Introduction to graphics processors | CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- John L. Hennessy, :(David A. Patterson (2012" Computer Architecture: A Quantitative Approach", 6th edition. Morgan Kaufmann.
- William F. Gilreath, (Phillip A. Laplante (2012: " Computer Architecture: A Minimalist Perspective", 4th edition. Springer.
- John L. Hennessy, (David A. Patterson (2017: " Computer Architecture: A Quantitative Approach", 5th edition. Morgan Kaufmann.
- John Y. Hsu (2017): "Computer Architecture: Software Aspects, Coding, and Hardware", 5th edition. CRC Press.

**Department of Genetics and Plant Breeding**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **GPB 2203 Genomics and Proteomics** |
| Level & Semester | L-2, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course will provide basic knowledge of genomics, transcriptomics and proteomics including genome evolution, chromosome mapping, protein identification, digestion, purification and their structure prediction

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

CLO1: Describe overview of genome, composition and evolution
CLO2: Explain the markers and types of maps in locating the genes in the chromosome
CLO3: Interpret the location of genes in the chromosomes using mapping techniques
CLO4: Describe about the basic principles and techniques of transcriptomic analysis
CLO5: Analyze and interpret gene sequences
CLO6: Describe fundamentals of proteomics
CLO7: Learn the analytical techniques and instrumentations for protein identification, separation

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |
| *CLO 6* | | √ | | | | | √ | | | |
| *CLO 7* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Concept of genomics:** Introduction, history and scope of genetics, Overview of genome, genome composition & genome evolution, Genes and inheritance, Inherited diseases. | CLO 1 | 6 |
| **Chromosome mapping and molecular markers:** Chromosome mapping, Types of chromosome maps and their uses, Basis and procedure of chromosome mapping, Different types of derived maps: composite maps, interval maps, consensus maps, comparative maps, *in silico* maps, Polymorphic markers: basis, types and uses, Principle and procedure of molecular marker development, Use of primary and secondary sequence resources for molecular marker development, Manipulation and automation of molecular marker systems. | CLO 2, CLO 3 | 6 |
| **Transcriptomics:** RNA extraction and cDNA synthesis, Gene expression analysis, Microarray and RNA-seqs, qPCR, Alternative splicing, Post-transcriptional modification, multiple sequence alignment. | CLO 4 | 6 |
| **Proteomics:** Protein Chemistry, Protein extraction, digestion and purification, Analytical protein and peptide separation, Protein identification, Life and death of protein, Significance and overview of analytical proteomics. | CLO 5 | 6 |
| **Proteomic Applications:** Multidimensional Peptide Chromatography. Protein Expression Profiling, LC-MS and Isotope Tags, Protein – Protein Interaction, Mapping protein modifications - Mining MS-MS Data, New Direction in Proteomics- Automation and Robotics, Micro- and Nanoscale Instrumentation, Protein Arrays, , application of bioinformatics tools in gel based proteomics, Application of proteomics in crop improvement. | CLO 6 CLO 7 | 7 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- David W. Mount (2004): "Bioinformatics Sequence and Genome Analysis", 2nd edition. Cold Spring Harbor Laboratory Press.
- Devarajan Thangadurai and Jeyabalan Sangeetha (2015): "Genomics and Proteomics: Principles, Technologies, and Applications", 1st edition or later. Apple Academy Press.
- A. Malcolm Campbell and Laurie J. Heyer (2007): "Discovering Genomics, Proteomics and Bioinformatics", 2nd edition. Cold Spring Harbor Laboratory Press.
- Darius M. Dziuda (2010): "Data Mining for Genomics and Proteomics: Analysis of Gene and Protein Expression", 3rd edition. John Wiley & Sons.
- Michael Kaufmann, Claudia Klinger and Andreas Savelsbergh (2017): "Functional Genomics: methods and protocols", 3rd edition. Humana Press. Y Xu. (2010): "Molecular Plant Breeding", 2nd edition. CAB.

**Department of Irrigation and Water Management**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **IWM 2203 Agricultural Meteorology** |
| Level & Semester | L-2, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
To enable students with necessary knowledge and skills on different weather and climatological features and their interactions with agriculture and measurement of meteorological parameters so that they can successfully apply this knowledge in agricultural planning and management.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:
CLO 1: explain the scope and importance of agricultural meteorology,
CLO 2: differentiate and characterize the distinct features of world climates and climatic data,
CLO 3: explain solar and earth radiation, heat balance, and migratory systems,
CLO 4: describe the formation processes, causes and effects of clouds, thunderstorms, and tornadoes, and
CLO 5: Measure important climatic parameters and estimate climate change impacts on biosystems.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | √ | | √ | | | √ |
| *CLO 2* | | √ | | | √ | | √ | | | √ |
| *CLO 3* | | √ | | | √ | | √ | | | √ |
| *CLO 4* | | √ | | | √ | | √ | | | √ |
| *CLO 5* | | √ | | | √ | | √ | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction:** Scope and importance of agricultural meteorology for Bioinformatics Engineers | CLO 1 | 2 |
| **Weather and Climate:** World climates, Classification, Boundaries and characteristics, Weather and climate of Bangladesh | CLO 2 | 3 |
| **Solar Radiation:** Solar and earth radiation, Nature and laws of electromagnetic radiation, Heat balance of earth's surface and atmosphere | CLO 3 | 4 |
| **General Circulation of Atmosphere:** Thermal circulation, Three cell model, Effects of earth's rotation, Jet streams, Effect of land and water distribution, Migratory systems, Fronts, Air masses | CLO 3 | 5 |
| **Clouds, Thunderstorms and Tornadoes:** Forms of Clouds, Clouds and air motions, Convective clouds, Thunderstorms, Tornadoes | CLO 4 | 3 |
| **Climatic Parameters and Their Measurements:** Temperature, Precipitation, Drought, Humidity, Air, Wind, Evaporation | CLO 5 | 6 |
| **Effect of Climatic Elements on Biosystem:** Radiation and light distribution within plant canopy, Photosynthesis, Photoperiodism, Thermoperiodism, Vernalization, Soil moisture, Soil temperature, Evapotranspiration, Wind effect, Wind breaks and shelter effects | CLO 5 | 5 |
| **Climate Change and Ecosystem:** Weather and Climate of Bangladesh, Causes of weather and climatic change, Climate changes and ecosystem, Impact of climate changes on crop production, Greenhouse effect and its consequences | CLO 5 | 4 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Microclimate: The Biological Environment – by J.R. Norman, John Wiley and Sons, New York, 1974.
- Principles of Environmental Physics– by J.L. Monteith, Edward Arnold Ltd., London, 1980.
- Hydrology – by H.M. Raghunath, Wiley Eastern Limited, New Delhi, India, 1985.
- Introduction to Agro-Meteorology - by H.S. Mavi, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1974.
- Hydrology for Engineers (SI Metric Edn.) – by R.K. Linsley, Max A. Kohler and J.L.H.Paulhus, McGraw-Hill Book Company, New York, USA, 1988.
- Introduction to Meteorology (3rd Edn.) – by S. Petterssen, McGraw-Hill Book Company, New York, 1969.

**Level- 3, Semester- 1**

**Department of Crop Botany**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CBOT 3101 System Biology** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

This course explores the use of mathematical and computational models to rigorously account for the inherent complexity of biological systems. This complexity arises from the diversity of components (genes, proteins, metabolites and pathways). Systems biology can be done by breaking down each system (cellular, tissue-level, organism-level and ecosystem) into modules. Each system has methods for modeling and technologies to study the systems at different levels (genomic, transcriptomics, proteomics and metaboliomics). Actually, systems approaches provide a deeper understanding of diverse physiological and biochemical processes, from individual metabolic pathways, to signaling networks, to genome-scale metabolic networks. The ultimate goal of biology and bioinformatics is to tie all together and understand the system to forecast future needs and capabilities for better yield.

**Course Learning Outcome (CLO)**

Upon completion of this course, the student will be able to:

*CLO 1:* Understand the entire biological system and its mathematical relationships
*CLO 2:* Integrate morpho-physiological data and computational models for species/plant diversities
*CLO 3:* Evaluate diversified physiological and metabolic processes at different levels and systems
*CLO 4:* Apply system approaches for better yield and quality products in changing climate
*CLO 5:* Construct phylogenetic tree, species characterization and geographic distribution

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to Systems biology:** Concept, Importance, Advanced physiological techniques: genomic, transcriptomic, proteomic, metaboliomic, and ionomic aspects of molecular physiology. | CLO 1 | 4 |
| **Morphometrics:** Morphometrics of leaves, flowers and other plant parts, Geometric morphometric methods, Visualisation and quantification of morphological variation with multivariate analyses, Protocols for imaging and collecting landmark data on flowers. Machine Learning for Plant Leaf Analysis. | CLO 2 | 6 |
| **Metabolomics and Metabolic engineering:** Metabolism, metabolome, metabolic profiling, metabolic fingerprinting, metabolome informatics, Resources/databases of metabolomics; Omic approaches for stressed tolerance variety development, Signaling pathways and autoimmune system, Metabolic pathways and metabolic engineered crop varieties: $C_4$ rice, golden rice, Lys038 maize; Secondary metabolites, reduction of nanoparticles and nanotechnology in crop yield improvement. | CLO 3 | 9 |
| **Phylogenetics:** The terminology of phylogenetics- Trees, Root, branches, Node, Leaf, Clade; lineage sorting, orthology, paralogy, xenology; "basal" lineages, crown vs. stem groups, Phylogram vs. cladogram. Constructing molecular phylogenetic trees and its application on classification, landscape planning, plant genetic resources and their conservation in changing climate. | CLO 4 | 7 |
| **System Ecology and Biodiversity:** Ecosystem stability, critical transitions, and the maintenance of biodiversity, the neutral theory of ecology, dynamics of population in space, survival in fluctuating environments. Biodiversity informatics initiatives – PlantList, CBOL, CBIF, GRIN, PGRIMS, etc. | CLO 2, CLO 5 | 6 |
| **Class test** | | 1 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Baginsky, S. and Fernie, A.R. 2007. Plant Systems Biology. BirkhäuserVerlag, Berlin.
- Bu Z, Callaway DJ (2011). "Proteins MOVE! Protein dynamics and long-range allostery in cell signaling". *Protein Structure and Diseases*. Advances in Protein Chemistry and Structural Biology. **83:** 163–221.
- Chiara Romualdi; GerolamoLanfranchi (2009). "Statistical Tools for Gene Expression Analysis and Systems Biology and Related Web Resources". In Stephen Krawetz (ed.). *Bioinformatics for Systems Biology* (2nd ed.). Humana Press. pp. 181–205.
- Hennig, W. 1966. Phylogenetic Systematics. University of Illinois Press.
- Ivan V. Maly, 2009. System Biology, Methods in Molecular Biology. Springer Ptotocols, Humana Press, UK.
- Kholodenko, Boris N; Sauro, Herbert M (2005). "Mechanistic and modular approaches to modeling and inference of cellular regulatory networks". In Alberghina, Lilia; Westerhoff, Hans V (eds.). *Systems Biology: Definitions and Perspectives*. Topics in Current Genetics. **13**. Berlin: Springer-Verlag. pp. 357–451.
- Longo, Giuseppe; Montévil, Maël (2014). *Perspectives on Organisms - Springer*. Lecture Notes in Morphogenesis.
- Remagnino, P., Mayo, S., Wilkin, P., Cope, J. and Kirkup, D. 2017. Computational Botany. Springer-Verlag GmbH, Germany.
- Sneath, P.H.A. and Sokal, R.R. 1973. Numerical Taxonomy. W.H. Freeman, New York.
- Stace, C.A. 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London.
- Stephen Krawetz, 2009. Bioinformatics in System Biology, Humana Press, UK.
- Wiley, Siegel-Causey, Brooks and Frunk. 1991. The Complete Cladist, University of Kansas.
- Williams, D.M. and Ebach, M.C. 2008. Foundations of Systematics and Biogeography. Springer, London

**Department of Crop Botany**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CBOT 3102 System Biology** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course has been designed to offer hands practices on data mining from biological systems for mathematical and computational models. These models will be used for classification, landscape planning, plant genetic resources and their conservation in changing climate.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Collect data from different biological systems/sources
*CLO 2:* Analyze data and make different models for identification and classification of plants.
*CLO 3:* Utilized knowledge for landscape planning and biodiversity conservation related issues.
*CLO 4:* Handle different software for data processing and presentation.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Data Sources:** Collecting and recording specimens, methodologies and character gathering – external & internal morphology, reproductive organs; Nucleic acids as a data source, DNA fingerprinting of plant populations. Building data matrix. | CLO 1 | 4 |
| **Data Processing:** Phonetic and Cladistic analyses – distance and similarity based data analysis, tree building and comparison, Cladistic Classification and Phylogeny, biogeography and evolution. | CLO 2, CLO 3 | 6 |
| **Systems Biology tools and standards:** MATLAB – Systems Biology toolbox; SBML (Systems Biology Markup Language); SBGN (Systems Biology Graphical Notation); Tools for systems Biology – Cell designer; Cytoscape. | CLO 4 | 6 |
| **Data Sources:** Collecting and recording specimens, methodologies and character gathering – external & internal morphology, reproductive organs; Nucleic acids as a data source, DNA fingerprinting of plant populations. Building data matrix. | CLO 1 | 4 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Baginsky, S. and Fernie, A.R. 2007. Plant Systems Biology. BirkhäuserVerlag, Berlin.
- Bu Z, Callaway DJ (2011). "Proteins MOVE! Protein dynamics and long-range allostery in cell signaling". *Protein Structure and Diseases*. Advances in Protein Chemistry and Structural Biology. **83:** 163–221.
- Chiara Romualdi; GerolamoLanfranchi (2009). "Statistical Tools for Gene Expression Analysis and Systems Biology and Related Web Resources". In Stephen Krawetz (ed.). *Bioinformatics for Systems Biology* (2nd ed.). Humana Press. pp. 181–205.
- Hennig, W. 1966. Phylogenetic Systematics. University of Illinois Press.
- Ivan V. Maly, 2009. System Biology, Methods in Molecular Biology. Springer Ptotocols, Humana Press, UK.
- Kholodenko, Boris N; Sauro, Herbert M (2005). "Mechanistic and modular approaches to modeling and inference of cellular regulatory networks". In Alberghina, Lilia; Westerhoff, Hans V (eds.). *Systems Biology: Definitions and Perspectives*. Topics in Current Genetics. **13**. Berlin: Springer-Verlag. pp. 357–451.
- Longo, Giuseppe; Montévil, Maël (2014). *Perspectives on Organisms - Springer*. Lecture Notes in Morphogenesis.
- Remagnino, P., Mayo, S., Wilkin, P., Cope, J. and Kirkup, D. 2017. Computational Botany. Springer-Verlag GmbH, Germany.
- Sneath, P.H.A. and Sokal, R.R. 1973. Numerical Taxonomy. W.H. Freeman, New York.
- Stace, C.A. 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London.
- Stephen Krawetz, 2009. Bioinformatics in System Biology, Humana Press, UK.
- Wiley, Siegel-Causey, Brooks and Frunk. 1991. The Complete Cladist, University of Kansas.
- Williams, D.M. and Ebach, M.C. 2008. Foundations of Systematics and Biogeography. Springer, London

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3121 Systems and Software Engineering** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | CSM 1123, CSM 1221 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of system and software Engineering is to focus on the principles and knowledge of software engineering. It covers the approaches taken in developing large programming projects, including requirements analysis, specification, design, coding, debugging, testing and maintenance. This course will prepare students for working in teams to build quality software, and it provides the necessary hands-on practice for those who wish to enhance their knowledge base. This course is designed for people who work or are about to work in any aspect of software development. It is also intended for people who have managerial responsibility for software development and anyone who is interested in how complex software systems are designed and built. In addition, they will able to demonstrate their developed software in different national and international software industries.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire fundamental knowledge on software system and software engineering.
- *CLO 2:* Understand principles, concepts, methods, and techniques of the software engineering approach to produce quality software.
- *CLO 3:* Organize and manage a medium sized software development project, including project plans and documentation, schedule and cost estimates, and quality assurance activities.
- *CLO 4:* Apply different project management model to find software complexity and life cycle.
- *CLO 5:* Demonstrating software in different national and international industries.
- *CLO 6:* Develop software by following software engineering concepts

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | | | | | | | √ |
| *CLO 2* | √ | | √ | | | √ | | | | √ |
| *CLO 3* | √ | | √ | | | √ | | | | √ |
| *CLO 4* | √ | | √ | | | √ | | | | √ |
| *CLO 5* | √ | | √ | | | | | | | √ |
| *CLO 6* | √ | | √ | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Information Systems Concepts:** Business information systems; Describing the business organization – organization chart, organization function list; information system levels - operational, lower, middle, top management; the system development life cycle concepts; hardware and software end products. Life cycle activities: life cycle flow chart, task, management review, baseline specifications, role of system analyst. | CLO 1 | 5 |
| **Software Process:** Introduction –S/W Engineering Paradigm – life cycle models (water fall, incremental, spiral, WINWIN spiral, evolutionary, prototyping, object oriented) - system engineering –computer based system – verification – validation – life cycle process – development process –system engineering hierarchy. | CLO 1, CLO 2, CLO 6 | 5 |
| **Software Requirements:** Functional and non-functional - user – system –requirement engineering process – feasibility studies – requirements – elicitation – validation and management – software prototyping –prototyping in the software process – rapid prototyping techniques – user interface prototyping -S/W document. Analysis and modeling – data, functional and behavioral models – structured analysis and data dictionary. | CLO 2, CLO 4, CLO 6 | 7 |
| **Design Concepts and Principles:** Design process and concepts – modular design – design heuristic – design model and document. Architectural design – software architecture – data design – architectural design – transform and transaction mapping – user interface design – user interface | CLO 5, CLO 6 | 5 |

| | | |
|---|---|---|
| design principles. Real time systems - Real time software design – system design – real time executives – data acquisition system - monitoring and control system. SCM – Need for SCM – Version control – Introduction to SCM process – Software configuration items. | | |
| **Testing:** Taxonomy of software testing – levels – test activities – types of s/w test – black box testing– testing boundary conditions – structural testing – test coverage criteria based on data flow mechanisms – regression testing – testing in the large. S/W testing strategies – strategic approach and issues - unit testing – integration testing – validation testing – system testing and debugging. | CLO 5, CLO 6 | 5 |
| **Software Project Management:** Measures and measurements – S/W complexity and science measure – size measure – data and logic structure measure – information flow measure. Software cost estimation – function point models – COCOMO model- Delphi method. - Defining a Task Network – Scheduling – Earned Value Analysis – Error Tracking - Software changes – program evolution dynamics– software maintenance – Architectural evolution. Taxonomy of CASE tools. | CLO 3, CLO 4 | 5 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Elias M. Awad (2010): "System Analysis and Design", 6th edition or later. R.D. Irwin Publisher.
- Richard Fairley (2001): "Software Engineering Concepts", Latest edition. Tata McGraw Publication.
- Roger S Pressman, Bruce R. Maxim, (2014): "Software engineering- A practitioner's Approach", 5th edition. McGraw-Hill Education.
- Ian Sommerville (2015): "Software engineering", 10th edition. Pearson Education.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3122 Systems and Software Engineering** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | CSM 3121 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of system and software Engineering is to gain practical knowledge on software engineering. It covers the approaches taken in developing large programming projects, including requirements analysis, specification, design, coding, debugging and testing, maintenance, and thorough documentation. This course will prepare students for working in teams to build quality software, and it provides the necessary hands-on practice for those who wish to enhance their knowledge base.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire practical knowledge on software engineering.
- *CLO 2:* Understand feasibility analysis, cost estimation to develop a software.
- *CLO 3:* Analyze different design patterns and drawbacks.
- *CLO 4:* Design, write and debug computer programs in appropriate languages.
- *CLO 5:* Develop software for solving real world problems.
- *CLO 6:* Visiting national and international software industries.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | | | | | | | √ |
| *CLO 2* | √ | | √ | | | √ | | | | √ |
| *CLO 3* | √ | | √ | | | √ | | | | √ |
| *CLO 4* | √ | | √ | | | √ | | | | √ |
| *CLO 5* | √ | | √ | | | | | | | √ |
| *CLO 6* | √ | | √ | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Explain the challenges inherent in cost estimation for software development, and create defensible estimates with the help of work breakdown structures. | CLO 1, CLO 2 | 2 |
| Make use of industry standard tools for version management, issue tracking, automated build, unit testing, code quality management, code review and continuous integration. | CLO 3, CLO 5 | 3 |
| Write unit tests to reveal a bug or describe a new feature to be added to a system, using a test-first coding approach. | CLO 4, CLO 5, CLO 6 | 3 |
| Explain the role of patterns (design and architectural) in creating large code bases that will be maintainable over the long term. | CLO 3, CLO 5 | 5 |
| Apply basic refactoring with the aim of maintaining or improving code quality. | CLO 4, CLO 5, CLO 6 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Elias M. Awad (2010): "System Analysis and Design", 6th edition or later. R.D. Irwin Publisher.
- Richard Fairley (2001): "Software Engineering Concepts",Latest edition. Tata McGraw Publication.
- Roger S Pressman, Bruce R. Maxim, (2014): "Software engineering- A practitioner's Approach", 5th edition. McGraw-Hill Education.
- Ian Sommerville (2015): "Software engineering", 10th edition. Pearson Education.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3123 Computer Graphics** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objectives of this course are to introduce the students about computer graphics modeling, animation, and rendering which include basic image processing, geometric transformations, geometric modeling of curves and surfaces, animation, 3-D viewing, visibility algorithms, shading, and ray tracing.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

*CLO 1:* Describe the basic graphics pipeline, forward and backward rendering, and displaying 2D and 3D images.
*CLO 2:* Compare and contrast the different rendering techniques.
*CLO 3:* Apply affine transformations, 3D coordinate system and 2D transformation operations to handle transformations in 3D.
*CLO 4:* Implement texture mapping, sampling, anti-aliasing, transformation and clipping operations and a simple real-time renderer.
*CLO 5:* Create simple polyhedral models by surface tessellation and using 3D modeling tools.
*CLO 6:* Implement the spline interpolation method for producing in-between positions and orientations and basic physics-based animation algorithms for particle dynamics using simple Newtonian mechanics with Euler methods.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | √ |
| *CLO 2* | √ | | | | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | √ | | | | √ |
| *CLO 6* | √ | | | | | √ | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Computer Graphics Overview:** Images, Models, Pipeline architecture; OpenGL pipeline, Libraries, Conventions, Basic shaders, Rendering. | CLO 1, CLO 2 | 4 |
| **Geometry:** Curves, Surfaces, Implicit vs. Parametric forms, Polygons. Transformations: Points vs. Vectors, Homogeneous transformations. Viewing: Projections, OpenGL camera control. | CLO 1, CLO 3 | 6 |
| **Shading:** Lighting models, Surface normals, Phong shading. Texture Mapping: Mapping methods, Texture coordinates. Buffers and Blending: Translucency, Compositing images, Anti-aliasing. | CLO 4 | 6 |
| **Clipping:** Cohen-Sutherland, Bounding boxes, Hidden-surface removal. Rasterization Line drawing, Polygon fill, Line scanning. Environment Maps: Reflection models, Sphere map, Cube map. Shadow Maps: Projective shadows, Depth maps, Shadow test. | CLO 5 | 10 |
| **Parametric Animation:** Camera motion, Splines, Quaternions. Physics-based Animation: Dynamics, Particles, Rigid-bodies, Fluid simulation. 3D Displays: Visual cues, Stereoscopic displays, Head-coupled rendering. | CLO 5, CLO 6 | 6 |

**Teaching Strategy**

Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**

Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Peter Shirley et. al. (2005): "Fundamentals of Computer Graphics", 2nd or later Edition. Wellesley.
- Edward Angel (2012): "Interactive Computer Graphics", 7th or later Edition. Pearson.
- Dave Shreiner et al (2013): "OpenGL Programming Guide", 8th or later Edition. Addison-Wesley.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3124 Computer Graphics** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of this course is to provide the students with hands-on experiences about computer graphics modeling, animation, and rendering which include basic image processing, geometric transformations, geometric modeling of curves and surfaces, animation, 3-D viewing, visibility algorithms, shading, and ray tracing.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Understand graphics programming.
- *CLO 2:* Create 2D and 3D graphical scenes using open graphics library suits.
- *CLO 3:* Apply image manipulation and enhancement techniques.
- *CLO 4:* Create animations.
- *CLO 5:* Create multimedia presentations/Games/Projects.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | √ |
| *CLO 2* | √ | | | | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | √ | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Implementation of Algorithms for drawing 2D Primitives – Line (DDA, Bresenham) – all lopes Circle (Midpoint). | CLO 1, CLO 2 | 4 |
| 2D Geometric transformations – Translation, Rotation Scaling, Reflection Shear, Window-Viewport, Composite 2D Transformations, Line Clipping. | CLO 1, CLO 3 | 4 |
| 3D Transformations – Translation, Rotation, Scaling. 3D Projections – Parallel, Perspective. Creating 3D Scenes. | CLO 4 | 4 |
| Image Editing and Manipulation – Basic Operations on image using any image editing software, Creating gif animated images, Image optimization. 2D Animation – To create Interactive animation using any authoring tool. | CLO 5 | 4 |

**Teaching Strategy**

Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**

Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Peter Shirley et. al. (2005): "Fundamentals of Computer Graphics", 2nd or later Edition. Wellesley.
- Edward Angel (2012): "Interactive Computer Graphics", 7th or later Edition. Pearson.
- Dave Shreiner et al (2013): "OpenGL Programming Guide", 8th or later Edition. Addison-Wesley.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3125 Theory of Computation** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil. |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The objective of this course is to introduce the students with the theory of computation through a set of abstract machines that serve as models for computation finite automata, pushdown automata, and turing machines and examines the relationship between these automata and formal languages.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Acquire fundamental knowledge of Automata, Computability and Complexity.
*CLO 2:* Understand and manipulate formal descriptions of languages, automata and grammars with focus on Regular and Context Free Languages, Finite State Automata and Regular Expressions.
*CLO 3:* Construct Turing machines and Post machines and prove the equivalence of languages described by Turing machines and Post machines
*CLO 4:* Determine the time and space complexities of their codes and write more efficient and effective codes to reduce.
*CLO 5:* Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | | | | | | | √ |
| *CLO 2* | √ | | √ | | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | √ | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Regular languages:** Regular Languages, finite automaton, Examples of finite automata, Designing finite automata, Equivalence of NFAs and DFAs, The regular operations - Closure under the regular operations. Regular Expressions. Equivalence with finite automata. Non-regular Languages - The pumping lemma for regular languages. | CLO 1, CLO 2 | 6 |
| **Context-Free Languages:** Formal definition of a context-free grammar - Examples of context-free grammars. Ambiguity - Chomsky normal form. Pushdown Automata, Formal definition of a pushdown automaton - Examples of pushdown automata, Equivalence with context-free grammars. | CLO 1, CLO 2 | 6 |
| **Computability Theory:** The Church-Turing Thesis. Turing machine, Nondeterministic Turing machines, Hilbert's problems. | CLO 1, CLO 3 | 6 |
| **Decidability:** Decidable languages, The halting problem – the diagonalization method. | CLO 1, CLO 5 | 8 |
| **Complexity Theory:** The Classes P, NP, Examples of problems in these classes. The P versus NP question. NP-Completeness, Polynomial time reducibility, The Cook-Levin Theorem. Examples of NP-Complete Problems: The vertex cover problem - The Hamiltonian path problem - The subset sum problem. Approximation algorithm, Probabilistic Algorithms. | CLO 1, CLO 4 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Michael Sipser (2012): "Introduction to the theory of computation", 3rd edition. CENGAGE Learning.
- Hopcroft, Motwani, Ullman (2008): "Introduction to Automata Theory, Languages and Computation", 3rd edition. Pearson.
- Harry R. Lewis (1998): "Elements of the theory of computation", 2nd edition. Prentice Hall.
- Peter Linz (2016): "An introduction to formal languages and automata", 6th edition. Jones and Bartlett.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3127 Laplace Transformation and Fourier series** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to familiarize the learner with a range of transform techniques of use in the solution of problems of engineering interest (such as Laplace transformation, Fourier analysis of both periodic and a-periodic signals) and to enable the learner to understand their uses in concurrent and later modules of the program.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Learned about a broad range of basic concepts in mathematical analysis.

*CLO 2:* Understand different types proof techniques, what constitutes a proof and the level of mathematical rigor that goes with it.

*CLO 3:* Use the transfer functions and frequency response to analyze and design filters.

*CLO 4:* Apply the knowledge of mathematics and an engineering specialization to the solution of complex engineering problems.

*CLO 5:* Compute Fourier analysis using integrals and frequency response of a simple system and determine stability.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | √ | | | | √ | | | |
| *CLO 2* | | | √ | | | | √ | | | |
| *CLO 3* | | | √ | | | | √ | | | |
| *CLO 4* | | | √ | | | | √ | | | |
| *CLO 5* | | | √ | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Laplace Transform:** Definition, existence and basic properties, Laplace transforms of some elementary functions. | CLO 1 | 5 |
| Sufficient conditions for existence of Laplace transforms, Laplace transforms of derivatives, Applications of Laplace transforms. | CLO 2 | 7 |
| **Inverse Laplace Transform:** Inverse Laplace transforms, Solution of differential equations by Laplace transformations, Applications of inverse Laplace transforms. | CLO 3 | 7 |
| **Fourier series and Fourier integrals:** Real and complex form of Fourier series, Fourier coefficients, Fourier sine and cosine series, Fourier integral, Dirichlet's theorem, Applications of Fourier series in engineering problems. | CLO 4 | 7 |
| **Fourier Transforms:** Fourier sine and cosine transforms, Complex Fourier transform, Finite Fourier transform, Convolution theorem, Applications to the boundary value problems. | CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Phil Dyke (2014): "An Introduction to Laplace Transforms and Fourier Series", 2nd edition. Springer.
- Murray R. Spiegel (1965): "Schaum's Outlines: Laplace Transforms", 5th edition. McGraw Hill Professional.
- H.K. Dass (2011): "Advanced Engineering Mathematics", Latest edition. S.Chand & Company ltd.
- Georgi P. Tolstov (2012): "Fourier Series", Latest edition. Pan America.
- Robert M. Gray, Joseph W. Goodman (2011): "Fourier Transforms: An Introduction for Engineers", 3rd edition. Springer.

**Department of Farm Structure & Environmental Engineering**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FSEE 3107 Environmental Impact Assessment** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The Environmental Impact Assessment (EIA) process is essentially the study and evaluation of change introduced by human activity on environmental systems. The EIA is also a device to assure disclosure of environmental consequences before human actions are taken. This course focuses on the concept of environmental impacts as set forth in the National Environmental Policy Act (NEPA) of 1970. This course further introduces students to the legal, scientific, and administrative considerations and procedures that define the environmental impact analysis process.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:
*CLO 1:* describe the National Environmental Policy Act (NEPA) and its requirements,
*CLO 2:* perform basic environmental assessment techniques,
*CLO 3:* develop an Environmental Impact Assessment report as determined by NEPA and
*CLO 4:* Present the Environmental Impact Assessment report to a group of stakeholders.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | | √ | | |
| *CLO 2* | | √ | | | | | | √ | | |
| *CLO 3* | | | | | | | | √ | | |
| *CLO 4* | | | | | | | | √ | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction: I**ntroduction to environmental impact assessment (EIA), aims & objectives, EIA in Bangladesh, steps in EIA, documentations, indices & indicators for describing the affected environment. | CLO 1, CLO 2 | 10 |
| **Screening**: Procedure, Project lists for screening. | CLO 1, CLO 2, CLO 3 | 2 |
| **Scoping:** Elements, objectives, guiding principles, Terms of Reference, Stages. | CLO 1, CLO 2, CLO 3 | 2 |
| **Public involvement:** Purposes, Principles, Techniques. | CLO 1, CLO 2, CLO 3 | 2 |
| **IEE:** Introduction, objectives, steps, structure of an IEE report, review. | CLO 1, CLO 2, CLO 3 | 2 |
| **EIA:** Aims, objectives, elements, EIA processes, outcomes, EIA review, EIA reporting, follow up. | CLO 1, CLO 2, CLO 3 | 2 |
| **Impact analysis:** prediction, identification, assessment, quantification | CLO 1, CLO 2, CLO 3 | 2 |
| **Impact management:** EMP components, EMP strategy, schedule and cost, post-project monitoring. | CLO 1, CLO 2, CLO 3 | 2 |
| **EIA for:** Energy, irrigation, infrastructure and agricultural industries. | CLO 1, CLO 2, CLO 3, CLO 4 | 8 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- EIA Guidelines for Industries by DoE, Ministry of Environment and Forest, The Government of the people's Republic of Bangladesh
- Environmental Impact Assessment for Developing Countries Editors: Asit K. Biswas S. B. C. Agarwal Butterworth-Heinemann
- Introduction to Environmental Impact Assessment Third Edition By John Glasson, RikiTherivel and Andrew Chadwick Routledge, Taylor and Francis Group
- Environmental Impact Assessment: A Practical Guide Environmental Impact Assessment: A Practical Guide by Betty Bowers Marriott McGraw-Hill Professional Publishing

**Department of Farm Structure & Environmental Engineering**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FSEE 3108 Environmental Impact Assessment** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | FSEE 3107 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course focuses on the concept of environmental impacts as set forth in the National Environmental Policy Act (NEPA) of 1970 and focuses on the definition, history and law related to Environmental Impact Assessment (EIA). This course introduces the necessary tools for evaluating impacts and techniques for mitigation and monitoring.

**Course Learning Outcome (CLOs)**
*CLO 1:* Analyze and interpret collected data and environmental information from diverse sources.
*CLO 2:* Prepare written environmental assessments in the proper style and format.
*CLO 3:* Critic reviews and prepare comments on a variety of environmental documents.
*CLO 4:* Demonstrate proficiency in written and oral communication on the technical aspects of an EIA report.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | | √ | | |
| *CLO 2* | | √ | | | | | | √ | | |
| *CLO 3* | | | | | | | | √ | | |
| *CLO 4* | | | | | | | | √ | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Prediction & assessment of different impacts:** water, socio-economic, biological | CLO 1, CLO 2, CLO 3 | 10 |
| **Conducting EIA for certain schemes:** agricultural projects, infrastructural development, flood-mitigation projects | CLO 1, CLO 2, CLO 4 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Environmental Impact Assessment: A Practical Guide by Betty Bowers Marriott McGraw-Hill Professional Publishing
- Ministry of Environment and Forest (2018): "EIA Guidelines for Industries by DoE", Latest Edition. The Government of the people's Republic of Bangladesh.
- Asit K. Biswas, S. B. C. Agarwal (2013): "Environmental Impact Assessment for Developing Countries", Latest edition. Elsevier.

**Department of Pharmacology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **VPHA 3103 Molecular Modeling and Drug Designing** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

This course provides the basic knowledge on molecular geometry information to determine the stability of small molecule interactions with the proteins, understand the algorithms used to develop software to predict the molecular activities through computational approach, knowledge on pharmacophore, its features, applications and to get access to the sources exist at present, understand the algorithms used in the molecular docking concepts and its types, aware of molecular databases available at present to explore the biological molecules.

**Course Learning Outcome (CLOs)**

Upon completion of this course, the student will be able to:

*CLO 1:* Acquire basic knowledge on the molecular geometry information, basic concepts of a molecule.
*CLO 2:* Understand the activities of a molecule inside the biological system through simulation studies.
*CLO 3:* Determine a significant pharmacophore model in order to identify the most promising candidates.
*CLO 4:* Get an exposure to the existing docking software and to observe the result.
*CLO 5:* Analyze the basic steps in querying database and to interpret information from the data's available.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | | | | | | √ | | | |
| *CLO 3* | | | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |
| *CLO 5* | | | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Molecular Geometry:** Molecular Geometry – Introduction to Molecular Geometry, Electronic Spatial Extent and Molecular Volume, Electron Affinity and Ionization Potential, Hyperfine Coupling, Dielectric Constant, Force Field Customization., The influence of thermal excitation, Bonding, Isomers, Types of molecular structure(VSEPR table), 3D representations, Molecular geometry determination. | CLO 1 | 4 |
| **Molecular Dynamics:** Molecular Dynamics- Introduction to Molecular Dynamics, History, Areas of application and limitations, Design constraints, Potentials in MD simulations, Examples of applications, Density Functional Theory, Linear Scaling Techniques, Ab initio Methods, Hartree-Fock approximation, Mùller-Plesset Perturbation Theory, Quantum Monte Carlo Methods, Natural Orbitals and Monte Carlo Simulations. | CLO 2 | 6 |
| **Pharmacophore:** Pharmacophore – Historical Perspective and Features, Viewpoint of Pharmacophore, Functional Groups Considered as Pharmacophores, Molecular Alignments, Handling Flexibility, Alignment Techniques, Scoring and Optimization, Pharmacophores, Model development – Select a training set of ligands, Conformational analysis, Molecular superimposition, Abstraction, Validation. Applications | CLO 3 | 4 |
| **Molecular Docking:** Molecular Docking – Introduction to molecular docking, Definition of problem, Docking approaches, Mechanics of docking, Applications, Types of docking – Rigid docking, Flexible docking, manual docking, Advantage and disadvantage of Flex-X, Flex-S, List of Protein-Ligand Docking Software AUTODOCK, Arguslab, Hex, PyRx. | CLO 4 | 8 |
| **Molecular and Structural Database:** Library and Database- Molecular Database – Swiss-model, ModBase, Protein Model Portal and Structural Database - Protein Data Bank, (SCOP) Structural Classification of Proteins, (CATH) Protein Structure Classification, PDBsum, Bioactivity Databases, Gene and Protein Sequence Databases, Cambridge Crystallographic Database, Compound Storage and Management. | CLO 5 | 8 |
| **Class Test and Revision** | | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Andrew R. Leach. Molecular Modelling (2001): "Principles and Applications", 2nd edition. Pearson Education EMA.
- D. C. Rapaport, Rapaport, Dennis C. Rapaport (2004): "The Art of Molecular Dynamics Simulation", 2nd edition, Cambridge University Press.
- M. P. Allen and D. J. Tildesley (1989): "Computer simulation of liquids", Latest edition. Oxford University Press.
- R. J. Sadus (2002): "Molecular Simulation of Fluids: Theory, Algorithms and Object-Orientation", Latest edition. Elsevier.
- J.M.Haile (1997): "Molecular Dynamics Simulation Elementary Methods", Latest edition. Wiley.

**Department of Aquaculture**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **AQ 3107 Applied Aquaculture** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The course has two primary objectives: to teach the students aquaculture science, particularly different aquaculture systems, design, construction and operation of aquaculture systems; and to illuminate their links to the scientific advice to fish farmers for aquaculture practices in a sustainable fashion.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

- *CLO-1:* Describe basic aspects of aquaculture science, its historical development, potential scope of practices for protein-rich animal food production in Bangladesh, and its interdisciplinary linkage with other branches of science in local and global context.
- *CLO-2:* Explain various land- and water-based aquaculture systems, their design, and construction for aquaculture farmers in different agro-ecological conditions of Bangladesh.
- *CLO-3:* Describe detailed aquaculture farm operation procedures such as systems preparation, seed production and nursing, stocking of fingerling, fish feed formulation, manufacturing and feeding, water quality monitoring, disease diagnosis and treatment.
- *CLO-4:* Apply and relate the knowledge of responsible code of conduct for aquaculture practices, data collection, analysis and synthesis of scientific advice for the farmers in running aquaculture farms sustainably.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Introduction: Definition, aims and historical development of aquaculture science, present status and scope of aquaculture in Bangladesh, and its interdisciplinary in local and global context. | CLO-1 | 8 |
| Aquaculture systems: Land-based, land-based specialized, water-based, water-based specialized, integrated land and water based aquaculture systems; their design and construction in different agro-ecological context of Bangladesh. | CLO-1, CLO-2 | 8 |
| Aquaculture operation: Pond and other systems preparation, seed production and nursing, stocking of fingerling, analysis of feed ingredients, fish feed formulation, feed manufacturing, feeding regime; water quality monitoring, disease diagnosis and treatment. | CLO-2, CLO-3 | 8 |
| Impacts: Responsible code of conduct for aquaculture practices, analyzing the impacts of aquaculture operation on quality fish production considering social, economic and environmental sustainability. | CLO-2, CLO-3, CLO-4 | 8 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- G. Jhingran (1988): “Fish and Fisheries of India”. Hindustan Publishing Corporation (India), Delhi.
- Tsai and M. Y. Ali. (1997): “Openwater Fisheries of Bangladesh”. The University Press Limited, Dhaka 1000, Bangladesh.
- R. G. Templeton (1995): “Freshwater Fisheries Management”. Fishing News Books, Farnham, Surey, UK.
- T. V. R. Pillay and M. N. Kutty (2005): “Aquaculture: Principles and Practices”, 2nd Edition or later. Oxford, UK.
- T. B. Lawson (1995): “Fundamentals of Aquaculture Engineering”. Chapman and Hall, An International Thomson Publishing Company, New York, USA.
- ASC, 2012. ASC Pangasius Standards, Aquaculture Stewardship Council, P.O. Box 19107, 3501 DC Utrecht The Netherlands. http://www.asc-aqua.org/upload/ASC%20Pangasius%20Standard_v1.0.pdf
- S. S. De Silva and T. A. Anderson (1995): “Fish Nutrition in Aquaculture”. Chapman & Hall, London.
- J. A. Plumb (1999): “Health Maintenance of Cultured Fishes: Principal Microbial Diseases”. Iowa State University Press.
- FAO, 2012. Codex Alimentarius: Code of practice for fish and fishery products, 2nd Edition. Food and Agriculture Organization, Rome, Italy. ftp://ftp.fao.org/codex/Publications/Booklets/Practice_code_fish/CCFFP_2012_EN.pdf

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3129 Network and Telecommunication** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of this course unit aims to build on the ideas on fundamentals of distributed systems. It aims to provide students with an understanding of the techniques that networking protocols, OSI model, real time live data streaming and use to achieve error detection and recovery, multiplexing and security protection. This course also seeks to show students how the limitations of communication media can limit what applications can achieve. Equipment with the skills needed to go out and setup networks in small and medium sized organizations.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire fundamental knowledge on data, network and its applications on telecommunication.
- *CLO 2:* Understand the concept of communication, model, media, error detection and multimedia networks.
- *CLO 3:* Distinguish different types of multimedia networks.
- *CLO 4:* Interpret and sketch the flow of communication in real world convergence problem.
- *CLO 5:* Design security protocols and methods to solve specified security problems.
- *CLO 6:* Develop a program that allows client-server file transfer.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | √ |
| *CLO 2* | √ | | | | | | | | | √ |
| *CLO 3* | √ | | | | | √ | | | | √ |
| *CLO 4* | √ | | | | | √ | | | | √ |
| *CLO 5* | √ | | | | | | | | | √ |
| *CLO 6* | | | | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Data Communication:** Component, Distributed processing, network criteria, protocol and standards, Line configuration, Topologies, Transmission mode, Categories of networks, Inter-networks | CLO 1, CLO 2 | 5 |
| **OSI Model And Conversion:** The OSI model, Function of the layers, TCP/IP Protocol suite, Analog - Digital data &signals, Periodic and Aperiodic signals, Time and Frequency Domains, Composite Signals. Digital to Digital Conversion, Analog to digital conversion, Digital to analog Conversion, Analog to Analog conversion, Digital data transmission, DTE- DCE Interface, EIA449, EIA530, X.21 Standards, Modems, Cable Modem. | CLO 2, CLO 4 | 7 |
| **Media and Error Detection:** Transmission media - Introduction, Guided Media, Unguided Media, Transmission Impairment, Performance, Wavelength, Shannon capacity, Media Comparison, Multiplexing– FDM, WDM, TDM, Multiplexing Application, DSL and types of Digital subscriber lines. Error detection and correction, types of errors, detection, VRC, LRC, CRC, error correction, LAN Project 802, IEEE 802.x, LLC, MAC, PDU, Ethernet, Token Bus, Token Ring. FDDI, LAN Comparison. | CLO 2, CLO 5 | 5 |
| **Networks, Applications and Security:** Network elements, network structures, protocols, service models, encapsulation, sharing, performance measures. Applications: networking elements of an application (multiple protocols, clients, servers, meaning of data, data encoding), styles of protocols, relationship of control and data, distributing information, caching. Security attacks, authentication, confidentiality, integrity, non-repudiation, Encryption/decryption, keys, key distribution, digital certificates, implementing secure systems (IPSEC, TLS), firewalls | CLO 3, CLO 4, CLO 6 | 5 |
| **Multimedia Networks:** IP multimedia, VoIP, streaming and buffering, jitter, multimedia error | CLO 3, | 5 |

| | | |
|---|---|---|
| recovery, RTP, content distribution networks, peer-to-peer, bit torrent, multimedia QoS. | CLO 5 | |
| **Communications and Convergence:** Service models, reliability (acknowledgements, retransmission, variable timeouts), flow control, congestion control, RPC, discovery (port mappers)Host-to-host communication forwarding, mapping to physical networks (address, fragmentation), address management (sub-netting, cidr) Node-to-node communication error detection (parity, CRC), framing, bit encoding, wireless transmissions Convergence: relationship mobile phones and data communications | CLO 4, CLO 5, CLO 6 | 5 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- B. A. Forouzan (2000): "Data Communications and Networking", 6th Edition or later. McGraw-Hill International Edition.
- S. Tanenbaum (2010): "Computer Networks", 5th edition. Pearson Publications.
- Kurose, James and K. Ross (2016): "Computer networking: a top-down approach", 7th edition. Pearson.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3130 Network and Telecommunication** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | CSM 3123 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of this course unit aims to provide practical knowledge on the ideas on distributed systems. It aims to provide students with an understanding of the techniques that networking protocols, OSI model, network delay, throughput and use to achieve error detection and recovery, multiplexing and security protection. To also seeks to show students how the limitations of communication media can limit what applications can achieve. Equipment with the skills needed to go out and setup networks in small and medium sized organizations.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire practical knowledge on computer communication.
- *CLO 2:* Understand message delay, error detection and recovery.
- *CLO 3:* Analyze message transfer and throughputs in a network.
- *CLO 4:* Design packet forwarding and writing protocols.
- *CLO 5:* Develop error detection and recovery mechanisms.
- *CLO 6:* Implementation of real time networking solutions.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | √ |
| *CLO 2* | √ | | | | | | | | | √ |
| *CLO 3* | √ | | | | | √ | | | | √ |
| *CLO 4* | √ | | | | | √ | | | | √ |
| *CLO 5* | √ | | | | | | | | | √ |
| *CLO 6* | | | | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Understand how a collection of communication protocols co-operate and communicate to achieve the overall communication function. | CLO 1, CLO 2 | 2 |
| Carry out network designs using appropriate hardware and software components to provide specified services for a given site. | CLO 1, CLO 4 | 2 |
| Calculate message delays and throughput for a given application. | CLO 2, CLO 3 | 2 |
| Implement packet forwarding and the role of routing protocols. | CLO 4, CLO 5 | 2 |
| Implement error detection and recovery mechanisms | CLO 5, CLO 6 | 2 |
| Design and implement a program that allows client-server file transfer. | CLO 3, CLO 6 | 3 |
| Design security protocols and methods to solve specified security problems. | CLO 5, CLO 6 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- B. A. Forouzan (2000): "Data Communications and Networking", 6th Edition or later. McGraw-Hill International Edition.
- S. Tanenbaum (2010): "Computer Networks", 5th edition. Pearson Publications.
- Kurose, James and K. Ross (2016): "Computer networking: a top-down approach", 7th edition. Pearson.
- Peterson, Larry L. and Bruce S. Davie (2011): "Computer networks: a systems approach", 5th edition. Morgan Kaufmann.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3132 Python Programming** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil. |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The major objectives of this course are to provide hands on experiences about the Python programming language for students. The examples and problems used in this course are drawn from diverse areas such as life science research, text processing, simple graphics creation and image manipulation, HTML and web programming, and genomics.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Understand the various data structures available in Python programming language and apply them in solving computational problems.
- *CLO 2:* Implement biological algorithms as computer programs using Python.
- *CLO 3:* Adapt and combine standard python algorithms to solve a given biological problem.
- *CLO 4:* Use standard python programming for biological constructs of algorithm using repetition, selection, functions, composition, modules, and aggregated data.
- *CLO 5:* Create socket and GUI applications in Python.
- *CLO 6:* Build new Python software tools for life science research.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | | | | | | | √ |
| *CLO 5* | √ | | √ | | | | | | | √ |
| *CLO 6* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to Python:** Introduction to Python, History of Python, Python Features, Python Development Tools, Writing Python Program, Values. Variables: Numeric Values, Variables and Assignment, Identifiers, Control codes within Structure, Controlling the print Function. | CLO 1 | 3 |
| **Expressions:** Expressions and Arithmetic:- Operator Precedence and Associativity, Comments, Errors (Syntax, Run-time errors, Logic Errors), Arithmetic Examples, Conditional Execution:- Simple if Statement, if/else statement, Compound Boolean Expressions, Nested Conditionals, Multi-way Decision Statements, Conditional Expressions. | CLO 4 | 3 |
| **Conditional Execution:** Conditional Execution:- What is conditional statement in Python, Simple if Statement, if/else statement, nested if condition, else – if ladder, Compound Boolean Expressions, Nested Conditionals, Multi-way Decision Statements, Conditional Expressions. | CLO 3 | 2 |
| **Iteration:** Iteration:- While Statement, For Statement, Nested Loops, the break statement, the continue statement, Infinite Loops, Computing Square roots, Drawing a Tree, Using Functions – mathematical functions – time Functions, reading the files from existing database using Python. | CLO 4, CLO 5 | 4 |
| **Sequence Analysis Through Python:** Sequence Alignment:- Alphabets, Matching Sequences – Perfect Matches – Insertions and Deletions – Rearrangements – Global Versus Local Alignments – Sequence Length, Simple Alignment (Direct Alignment), Statistics:- Simple Statistics, Distributions, Normalizations, Multivariate Statistics, Probabilities, Odds. | CLO 2, CLO 3, CLO 6 | 4 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Kent D. Lee (2010): "Python Programming Fundamentals", 2nd or later Edition. Springer.
- Cody Jackson (2013): "Learning to Program Using Python", 2nd or later Edition. Tata McGraw-Hill.
- Mark Lutz (2007): "Learning Python", 3rd or later edition. O'Reilly.
- Jason Kinser (2009): "Python for Bioinformatics", 3rd edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.
- John V Guttag (2016): "Introduction to Computation and Programming Using Python", 2nd edition. Prentice Hall of India.
- Wesley J. Chun (2001): "Core Python Programming". 2nd or later Edition. Prentice Hall.
- Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser (2013): "Data Structures and Algorithms in Pyhon", 3rd or Later edition. Wiley.
- Kenneth A. Lambert (2011): "Fundamentals of Python – First Programs", 2nd edition. CENGAGE Publication.

**Department of Fisheries Biology and Genetics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FBG 3105 Fish Genetics and Informatics** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

Student wishing to develop their career in Fish Genetics & Bioinformatics will need to know basics of fish genetic engineering, sequence alignment, gene finding, genome assembly, drug design and discovery, protein structure alignment and prediction, prediction of gene expression and protein-protein interactions, genome-wide association studies, the modeling of evolution and ultimately provide the latest information and knowledge to equip students with the concepts and use of bioinformatics in the field of fisheries and aquaculture.

**Course Learning Outcome (CLO)**

Upon completion of this course, the student will be able to:

- *CLO-1:* Describe brief history and major researches in Fish Bioinformatics, basics of Molecular Biology and Genetic Engineering having importance in Fish Bioinformatics.
- *CLO-2:* Illustrate common approaches and tools used in the analysis of gene expression data.
- *CLO-3:* Determine sequence identities using BLAST, phylogenetic and synthetic analyses.
- *CLO-4:* Explain basic data visualization and cross species comparison of gene datasets.
- *CLO-5:* Discuss the sequence analysis for protein, genome annotation & assembly, gene family phylogeny, functional genomics and role of bioinformatics in fisheries management and aquaculture

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Introduction: Terminology, brief history of Bioinformatics research in fisheries, major researches in Fish Bioinformatics, goal of Bioinformatics and future scope. | CLO 1 | 6 |
| Basics of Molecular Biology: DNA, RNA and protein structure, central dogma, primer selection, restriction mapping. | CLO 1 | 5 |
| Basics of fish genetic Engineering: Recombinant DNA technology, Marker-assisted selective breeding, Chromosome manipulation, sex reversal system and Transgenesis. | CLO 1 | 9 |
| Sequencing and database: Types of sequencing, RNAseq, protein sequence, major fish species genome sequences, genome and proteome databases, types of different data in databases, fish data available in different databases, submission and retrieve data from database. | CLO 2, CLO 3 | 8 |
| Tools for sequence analysis and phylogeny: Sequence alignment, BLAST (Basic Local Alignment Search Tool), CLUSTALW, FASTA, phylogenicanalysis- evolutionary changes in Nucleotide sequences; rates and pattern of nucleotide substitution and model; methods for phylogenic estimation- maximum parsimony, distance matrix methods, maximum likelihood methods, Bayesian inference. | CLO 2, CLO 3, CLO 4 | 7 |
| Primary sequence analysis for protein: Software list:<br>i) Homology modeling; ii) Threading/fold recognition; iii) Ab initio structure prediction; iv) Secondary structure prediction; iv) Transmembrane helix prediction; and v) Signal peptide prediction. | CLO 5 | 3 |

| | | |
|---|---|---|
| Genome annotation and Assembly: i) investigate the properties of the genome-genome size, repeats, heterozygosity; ploidy level, GC content; ii) Extract high quality DNA; iii) Choosing of appropriate sequencing technology; iv) Estimate the necessary computational resources; v) Assemble genome; vi) Annotate Transposable Elements; vii) Annotate genes with high quality experimental evidence; viii) Use well-established output formats and submit data to suitable repositories; ix) Ensure methods are computationally repeatable and reproducible; and x) Investigate, re-analyse, re-annotate. | CLO 5 | 2 |
| Gene family phylogeny: Phylogeny, structural evolution and functional diversification of the fish gene family. | CLO 5 | 2 |
| Functional genomics: Definition and goals of functional genomics; Techniques and applications; Techniques and applications; Bioinformatics methods for Functional genomics; and Consortium projects focused on Functional Genomics. | CLO 5 | 3 |
| GMOs, LMOs and Biosafety: Protocol, safety issues, Risk analysis | CLO 5 | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- N.J. Chikhale and VirendraGomase (2007) Bioinformatics- Theory and Practice.Himalaya Publication House, India; 592p.
- Jonathan Pevsner (2015) Bioinformatics and Functional Genomics, 3rd edition. Wiley-Blackwell. 1160p.
- Christina Marshall(Editor) (2019) Bioinformatics and Functional Genomics. CALLISTO REFERENCE. 20p.
- Om P. Rajora (Editor) (2019) Population Genomics: Concepts, Approaches and Applications 1st ed. Springer. 822p.
- Daniel L. Hartl(2018) Essential Genetics and Genomics.Jones & Bartlett Learning; 7 edition, 632p.
- Tore Samuelsson (2012) Genomics and Bioinformatics 1st Edition.Cambridge University Press. 356p.
- Jeremy Ramsden (2015) Bioinformatics, AnIntroducion. Springer, 2015.
- Cummings, B. (2006) Discovering Genomics, Proteomics, and Bioinformatics, 2nd ed. Publisher: IEEE

**Department of Physiology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **VPHY 3109 Animal Cell Physiology** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
For a skilled bioinformatics engineer, it must be necessary to know about the physiological role of cells including blood cell and cellular processes, especially membrane protein, ion channels and cell signaling.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO-1:* Describe the mammalian cell functions and transport systems across the cell membrane.
*CLO-2:* Explain physiological phenomena and membrane physiology.
*CLO-3:* Discuss the formation, functions and components of animal cell, blood cell and body fluids.
*CLO-4:* Illustrate DNA, RNA synthesis, cell signaling and genetic code.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Functions and components of cells | CLO 1 | 2 |
| Physiological phenomena | CLO 2 | 2 |
| Membrane physiology: Transport through cell membrane, Membrane potential, Membrane protein, Ion channel related to drug discovery | CLO 1, CLO 2 | 3 |
| Organization of cell including blood cell, physical and chemical structure of cell and body fluids | CLO 3 | 5 |
| Protein synthesis | CLO 4 | 2 |
| Gene and genetic code | CLO 4 | 2 |
| Transcription of genetic code | CLO 4 | 2 |
| DNA（deoxyribonucleic acid) and RNA（ribonucleic acid) synthesis | CLO 4 | 2 |
| Cell signaling, cell junctions, cell adhesion and extracellular matrix | CLO 4 | 2 |
| Cell reproduction and differentiation | CLO 4 | 2 |
| Gene cloning | CLO 4 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Cell Physiology by Giese, A.C. WB Sanders Company, Philadelphia, London.
- Duke's Physiology of Domestic Animals by William O.Reece ,Howard H. Erickson , Jesse P. Goff, EtsuroE.Uemura, 13th edn. 2015, Cornel University Press, USA.
- Textbook of Medical Physiology, by Arthur C Guyton and John E Hall 13thEdn. 2015, W B Saunders Company, USA.
- Review of physiology, by L L Langley 3rd Edn. 1971, McGraw – Hill Book Company, USA.
- Essentials of Medical Physiologyby K Sembulingamand P Sembulingam 7th edition, 2016, AVI Publishing Company, USA.
- Molecular Biology of THE CELL, (3rd edition) by Bruce Alberts , Dennis Bray, Julian Lewis, Martin Raff , Keith Roberts, James D. Watson. (Garland Publishing,Inc. New York & London).

**Department of Physiology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **VPHY 3110 Animal Cell Physiology** |
| Level & Semester | L-3, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
For establishing the cellular and hematological reference values of various species of animals and birds. For intervention of genetic processes and gene cloning and sequencing

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO-1:* Perform routine examination of blood and blood cell.
*CLO-2:* Perform hormonal Assay.
*CLO-3:* Demonstrate molecular cloning.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Routine examination of blood (Hb, TEC,TLC, DLC, PCV, ESR) and body fluids | CLO 1 | 7 |
| Biochemical analysis of blood and body fluid | CLO 1 | 2 |
| Hormonal Assay | CLO 2 | 2 |
| Molecular cloning | CLO 3 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Laboratory Manual of Hematology and Urinalysis by S L Lamberg and R Rothstein, 1978, AVI Publishing Company, USA.
- Outline of Veterinary Clinical Pathology, 3rd edition. Maxine M. Benjamin, the Iowa State University press, Ames, Iowa, USA.

**Level- 3, Semester- 2**

**Department of Biochemistry and Molecular Biology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **BMB 3203 Biological Informatics** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course will introduce fundamental concepts of bioinformatics, biopolymer, sequence, protein structure, and sequence alignment, DNA coding and structural analysis for living things.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Acquire fundamental knowledge about bioinformatics
*CLO 2:* Understand biological database and biopolymers.
*CLO 3:* Create database for Protein, DNA and RNA.
*CLO 4:* Analyze protein and nucleic acid sequences.
*CLO 5:* Describe fundamentals of proteomics

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | √ | √ | | | √ | | | |
| *CLO 2* | | √ | √ | √ | | | √ | | | |
| *CLO 3* | | √ | √ | √ | | | √ | | | |
| *CLO 4* | | √ | √ | √ | | | √ | | | |
| *CLO 5* | | √ | √ | √ | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction To Bioinformatics:** Bioinformatics, Introductory Biology, Scales of life, Animal Cell , Molecular Biology Information, Macromolecular Structure, Genes and Proteins, Gene Expression Datasets, Human genome, Application domains. | CLO 1 | 4 |
| **Introduction to Biological Databases:** Introduction to Nucleic Acid Data Banks, Introduction to Protein Sequence Data Banks; Nucleotide Databases, Nucleic Acids Research Database Issue, Access, Species-Specific Databases Protein Databases (Swiss-Prot, Tr-EMBL, PIR_PSD, Expasy); Derived Databases Sequence Submission Methods and Tools (Sequin, Sakura, BankiT); Sequence Retrieval Systems (Entrez& SRS). | CLO 2, CLO 3 | 6 |
| **Biopolymers:** Introduction to Biopolymer, Synthetic Polymer, Biopolymers vs synthetic polymers, Conventions and nomenclature, Structural characterization, Biopolymers as materials Internal and external co-ordinate system; Generation of co-ordinates of biopolymers in Cartesian and cylindrical polar co-ordinate system; Genome Anatomy, Prokaryotic genomes structures, Eukaryotic genomes structures. | CLO 3 | 6 |
| **Sequence Analysis:** Introduction to Sequence analysis, History, Sequence Alignment , Profile comparison , Analysis of protein and nucleic acid sequences, multiple alignment programs, Development of programs for analysis of nucleic acid sequences, Pair wise Sequence Alignment – Similarity, Identity and Homology, Global Alignment, Local Alignment, Sequence assembly, Gene prediction, Protein Structure Prediction, Methodology. | CLO 4 | 10 |
| **Structural Analysis:** Structures and Loads- Classification of Structures & Loads, Analytical Methods- Limitations. Strength Of Materials Methods (Classical Methods), Example – Method Of Joints, Method Of Sections, Elasticity Methods, Methods Using Numerical Approximation, Timeline, Analysis Of Structures And Correctness Of Structures, Submission Of Data To PDB: Atomic Coordinates And Electron Density Maps; Methods For Prediction Of Secondary And Tertiary Structures Of Proteins. | CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- D. Baxevanis, D. B. Davison, R. D. M. Page and G. A. Petsko (2004): "Current Protocols in Bioinformatics". New York, John Wiley & Sons Inc.
- David W. Mount (2004): "Bioinformatics: Sequence and Genome Analysis". CSHL Press.
- Harisha and S. Harisha (2007): "Fundamentals of Bioinformatics". I. K. International Publishing House Pvt. Lit. Mumbai-110 016 (India).
- Gu Jenny, Philip E. Bourne (2011): "Structural Bioinformatics", 2nd edition. John Wiley & Sons.
- Jonathan Pevsner (2009): "Bioinformatics and Functional Genomics", 2nd edition. John Wiley & Sons.
- M. Lesk (1999): "Introduction to Bioinformatics", 1st edition. Oxford University Press.
- N. Gautham (2006): "Bioinformatics", Narosa Publishing Company, New Delhi.

**Department of Biochemistry and Molecular Biology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **BMB 3204 Biological Informatics** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course will provide practical skill of bioinformatics, biopolymer, sequence, protein structure, and sequence alignment, DNA coding and structural analysis for living things.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Acquire skills to use different approaches for Retrieval of DNA Sequence.
*CLO 2:* Develop the skills to Retrieval of protein Sequence from the protein databases.
*CLO 3:* Determine the three-dimensional structure of protein.
*CLO 4:* Develop the knowledge to retrieve the particular information from the specialized databases.
*CLO 5:* Predict the classification of the protein based on its structural alignment.
*CLO 6:* Explore sophisticated biochemical techniques in different laboratories.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | √ | √ | | | √ | | | |
| *CLO 2* | | √ | √ | √ | | | √ | | | |
| *CLO 3* | | √ | √ | √ | | | √ | | | |
| *CLO 4* | | √ | √ | √ | | | √ | | | |
| *CLO 5* | | √ | √ | √ | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Retrieval of Protein Sequence using Sequence Databases: UNIPROT, Tr-EMBL.<br>DNA Sequence using Sequence Databases: NCBI, DDBJ, Genbank. | CLO 1 | 2 |
| Retrieval of Protein Structural information using Structure Databases: SCOP, CATH.<br>Retrieval of 3D Protein Structure Using Protein Data Bank. | CLO 1,<br>CLO 2 | 2 |
| Specialized Databases: BEST(Database for Expressed Sequence Tags),DBSTS(Database of Sequence Tagged Sites).<br>Data retrieval tools: SRS (Sequence retrieval System). | CLO 3 | 2 |
| Biological data retrieval system using Entrez.<br>Retrieve the file formats of Sequence: Fasta Format, GCG Format. | CLO 4 | 2 |
| Molecular visualization Of Protein Structure Using Pymol, Rasmol. Protein function prediction Tools.Gene prediction using GenScan tool. Accessing Genome databases. | CLO 5 | 4 |
| Bioinformatics Lab visit | CLO 1 | 4 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- D. Baxevanis, D. B. Davison, R. D. M. Page and G. A. Petsko (2004): "Current Protocols in Bioinformatics". New York, John Wiley & Sons Inc.
- M. Lesk (1999): "Introduction to Bioinformatics", 1st edition. Oxford University Press.
- N. Gautham (2006): "Bioinformatics", Narosa Publishing Company, New Delhi.
- V. R. Srinivas (2005): "Bioinformatics: Sequences and genomics analysis", cold Spring Harbor Laboratory, press,Cold Spring harbor,USA.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3221 Compiler** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | CSM 3127 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of this course is to provide knowledge on compiler internal architecture and its implementation, to introduce students about the principles and techniques used to perform translation by using the basic concept, lexical scanning, optimizing code, semantic analysis, run time organization, code generation and parallelism, and to construct a compiler.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Understand the principles governing all phases of the compilation process.
- *CLO 2:* Understand the role of each of the basic components of a standard compiler.
- *CLO 3:* Apply standard techniques to solve basic problems that arise in compiler construction.
- *CLO 4:* Program design to know when and how to use parallelism.
- *CLO 5:* Evaluate how the compiler can take advantage of particular processor characteristics to generate good code.
- *CLO 6:* Develop a real time purpose oriented compiler.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | | | | | √ |
| *CLO 6* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Language translators:** Compilers and interpreters. The structure of a compiler: lexical analysis, parsing, semantic analysis, intermediate code generation, register allocation, global optimization. Bootstrapping a compiler. | CLO 1, CLO 2 | 4 |
| **Lexical scanning:** Token classes, keyword recognition, minimizing the code-per-character cost of scanning, scanning numeric literals and string literals. The interface between the scanner and the parser. Hand-written vs. automatically generated scanners.<br>Formalism: regular grammars, regular languages, FSA, non-deterministic FSA, automatic generation of lexical scanners. Parsing. Abstract syntax vs. concrete syntax. Grammars and the formal specification of certain aspects of programming languages. Top-down parsing and recursive descent. Automatic parser construction. FIRST and FOLLOW functions. LL(1) parsers. Bottom-up parsing through LR parsers. Conflicts in LR grammars and how to resolve them. SLR, LR(k), and LALR parsers. | CLO 1, CLO 3 | 5 |
| **Semantic analysis:** Attributes and their computation, tree-traversals, visibility and name resolution. Inherited attributes and symbol tables. Name resolution in block-structured languages. Type checking. Type systems, varieties of strong typing, overload resolution, polymorphism and dynamic dispatching. Type-checking and type inference, unification. | CLO 2, CLO 3 | 6 |
| **Run-time organization:** Storage allocation, non-local references, parameter passing, dynamic storage allocation. Exception handling, debugging information. Intermediate code generation: control structures, expressions, simple register allocation. Aggregates and other high-level constructs. Code generation over basic blocks. Using dags. Global register allocation and graph coloring. | CLO 2, CLO 3, CLO 6 | 5 |
| **Code generation for RISC machines:** Delay slots, instruction scheduling, inlining, loop unrolling. Peephole optimization. Instruction selection by tree matching<br>VLIW/EPIC Architectures, Software Pipelining. | CLO 3, CLO 5 | 6 |
| **Parallelism:** Optimizing for parallelism and locality. Affine programs. Analysis for data reuse. Integer Linear Programming. | CLO 4, CLO 5, CLO 6 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- R. Wilhelm and H. Seidl (2010): "Compiler Design: Virtual Machines", Latest edition. Springer Publications.
- T. Mogensen and E.Mogensen (2017): "Introduction to Compiler Design", 2nd edition. Springer Publications.
- O.G. Kakde (2005): "Comprehensive Compiler Design", 3rd edition or later. Laxmi Publications.
- D.Grune, K.V.Reeuwijk and H. E. Bal (2012): "Modern Compiler Design", 2nd edition or later. Springer Publications.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3222 Compiler** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | CSM 3221 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of this course is to implement principles and techniques used to perform this translation by using the basic concept, lexical scanning, optimizing code, semantic analysis, run time organization, code generation and parallelism, and the issues that arise in the construction of a compiler.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Implement lexical analyzer for any language.
*CLO 2:* Develop syntax and semantic analyzer based on lexical analysis.
*CLO 3:* Develop different types of parser.
*CLO 4:* Implement of a syntax tree using Yacc.
*CLO 5:* Generate machine code from abstract syntax tree.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C language. | CLO 1 | 1 |
| Write a C program to identify whether a given line is a comment or not. | CLO 1 | 1 |
| Write a C program to recognize strings under 'a', 'a*b+', 'abb'. | CLO 1 | 1 |
| Write a C program to test whether a given identifier is valid or not. | CLO 2, CLO 3 | 2 |
| Write a C program to simulate lexical analyzer for validating operators. | CLO 1 | 1 |
| Implement the lexical analyzer using JLex, flex or other lexical analyzer generating tools. | CLO 1 | 1 |
| Write a C program for implementing the functionalities of predictive parser. | CLO 2, CLO 3 | 2 |
| a) Write a C program for constructing of LL (1) parsing.<br>b) Write a C program for constructing recursive descent parsing | CLO 3 | 4 |
| a) Write a C program to implement operator precedence parsing.<br>b) Write a C program to implement Program semantic rules to calculate the expression that takes an expression with digits, + and * and computes the value. | CLO 3 | 1 |
| Convert the BNF rules into Yacc form and write code to generate abstract syntax tree. | CLO 4 | 1 |
| Write a C program to generate machine code from abstract syntax tree generated by the parser. | CLO 5 | 1 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- R. Wilhelm and H. Seidl (2010): "Compiler Design: Virtual Machines", Latest edition. Springer Publications.
- T. Mogensen and E.Mogensen (2017): "Introduction to Compiler Design", 2nd edition. Springer Publications.
- O.G. Kakde (2005): "Comprehensive Compiler Design", 3rd edition or later. Laxmi Publications.
- D.Grune, K.V.Reeuwijk and H. E. Bal (2012): "Modern Compiler Design", 2nd edition or later. Springer Publications.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3223 Artificial Intelligence** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of this course is to introduce the students with the study of Artificial Intelligence covering AI concepts, different types of intelligent searching and AI techniques.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire the basic knowledge on artificial intelligence.
- *CLO 2:* Understand different types of AI agent and intelligent searching techniques.
- *CLO 3:* Use knowledge representation technique, uncertainty and decision making technique to solve real life problem.
- *CLO 4:* Compare and contrast different searching method for problem solving.
- *CLO 5:* Design game theory using AI techniques.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | √ | | | | | | √ |
| *CLO 2* | √ | | √ | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | √ | | | | | | √ |
| *CLO 5* | √ | | √ | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Overview and Agents:** Foundations, scope, problems, and approaches of AI. Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents. Artificial Intelligence programming techniques. | CLO 1, CLO 2 | 4 |
| **Problem-solving through Search:** Forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications. | CLO 1, CLO 2, CLO 4 | 6 |
| **Knowledge Representation and Reasoning:** ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications. | CLO 3, CLO 5 | 6 |
| **Planning and Game Theory:** Minimax, expectimax, Evaluation functions Alpha-beta pruning. Planning: planning as search, partial order planning, construction and use of planning graphs. | CLO 2, CLO 5 | 5 |
| **Uncertainty and Decision Making:** Knowledge: probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, sample applications. Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications. | CLO 3, CLO 4, CLO 5 | 6 |
| Sample Applications of AI, student project presentations. | CLO 4, CLO 5 | 5 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- S. Russell and P. Norvig (2015): "Artificial Intelligence: A Modern Approach", 3rd edition or later. Prentice Hall.
- G. F. Luger and W. A. Stubblefield (2005): "Artificial Intelligence - Structures and Strategies for Complex Problem Solving", 5th edition or later. Addison Wesley.

- F. Baader, D. Calvanese, D. McGuinness, D. Nardi and P. P. Schneider (2003): "The Description Logic Handbook: Theory, Implementation and Applications". Cambridge University Press.


**Department of Computer Science & Mathematics**

Bangladesh Agricultural University, Mymensingh

**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3224 Artificial Intelligence** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | CSM 3223 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of this course is to provide the students with practical knowledge on Artificial Intelligence (AI) covering AI concepts, different types of intelligent searching and AI techniques.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

*CLO 1:* Implement semantic analysis programs in AI.
*CLO 2:* Develop program to handle intelligent searching algorithms.
*CLO 3:* Game development by considering adverse situation.
*CLO 4:* Design programs using uncertainty problem.
*CLO 5:* Develop different AI algorithms.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | √ | | | | | | √ |
| *CLO 2* | √ | | √ | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | √ | | | | | | √ |
| *CLO 5* | √ | | √ | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Write a program for semantic analysis like predicting movie rating. | CLO 1 | 2 |
| Write a program for semantic analysis like sentiment classification. | CLO 1 | 2 |
| Write a program to text reconstruction like word segmentation and vowel insertion. | CLO 1 | 2 |
| Game development using alpha beta pruning, minimax algorithm and adverse situation. | CLO 1 | 2 |
| Game development using depth first search, breadth first search, A* search, Heuristic search. | CLO 2 | 2 |
| Design a program to implement tic-tac-toe game. | CLO 3 | 2 |
| Develop program to handle uncertainty in real life. | CLO 4 | 2 |
| Develop program to handle basic AI algorithm. | CLO 5 | 2 |

**Teaching Strategy**

Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**

Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- S. Russell and P. Norvig (2015): "Artificial Intelligence: A Modern Approach", 3rd edition or later. Prentice Hall.
- G. F. Luger and W. A. Stubblefield (2005): "Artificial Intelligence - Structures and Strategies for Complex Problem Solving", 5th edition or later. Addison Wesley.
- F. Baader, D. Calvanese, D. McGuinness, D. Nardi and P. P. Schneider (2003): "The Description Logic Handbook: Theory, Implementation and Applications". Cambridge University Press.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3225 Microprocessor and Embedded System** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | CSM 2123 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

This course aims to familiarize students with the use of microprocessors or microcontrollers for simple control and interfacing applications. The course aims to develop the understanding of the programming and operation of the ARM processor, modular program construction, separation of user and operating system tasks and interfacing techniques at the hardware and software levels. This course builds upon the understanding of processor operation and assembler programming and shows how hardware and software interact in the solution of interfacing problems. This course aims to teach student about embedded system for developing real time solution in agricultural domain.

**Course Learning Outcomes (CLO)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire technical knowledge including microprocessor architecture, I/O interface and peripherals, and debugging methodology.
- *CLO 2:* Understand debugging techniques for microcontroller programs, debug hardware/software interaction problems.
- *CLO 3:* Design and structuring a microcontroller control program.
- *CLO 4:* Program design to know when and how to use interrupts.
- *CLO 5:* Design the hardware-software interface and the implementation trade-offs around this boundary.
- *CLO 6:* Develop an embedded system for sensor communication in agricultural domain.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | √ |
| *CLO 2* | √ | | | | | | | | | √ |
| *CLO 3* | √ | | √ | | | | | | | √ |
| *CLO 4* | √ | | √ | | | | | | | √ |
| *CLO 5* | √ | | √ | | | | | | | √ |
| *CLO 6* | √ | | | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Microprocessor Basic:** Basic 8- and 16-bit microprocessor and microcontroller architectures, instruction sets and on-chip resources. | CLO 1, CLO 2 | 5 |
| **Memory:** Memory organizations and interfacing and DMA. Parallel input and output, handshaking, interfacing with common devices. Synchronous and asynchronous serial communication interfaces, topologies and protocols. | CLO 1, CLO 4 | 5 |
| **Microcontrollers:** Introduction to Microcontrollers and Embedded Processors – Microcontrollers survey-four bit, eight bit, sixteen bit, thirty two bit Microcontrollers --Comparing Microprocessors and Microcontrollers-Overview of the 8051 family. | CLO 2, CLO 3 | 5 |
| **Microcontroller Memory:** The 8051 Architecture- Hardware- Oscillator and clock-program counter –data pointer-registers-stack and stack pointer-special function registers- -memory Organization-program memory-data memory -Input / Output Ports –External memory counter and timer-serial data Input / output-Interrupts. | CLO 2, CLO 3, CLO 6 | 6 |
| **Modern Microcontrollers:** 8051 Serial Communication -Connection to RS-232- Serial Communication Programming- Interrupts Programming. Microcontroller Interfacing -Key Board - Displays- Pulse Measurement - D / A and A/D conversion- Stepper Motor- Basic concept of PIC microcontroller –Microcontroller Architecture – PIC16F Family. | CLO 3, CLO 4, CLO 6 | 6 |
| **Embedded Systems:** Sensors, actuators, sensor data read write, processes, scheduling, concurrency, Real-time scheduling, embedded power management, embedded control, embedded wireless, security for embedded wireless. | CLO 4, CLO 5, CLO 6 | 5 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- H. William (2014): "ARM Assembly Language: fundamentals and techniques", 2nd edition. CRC Press.
- S. Andrew, D. Symes and C. Wright (2004): "ARM system developer's guide: designing and optimizing system software", Elsevier Publications.
- J. R. Gibson (2007): "ARM Assembly Language: an introduction", Lulu.
- Jon S. Wilson (2004): "Sensor Technology Handbook", Morgan Kaufmann.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3226 Microprocessor and Embedded System** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | CSM 3225 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course aims to familiarize students with the use of microprocessors/microcontrollers for simple control and interfacing practical applications. The course aims to develop the understanding of the programming and operation of the ARM processor, modular program construction, and separation of user and operating system tasks and interfacing techniques, sensor communication, and embedded system, remote communication at the hardware and software levels.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Acquire practical knowledge on microprocessor/microcontroller.
*CLO 2:* Understand embedded system and its practical use.
*CLO 3:* Operate different types of controller using assembly program
*CLO 4:* Simulate different processor architecture and its complexity.
*CLO 5:* Develop programs to handle interrupts and exception.
*CLO 6:* Implementation of real time embedded system solution.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | √ |
| *CLO 2* | √ | | | | | | | | | √ |
| *CLO 3* | √ | | √ | | | | | | | √ |
| *CLO 4* | √ | | √ | | | | | | | √ |
| *CLO 5* | √ | | √ | | | | | | | √ |
| *CLO 6* | √ | | | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Understand the hardware-software interface and the implementation trade-offs around this boundary. | CLO 1, CLO 2 | 2 |
| Interface an ADC and a temperature sensor to measure temperature. | CLO 1, CLO 4 | 2 |
| Interface a stepper motor – and rotate it clock wise or anti clock wise through given angle steps. | CLO 3, CLO 6 | 2 |
| Interface a DAC & Generate a stair case wave form – with step duration and no. of steps as variables. | CLO 4, CLO 5 | 3 |
| Assembly Language Program Structure and debugging. | CLO 5, CLO 6 | 3 |
| Design and implement a program that allows communicates with remote sensor. | CLO 3, CLO 5 | 2 |
| Design an embedded system to solve real time problems in agricultural domain. | CLO 3, CLO 4, CLO 6 | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- H. William (2014): "ARM Assembly Language: fundamentals and techniques", 2nd edition. CRC Press.
- S. Andrew, D. Symes and C. Wright (2004): "ARM system developer's guide: designing and optimizing system software", Elsevier Publications.
- J. R. Gibson (2007): "ARM Assembly Language: an introduction", Lulu.
- Jon S. Wilson (2004): "Sensor Technology Handbook", Morgan Kaufmann.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3227 Digital Image Processing** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The objectives of this course are to familiarize the students on Image sampling and quantization, color, point operations, segmentation, morphological image processing, linear image filtering and correlation, image transforms, Eigen images, multi-resolution image processing, noise reduction and restoration, feature extraction and recognition tasks, image registration. Emphasis is on the general principles of image processing. Students learn to apply material by implementing and investigating image processing algorithms in Matlab and optionally on Android mobile devices.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Understand how digital images are generated, and how the method and conditions of acquisition affect the structure and information content of digital imagery.
- *CLO 2:* Be familiar with sources of radiometric and geometric distortion and know the general correction procedures.
- *CLO 3:* Be able to implement spatial and spectral enhancement procedures appropriately.
- *CLO 4:* Be familiar with basic feature extraction and classification procedures for multispectral and hyperspectral data.
- *CLO 5:* Have a conceptual understanding of hyperspectral and extended data analysis procedures.
- *CLO 6:* Learn to consider images as data.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | √ | | | | | √ |
| *CLO 2* | √ | | | √ | √ | | | | | √ |
| *CLO 3* | √ | | | √ | √ | | | | | √ |
| *CLO 4* | √ | | | √ | √ | | | | | √ |
| *CLO 5* | √ | | | √ | √ | | | | | √ |
| *CLO 6* | √ | | | √ | √ | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to Digital Image Processing:** Sampling/spatial resolution, IFOV, GIFOV, resolution cell, pure pixel; Spatial frequency, sampling, quantization/radiometric resolution. | CLO 1 | 4 |
| **Radiometric Corrections & Enhancements:** Imaging/digitizing systems/calibration: mechanical scanners, pushbroom scanners, 2-d array scanners, hyperspectral scanners; Simple remote sensing model (RTE), Field measurements (radiance, irradiance, reflectance), Atmospheric Effects (absorption, scattering, attenuation, path radiance), Atmospheric correction (intro); Instrument noise, data degradation, correction (instrument and atmosphere) and calibration (conversion to radiance); Histogram modification, histogram matching, density slicing, color enhancements, LUT's. | CLO 2 | 4 |
| **Geometric Corrections:** Sources of geometric distortion (optical distortion, panoramic effect, pitch, roll, yaw); General procedures for geometric corrections (distortion-specific corrections, linear geometric transforms). | CLO 2 | 6 |
| **Spatial Enhancements & Feature Extraction:** High-pass & low-pass filters, convolution, correlation; Fourier Transform, frequency domain filters; Texture features: convolution, statistical filters, edge-preserving smoothing, co-occurrence matrices. | CLO 3, CLO 4 | 3 |
| **Spectral Feature Extraction:** Algebraic operations; Multispectral transforms (Principal Components); Vegetation Indices (VI, NDVI, SAVI, Kauth-Thomas); Canopy models, water models; Classification & Pattern Recognition Principles (parallelepiped and minimum distance classifiers); Supervised classification (maximum-likelihood): Bayes Theorem, non-parametric classification, parametric classification (multi-normal distribution, covariance matrix, correlation matrix). | CLO 4 | 3 |

| | | |
|---|---|---|
| **Concepts of Hyperspectral Image Data:** Hyperspectral Concepts (sensor products, reflection spectra, emission spectra); Hyperspectral Data Bases; Hyperspectral imaging systems (whisk broom 1-D arrays-AVIRIS, push broom 2-D arrays-HYDICE, Fourier transform spectrometers). | CLO 4, CLO 5 | 3 |
| **Spectral Features & Atmospheric Correction:** Representation and manipulation of spectral data: Spectra vs. vectors, binary spectral match, line depth measurement; Spectral derivatives and derivative analysis; Atmospheric transmission, pressure, column water vapor, aerosols, continuum estimation and removal, band depth measurement. | CLO 2 | 4 |
| **Mixed Pixel Analysis:** Empirical spectral modeling (ELM); Atmospheric modeling: MODTRAN (radiosonde and satellite data), CIBR and ATREM (column water vapor), APDA and NLLSSF (pressure, column water vapor, aerosols); Image Endmembers: user-selected, pure pixel index (PPI), spectral libraries, use of shade. | CLO 6 | 3 |
| **Noisy Data & Advanced Algorithms:** Linear mixing models (unconstrained, partially; constrained, fully constrained); Noise adjusted Principal Components, Expert system; Maximum Noise Fraction Transformation; Orthogonal Subspace Projection, Unmixing, Binary Encoding; Unmixing by stepwise regression, Thermal Image Data. | CLO 2, CLO 6 | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Jae S. Lim (1990): "Two-Dimensional Signal and Image Processing", Latest edition. Prentice Hall.
- Alan C. Bovik (2010): "Handbook of Image and Video Processing", 2nd edition. Elsevier.
- Arun N. Netravali (2013): "Digital Pictures: Representation, Compression, and Standards", 2nd edition. Springer.
- Rafael C Gonzalez and Richard E. Woods (2009): "Digital Image Processing", 3rd edition. Pearson.
- Wilhelm Burger, Mark J. Burge (2016): "Digital Image Processing: An Algorithmic Introduction Using Java", 2nd edition. Springer.
- Richard Szeliski (2010): "Computer Vision: Algorithms and Applications", Latest edition. Springer.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3228 Digital Image Processing** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The objectives of this course are to provide hands-on experience on Image sampling and quantization, color, point operations, segmentation, morphological image processing, linear image filtering and correlation, image transforms, Eigeni mages, multi-resolution image processing, noise reduction and restoration, feature extraction and recognition tasks, image registration. Students will have practical knowledge on image processing algorithms in Matlab and optionally on Android mobile devices.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire practical knowledge on how digital images are generated, and how the method and conditions of acquisition affect the structure and information content of digital imagery.
- *CLO 2:* Get hands-on experience with sources of radiometric and geometric distortion and know the general correction procedures.
- *CLO 3:* Implement spatial and spectral enhancement procedures appropriately.
- *CLO 4:* Apply basic feature extraction and classification procedures for multispectral and hyperspectral data.
- *CLO 5:* Model hyperspectral and extended data analysis procedures.
- *CLO 6:* Create software tools for digital image processing.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | √ | | | | | √ |
| *CLO 2* | √ | | | √ | √ | | | | | √ |
| *CLO 3* | √ | | | √ | √ | | | | | √ |
| *CLO 4* | √ | | | √ | √ | | | | | √ |
| *CLO 5* | √ | | | √ | √ | | | | | √ |
| *CLO 6* | √ | | | √ | √ | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Practical knowledge on sampling/spatial resolution, IFOV, GIFOV, resolution cell, pure pixel, spatial frequency. | CLO 1 | 3 |
| Hands-on experience on radiometric corrections & enhancements using Imaging/digitizing systems/calibration.<br>Practical knowledge on histogram modification, histogram matching, density slicing, color enhancements, LUT's. | CLO 2 | 2 |
| Apply geometric Corrections through different sources of geometric distortion including optical distortion, panoramic effect, pitch, roll, yaw. | CLO 2 | 3 |
| Implementation and evaluation of spatial enhancements and feature extraction techniques including high-pass & low-pass filters, convolution, correlation, fourier transform, frequency domain filters and texture features. | CLO 3, CLO 4 | 1 |
| Implementation and evaluation of spectral feature extraction algorithms such as algebraic operations, multispectral transforms. | CLO 4 | 3 |
| Capturing and handling hyperspectral image data. | CLO 4, CLO 5 | 1 |
| Representation and manipulation of spectral data. | CLO 2 | 1 |
| Analyses of mixed pixel using empirical spectral modeling (ELM); atmospheric modeling. | CLO 6 | 1 |
| Handling noisy data using advanced algorithms such as linear mixing models, orthogonal subspace projection, unmixing, binary encoding; unmixing by stepwise regression, thermal image data. | CLO 2, CLO 6 | 1 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Jae S. Lim (1990): "Two-Dimensional Signal and Image Processing", Latest edition. Prentice Hall.
- Alan C. Bovik (2010): "Handbook of Image and Video Processing", 2nd edition. Elsevier.
- Arun N. Netravali (2013): "Digital Pictures: Representation, Compression, and Standards", 2nd edition. Springer.
- Rafael C Gonzalez and Richard E. Woods (2009): "Digital Image Processing", 3rd edition. Pearson.
- Wilhelm Burger, Mark J. Burge (2016): "Digital Image Processing: An Algorithmic Introduction Using Java", 2nd edition. Springer.
- Richard Szeliski (2010): "Computer Vision: Algorithms and Applications", Latest edition. Springer.

**Department of Agronomy**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **AGRON 3205 Field Crop Production** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course is designed to provide the students with a comprehensive understanding on principles of crop production with optimum utilization of natural resources, farm machineries and inputs towards increasing productivity of crops with maintaining the soil health and clean environment.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO-1:* Acquire knowledge on agronomic principles for crop production
*CLO-2:* Understand crops and cropping system and their relationship with weather and climate.
*CLO-3:* Optimization of inputs for maximizing crop production.
*CLO-4:* Gain knowledge about production technology of crops.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to Agronomy**: Definition, principles and scope of Agronomy. Relationship of Agronomy with other branches of Agriculture; | CLO-1 | 2 |
| **Weather and Climate**: Concept of weather and climate. Effect of temperature, day length and solar radiation on growth, development and yield of crops. Cropping seasons of Bangladesh and their characteristics. | CLO-2 | 3 |
| **Crops and Cropping Systems**: Agronomic classification of crops. Methods of cropping. Crop suitability in different agro-ecological zones in Bangladesh. Distribution of crops in relation to season, soil and land topography. Methods of crop establishment. Factors affecting seed rate and depth of seeding. Effect of plant density and planting geometry on crop yield and quality. | CLO-2 | 4 |
| **Tillage and intercultural Operations**: Concept, objectives and types of tillage. Types and methods of intercultural operations used in field crop production- irrigation, weeding, mulching, thinning and earthing up. Implements used for tillage and intercultural operations with their functions and efficiencies. **Mechanization of Agriculture: Present status, problems and prospects of mechanization of Agriculture in Bangladesh.** | CLO-3 | 4 |
| **Plant Nutrition**: Essential plant nutrient elements, their functions, deficiency symptoms and toxic effects in crop plants. Manures and fertilizers- concept, application methods. Tools and implements used for fertilization. | CLO-3 | 5 |
| **Seed and seedling**: Definition and classification of seed. Attributes of quality seed. Importance of quality seed in crop production. Seed processing, grading and treatment- methods and implements used. Maintenance of seed quality during production, processing and storage of seed. | CLO-3 | 5 |
| Production Technology of Crops: Climate and soil requirements, variety selection, cultivation practices and post-harvest operations of the following crops- rice, wheat, maize, sugarcane, jute, mustard, groundnut, soybean and lentil. Points to be considered during production and processing of crops for seed and for grain; | CLO-4 | 7 |
| Review class and class test | CLO-4 | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Craig C. Sheaffer and Kristine M Moncada (2011): “Introduction to Agronomy: Food, Crops, and Environment”, 2nd or later edition. Cengage Learning.
- Mark Ashman and Geeta Puri (2002): “Essential Soil Science: A Clear and Concise Introduction to Soil Science”, 6th edition. Wiley-Blackwell.
- Charles Yoe (2012): “Introduction to Natural Resource Planning”, 7th edition. CRC Press.

**Department of Biochemistry and Molecular Biology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **BMB 3201 Enzymes and Metabolism** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
This course covers the mechanism of enzyme action and their impact on metabolic processes and their impact on human nutrition under normal and adverse condition.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Describe various terms of enzymes, enzyme activity, enzyme kinetics and regulation.
*CLO 2:* Explain various metabolic processes (pathways / cycles) with their relationships.
*CLO 3:* Calculate energy kinetics in various metabolic processes.
*CLO 4:* Construct the relationship between the metabolic processes.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | √ | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to Enzymes:** Introduction to enzymes, nomenclature, classification, riboenzyme, general characteristics of theories of enzyme catalysis, substrate specificity, isozymes, coenzymes, cofactors, regulation of enzyme activity, chemical kinetics and enzyme kinetics, Michaelis-Menten equation, effect of various factors on rate of reactions, inhibition of enzymatic reactions and kinetics, multienzyme system and bisubstrate reactions, catalytic mechanisms, regulatory enzymes and immobilized enzyme. | CLO 1 | 5 |
| **Introduction to Metabolism:** Introduction to metabolism- Overview of anabolic and catabolic pathways of carbohydrates, proteins and lipids. Role of ATP, NAD, FAD and CoA in metabolism. Concept of Bioenergetics | CLO 2 | 3 |
| **Carbohydrate Metabolism:** Digestion and absorption of carbohydrates. Glycolysis and its significance, Fermentation, Fate of pyruvate, Citric acid cycle, Gluconeogenesis, Cori cycle, Glycogenesis, Glycogenolysis Glycogen storage diseases. HMP shunt, Uronic acid pathway, Metabolism of hexoses other than glucose, Regulation of glycogen metabolism, Glyoxylate pathway, Biosynthesis of oligosaccharides and glycoproteins | CLO 2, CLO 3, CLO 4 | 8 |
| **Lipid Metabolism:** Digestion and absorption of lipids. Introduction to lipid metabolism, β-Oxidation of fatty acids, Ketogenesis. Biosynthesis of fatty acids, Triacylglycerols and prostaglandins. Metabolism of phospholipids, glycolipids and cholesterol. Lipoproteins: Metabolism of HDL, Disorder of Plasma Lipoproteins, Fatty liver, Obesity, Atherosclerosis, Tay – Sachs disease, Gaucher's disease, Niemann – Pick disease. | CLO 2, CLO 3, CLO 4 | 6 |
| **Protein Metabolism:** Digestion and absorption of proteins. General aspects of amino acids metabolism; deaminaton, transamination, transmethylation, transpeptidation, and decarboxylation. Metabolism of ammonia: urea cycle and its regulation, Nitrogen balance, biosynthesis of non-essential amino acids. Metabolic breakdown of individual amino acids. Clinical correlations of protein metabolism. Integration of metabolism. | CLO 2, CLO 4 | 6 |
| **Nucleic Acid Metabolism:** Central dogma of life; replication, transcription and translation. Biosynthesis and degradation of purines and pyramidines, neucleosides and nucleotides. Clinical correlation of purine and pyrimidine metabolism. Nucleotides as coenzymes. | CLO 2, CLO 4 | 4 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Lehninger Principles of Biochemistry by David L. Nelson, 2008. 5th edition. W. H. freeman and company. New York.
- Textbook of Biochemistry by Thomas M. Devlin, 2002. 5th edition. John Wiley and Sons, Inc. Printed in USA.
- Biochemistry by Donald Voet, 1995. 2nd edition, John Wiley and Sons, New York.
- Outlines of Biochemistry by Eric E. Conn and Paul K. Stumpf, 1987. 5th edition. John Wiley and Sons, New York.
- Biochemistry by Albert L Lehninger, 1982. 2nd edition Kalyani Publishers. Ludhiana, New Delhi.
- Harper's Biochemistry by Robert K Murray, 2002. 25th edition. McGraw Hill. Printed in Singapore.
- Biochemistry by Lubert Stryer, 1995. 4th edition. W. H. freeman and company. New York.
- TextBook of Biochemistry by Edward S. West, Wilber R. Todd, Haward S. Mason and John T. Van Bruggan. 4th Edition, 1966. The MaCmillan Company. Collier-MaCmillan Ltd. London.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3229 Parallel and Distributed Systems** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil. |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The objectives of this course are to introduce the students with core concepts of parallel and distributed systems. In this course, the various ways and themes will be explored to develop software for such systems.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Acquire fundamental definitions and concepts of hardware architectures relevant to parallel and distributed systems.
*CLO 2:* Understand performance metrics and how they relate to our understanding of a program's behavior.
*CLO 3:* Describe tradeoffs between wide-scale parallel paradigms, including cluster, grid, and peer-to-peer computing.
*CLO 4:* Analyze local, shared, parallel, and distributed file systems.
*CLO 5:* Develop software for shared-memory multiprocessing, and for distributed computation using message-passing.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | | | | | | | √ |
| *CLO 5* | √ | | √ | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Parallel patterns:** Task vs data decomposition, Shared memory vs message-passing, Flynn's taxonomy, Instruction-level parallelism, Foster's methodology, communication patterns, matrix operations. | CLO 1 | 6 |
| **System architectures:** Shared memory, coprocessors and accelerators, distributed clusters, wide-area networks, clouds, grids, p2p.<br>Performance analysis: Speedup and efficiency, communication overhead, energy usage, analysis tools. | CLO 1, CLO 2 | 6 |
| **Multiprocessing:** Explicit vs Implicit, threads vs process, thread safety, synchronization, parallelizable loops, and parallel languages. | CLO 2, CLO 3 | 6 |
| **Distributed computing:** Naming, topologies, locality, synchronization, collective operation, fault tolerance, middleware. Distributed file systems:<br>Remote procedure, network file systems, replication and consistency, protocols. | CLO 3, CLO 4 | 8 |
| **Grids, clouds and p2p:** Decentralized computation, consensus protocols. | CLO 3, CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Peter Pacheco (2016): "Parallel Programming", 1st Edition or later.
- Maarten v. Steen and Andrew S. Tanenbaum (2017): "Distributed Systems", 3rd edition. CreateSpace Independent Publishing.
- Kai HKai Hwang, Jack Dongarra and Geoffrey C. Fox (2013): "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things", 1st Edition or later. Elsevier.
- Richard M. Fujimoto (2000): "Parallel and Distributed Simulation Systems", 1st Edition or later. Wiley.
- Arslan Munir, Ann Gordon-Ross and Sanjay Ranka (2016): "Modeling and Optimization of Parallel and Distributed Embedded Systems", 1st Edition or later. Wiley.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3231 E-commerce** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil. |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The objectives of the course are to introduce the concept of electronic commerce, and to understand how electronic commerce is affecting business enterprises, governments, consumers and people in general.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Explain the components and roles of the Electronic Commerce environment.
*CLO 2:* Explain how businesses sell products and services on the Web.
*CLO 3:* Describe the qualities of an effective Web business presence.
*CLO 4:* Describe E-Commerce payment systems.
*CLO 5:* Explain how to meet the needs of Web site visitors.
*CLO 6:* Identify and reach customers on the Web.
*CLO 7:* Understand Web marketing approaches and elements of branding.
*CLO 8:* Explain the client/server infrastructure that supports electronic commerce.
*CLO 9:* Explain basic electronic commerce functions.
*CLO 10:* Understand legal and ethical issues related to E-Commerce.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | | | | | | | √ |
| *CLO 5* | √ | | √ | | | | | | | √ |
| *CLO 6* | √ | | | √ | | | | | | √ |
| *CLO 7* | √ | | | √ | | | | | | √ |
| *CLO 8* | √ | | √ | √ | | | | | | √ |
| *CLO 9* | √ | | √ | | | | | | | √ |
| *CLO 10* | √ | | √ | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Introduction to e-commerce: Overview, Candidate Models, web Resource; | CLO 1, CLO 5 | 6 |
| Security and encryption: Computer and Network Security Risks, Digital Certificates, Encryption and PGP, Firewalls, Transaction Security; | CLO 2, CLO 4 | 6 |
| Electronic Payment Systems: Web based payment system based on credit cards, checking accounts and cash; | CLO 3, CLO 4 | 6 |
| Business to consumer e-commerce: e-commerce business models, On-line retailing, On-line publishing, On-line customer Service and Support, On-line Banking; | CLO 7, CLO 8, CLO 9 | 8 |
| Legal Issue: Intellectual Property, Copyright, Trademark and patents, Cyber Crime and Money Laundering. | CLO 6, CLO 10 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Kenneth C. Laudon and Carol Guercio Traver (2012): "E-Commerce, Business, Technology, Society", 2nd edition. Person.
- John McMahon (2017): "E-commerce: A Beginners Guide to e-commerce", 1st edition or later. CreateSpace Independent Publishing.
- Tanner Larsson (2016): "To Build, Grow & Scale A Successful Ecommerce", 1st edition or later. CreateSpace Independent Publishing.
- Judah Phillips (2016): "Ecommerce Analytics: Analyze and Improve the Impact of Your Digital Strategy", 1st edition or later. Pearson.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3233 Computer Peripherals and Interfacing** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil. |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objectives of this course are to familiarize students with all types of semiconductor memory devices, memory interface requirements, different types of interrupt structures and digital communication interface adapters. The students will also be able to analyze and design digital interface circuits, and select appropriate and compatible computer/peripherals combinations.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Understand the operation of a sophisticated computer system, including high-performance peripheral interfaces, extensive signal processing and graphics software.
- *CLO 2:* Analyze different types of interrupt structures.
- *CLO 3:* Evaluate specification of computer/peripherals.
- *CLO 4:* Apply knowledge of digital communication interface adapters.
- *CLO 5:* Design digital interface circuits for Input, Output, Keyboard, and Display Circuits.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | | | | | | | √ |
| *CLO 5* | √ | | √ | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction To Computer Interfacing:** Interfaces and Interfacing, System-Level Interfaces, Parallel Interfaces, universal Serial bus. | CLO 1, CLO 2 | 6 |
| **Universal Serial Bus (USB):** Introduction about USB, USB interfaces, Types of USB Connectors, USB types and USB Power. | CLO 2, CLO 3 | 6 |
| **Introduction to Microcontroller and PIC Microcontroller:** Embedded System, Microcontroller, Microprocessor and Microcomputer, Microcontroller Hardware, Memory in a Microcontroller, Microcontroller ROM and Microcontroller RAM, Peripheral Interface Controller (PIC), Comparison Between Architectures, PIC Family, and PIC Peripheral. | CLO 4, CLO 5 | 6 |
| **Terminal Commands:** Introduction, Digital Part Commands, Analog Input Commands, Analog Output Commands, and Event Counter Commands. | CLO 4, CLO 5 | 8 |
| **Interfacing:** Interfacing LEDs, 7 segments, Analog to Digital Converter (ADC), Pulse Width Modulation (PWM). | CLO 4, CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Guido Dornhege, Jose del R. Millan, Thilo Hinterberger (2007): "Toward Brain-computer Interfacing", 2nd edition. MIT Press.
- Howard Hutchings and Mike James (2000): "Interfacing with C", 2nd edition or later. Elsevier.
- Douglas V. Hall and Andrew L. Rood (1993): "Microprocessors and Interfacing: Programming and Hardware", 2nd edition. Glencoe McGraw-Hill.
- Jyoti Snehi (2006): "Computer Peripherals and Interfacing", 2nd edition or later. Firewall Media.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3235 Internet of Things** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil. |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

This course aims to provide students with an understanding to building different IoT solutions. IoT based applications such as innovative shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems. Topics covered on architecture, connectivity, communication techniques, Networking and BigData handling on IoT.

**Course Learning Outcome (CLO)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Explain in a concise manner how the general Internet as well as Internet of Things work.
- *CLO 2:* Understand constraints and opportunities of wireless and mobile networks for Internet of Things and its architecture.
- *CLO 3:* Use basic measurement tools to determine the real-time performance of packet based networks and connectivity.
- *CLO 4:* Analyze trade-offs in interconnected wireless embedded sensor networks.
- *CLO 5:* Analyze the different types of range communication and big data handling on IoT.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | | | | | | | √ |
| *CLO 5* | √ | | √ | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Services And Applications: Use case examples: AMR (Automatic Meter Reading), Smart City, Smart Home, Industrial Control, Smart Social Networks, Big Data Analytics. | CLO 1 | 6 |
| IoT Systems Architectures: IoT system components: IoT Devices, IoT Gateways, Cloud Access, Cloud Components, Cross connectivity across IoT system components. Device to Gateway –Short Range Wireless, Cell Phone as Gateway, Dedicated Wireless Access Point, Gateway to Cloud-Long Range connectivity, Wired, Cellular, Satellite, WAN, Direct Device to Cloud connectivity, IoT Device Power Constraints, Powered and Unpowered Sensors, Power Harvesting. Energy Storage Technologies, IoT Device Data Rate with relation to Use Cases, Example per use case. | CLO 2 | 6 |
| IoT PHY Connectivity: Background on digital communication techniques up-to-date: wireless, satellite and wired media, modulation, coding, antennas and MIMO, MSK (example 802.15.4g), OFDM (example 802.11), DSSS (example 802.15.4). FHSS (Bluetooth), Architectures: cellular, star, mesh, ring, Cellular communication through generations and applicability to IoT, LTE Advanced for Machine Type Communications (LTE-MTC), an evolution of LTE communications for connected things by 3GPP.NarrowBand IoT, (NB-IOT), standardization effort by 3GPP for a LPWAN used in cellular networks. | CLO 3 | 6 |
| Short-Range Wireless: Near-field communication (NFC), Radio-frequency identification (RFID), Thread – Network protocol based on the IEEE 802.15.4 standard, similar to ZigBee, Bluetooth low energy (BLE)<br>Light-Fidelity (Li-Fi), Wi-Fi, ZigBee, Body area Networks – BAN. Medium And Long-Range Wireless: HaLow (802.11ah), variant of the Wi-Fi standard providing extended range for low-power communication at a lower data rate.<br>Long-range wireless. Very small aperture terminal (VSAT) – Satellite communication technology using small dish antennas for narrowband and broadband data. Low-power wide-area networking (LPWAN) – Wireless networks designed to allow long-range communication at a low data rate, reducing power and cost for transmission. LoRa, Sigfox. Weightless. Wired: Ethernet, Multimedia over Coax Alliance (MoCA), Power-line communication (PLC) | CLO 5 | 8 |
| IoT Networking: Networking Architectures-Star, Mesh, Tree Networking Protocols, TCP/IP, 6LowPan, RPL Thread, IoT Devices Application Level Protocols, MQTT, CoAP, REST. | CLO 4 | 6 |

| | | |
|---|---|---|
| Implementation: Hardware/Embedded Systems, Software/ Firmwares & OS/RTOS (TinyOS, Contiki, RIOT, ARM ), Integration and Testing Certification bodies.<br>IoT Security: The problem- "Identity of Things", Device On-Boarding, Symmetric Encryption Standards, Symmetric Encryption (DES, AES 128…), Hashing, Authentication, CCMP Authentication and Encryption protocol, Usage in 802.11, Usage in 802.15.4, Non Symmetric Encryption Standards, Diffie Hellman (principle, Man in the Middle attack), RSA. | | |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Samuel Greengard (2015): "The Internet of Things", Second edition. MIT Press.
- Huansheng Ning (2016): "Unit and Ubiquitous Internet of Things", Fifth edition. CRC Press.
- Hwaiyu Geng (2017): "Internet of Things and Data Analytics Handbook", Sixth edition. Wiley.
- Johnson I. Agbinya (2011): "Principles of Inductive Near Field Communications for Internet of Things", 7th edition. River Publishers.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3227 Operating Systems** |
| Level & Semester | L-3, S-2 (January-June) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of this course is to provide an introduction to the internal operation of modern operating systems. In particular, the course will cover processes and threads, mutual exclusion, CPU scheduling, deadlock, memory management, and file systems. If time permits, we may briefly examine networking and distributed computing, and perhaps other topics. Students will use the Nachos instructional operating system for several programming projects.

**Course Learning Outcomes (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Acquire the basic knowledge on operating systems.
*CLO 2:* Understand process control and management, synchronization and concurrent process.
*CLO 3:* Use deadlock handling mechanisms in real time.
*CLO 4:* Compare and contrast different types of memory with paging system.
*CLO 5:* Evaluate operating system performance using various techniques.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | | | | | | | √ |
| *CLO 5* | √ | | √ | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Overview:** Functionalities and characteristics of OS, Hardware concepts related to OS, CPU states, I/O channels, memory hierarchy, micro-programming. The concept of a process, operations on processes, process states, concurrent processes, process control block, process context. | CLO 1 | 5 |
| **Process Control and Management**: PCB, signals, forks and pipes. Interrupt processing, operating system organization, OS kernel FLIH, dispatcher. Job and processor scheduling, scheduling algorithms, process hierarchies. | CLO 2, CLO 5 | 5 |
| **Concurrent Processes:** Critical sections, mutual exclusion, synchronization, deadlock. Mutual exclusion, process co-operation, producer and consumer processes. Semaphores: definition, init, wait, signal operations. | CLO 2, CLO 5 | 6 |
| **Synchronization:** Use of semaphores to implement mutex, process synchronization etc., implementation of semaphores. Critical regions, Conditional Critical Regions, Monitors, Ada Tasks. Inter-process Communication (IPC), Message Passing, Direct and Indirect. | CLO 2, CLO 5 | 5 |
| **Deadlock and Memory Organization:** Prevention, detection, avoidance, banker's algorithm. Memory organization and management, storage allocation. Virtual memory concepts, paging and segmentation, address mapping. | CLO 3, CLO 4, CLO 5 | 6 |
| **Virtual Memory management:** Page replacement strategies. File organization: blocking and buffering, file descriptor, directory structure. File and Directory structures, blocks and fragments, directory tree, nodes, file descriptors, UNIX file structure. | CLO 4, CLO 5 | 5 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Silberschatz, P. B. Galvin, G. Gagne (2003): "Operating System Concepts", 6th edition. Addison Wesley.
- Andrew S. Tanenbaum, Herbert Bos (2015): "Modern Operating Systems", 4th edition. Prentice Hall.
- William Stallings (2006): "Operating Systems", 5th edition. Pearson Education.
- Harvey M. Deitel (2004): "An introduction to operating systems", 3rd edition. Pearson Education.
- John L. Hennessy, David A. Patterson (2014): "Computer Architecture: A Quantitative Approach", 5th edition. Morgan Kaufmann.
- John Y. Hsu (2017): "Computer Architecture: Software Aspects, Coding, and Hardware", 5th edition. CRC Press.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3239 Computer and Network Security** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil. |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of this course is to cover basic security topics, including symmetric and public key cryptography, digital signatures, hash functions, and network security protocols. By the end of this course, students will understand basic security terms such as plaintext, cipher-text, encryption/decryption, and authentication. Students will be able to explain the basic number theory required for cryptographic applications, and manually encrypt/decrypt and sign/verify signatures using cryptographic approaches. Students will be able to identify typical security pitfalls in authentication protocols, and outline the protocols, i.e., AH and ESP protocols, for IP Security.

**Course Learning Outcome (CLO)**

Upon completion of this course, the student will be able to:

*CLO 1:* Acquire fundamental definitions and concepts of security and cryptography.
*CLO 2:* Understand the Secret Key Cryptography and Message Digests.
*CLO 3:* Apply different types of Public Key Cryptography in real life.
*CLO 4:* Evaluate different types of authentication.
*CLO 5:* Apply Security knowledge in Real-time Communication Security.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | | | | | | | √ |
| *CLO 5* | √ | | √ | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Basic Security Concepts:<br>-Confidentiality, integrity, availability<br>- Security policies, security mechanisms, assurance<br>Basic Cryptography:<br>- Historical background<br>- Transposition/Substitution, Caesar Cipher<br>- Introduction to Symmetric crypto primitives, Asymmetric crypto primitives, and Hash functions | CLO 1 | 6 |
| Secret Key Cryptography:<br>- Data Encryption Standard (DES)<br>- Encrypting large messages (ECB, CBC, OFB, CFB, CTR)<br>- Multiple Encryption DES (EDE)<br>Message Digests:<br>- Applications<br>- Strong and weak collision resistance<br>- The Birthday Paradox, MD5, SHA-1 | CLO 2 | 6 |
| Public Key Cryptography:<br>- Number theory: Euclidean algorithm, Euler Theorem, Fermat Theorem, Totten functions, multiplicative and additive inverse<br>- RSA, Selection of public and private keys | CLO 3 | 6 |
| Authentication:<br>- Basic concepts of identification and authentication<br>- Password authentication<br>- Authentication protocols | CLO 4 | 8 |
| Trusted Intermediaries:<br>- Public Key infrastructures | CLO 5 | 6 |

| | | |
|---|---|---|
| - Certification authorities and key distribution centers<br>- Kerberos<br>Real-time Communication Security:<br>- IPsec: AH and ESP, IPsec: IKE | | |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Charlie Kaufman, Radia Perlman, and Mike Speciner (2002): "Network Security: Private Communication in a Public World", 2nd edition or later. Prentice Hall.
- Wenliang Du (2017): "Computer Security: A Hands-on Approach", Latest edition. CreateSpace Independent Publishing.
- William Stallings and Lawrie Brown (2008): "Computer Security: Principles and Practice", 4th edition. Pearson.
- Joseph Migga Kizza (2017): "Guide to Computer Network Security (Computer Communications and Networks)", 4th edition. Springer.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 3242 Apps Development** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil. |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of this course is providing practical knowledge of mobile application development for smart phone platform. It is designed to provide practical knowledge on current mobile phones architecture, power optimization, game development, machine learning concepts implementation in smartphones, commercial app development, app publishing in store and getting income from app development.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Develop basic smart phone applications.
*CLO 2:* Develop commercial and business solution applications.
*CLO 3:* Game development for smart phone platform.
*CLO 4:* Design applications for real time problem solution.
*CLO 5:* Develop applications based on different machine learning algorithms.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | | | | | | | √ |
| *CLO 5* | √ | | √ | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Getting Started with Mobile application development | CLO 1 | 1 |
| Building a Simple User Interface, handing basic tools and controls | CLO 1 | 1 |
| Building a Simple Calculator, BMI and data read write app. | CLO 1 | 2 |
| Using Services, Preferences and Handling Files | CLO 1 | 2 |
| Using AsyncTask class, Multithreading programming, Game programming | CLO 2 | 2 |
| Different sensor data reading and analyzing, cloud and big data handing in smartphone | CLO 3 | 2 |
| Power consumption optimization, OS optimization and Machine Learning concept implementation. | CLO 4 | 3 |
| Project completing and app publishing in store | CLO 5 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- J. McWherter and S. Gowell (2012): "Professional Mobile Application Development", 3rd Edition or later. Wrox publication.
- R. Rodger (2015): "Beginning Mobile Application Development in the Cloud", Latest edition. Wiley.
- M. Sougata (2016): "Mobile Application Development, Usability, and Security", 5th edition or later. New York, Addison Wesley.
- N. Panigrahy (2015): "Xamarin Mobile Application Development for Android", Latest Edition. Cambridge University Press.

**Department of Farm Structure and Environmental Engineering**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FSEE 3213 Surveying** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Engineering Drawing |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
Knowledge on principles of plane surveying with the science of measuring distances, elevation and angles to prepare plan and map, and calculation of area and volume is essential for all branches of Engineering.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* explain various methods of surveying and the usages of survey instruments;
*CLO 2:* apply the fundamental knowledge in the field to work on some small projects;
*CLO 3:* estimate distance, angle and height through different instruments;
*CLO 4:* calculate area and volume and to generate maps.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | √ | | | |
| *CLO 2* | | | | | | | √ | | | |
| *CLO 3* | | | | | | | √ | | | |
| *CLO 4* | | | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction:** importance, types and instruments of surveying. | CLO 1, CLO 2 | 2 |
| **Chain survey:** plotting details, errors, merits and demerits. | CLO 3, CLO 4 | 2 |
| **Traverse survey:** procedures, bearing measure and plotting, errors and adjustment, merits and demerits. | CLO 3, CLO 4 | 4 |
| **Plane Table survey:** orientation, merits and demerits, two and three point problems. | CLO 3, CLO 4 | 2 |
| **Levelling:** objectives, methods, reduced level, effects of curvature and refraction and their corrections. | CLO 3, CLO 4 | 4 |
| **Contouring:** characteristics and uses, direct and indirect methods. | CLO 3, CLO 4 | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- A Text Book of Surveying – M. A. Aziz and M. Shahjahan, Hafiz Book Center, Dhaka
- Elementary Surveying, an Introduction to Geomatics", P. Wolf & C. Ghilani, 14th edition, Prentice Hall.
- Survey Tutor – A. G. Khan, Enayetullah Khan, bagan Bari, Comilla
- Surveying – R.E. Davis and F.S. Foote, McGraw-Hill Book Co., London

**Department of Farm Structure and Environmental Engineering**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FSEE 3214 Surveying** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | FSEE 3214 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
Provide basics of digital surveying and mapping of earth surface using total station, Global positioning systems (GPS), and mapping software.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* utilize the modern surveying equipment's and total stations for getting required information;
- *CLO 2:* capable of using the GPS instrument to obtain appropriate information of the objects and their positions;
- *CLO 3:* identify error sources in GPS observations, and apply the corrections for accurate positioning;
- *CLO 4:* identify specific data and methodologies for effective mapping and evaluation of natural resources;
- *CLO 5:* classify coordinate systems and projections, process spatial and attribute data and prepare thematic maps.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | √ | | | |
| *CLO 2* | | | | | | | √ | | | |
| *CLO 3* | | | | | | | √ | | | |
| *CLO 4* | | | | | | | √ | | | |
| *CLO 5* | | | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| ***Total stations:*** Fundamentals, measurement of horizontal angles, vertical angles, horizontal distance, slope distance, remote elevation measurement (REM), remote distance measurement (RDM) and continuous distances for measuring the lengths and sides of the closed circuits, areas and perimeters calculations. | CLO 1, CLO 4 | 5 |
| ***Global positioning system (GPS):*** Introduction and components of GPS, Space segment, control segment and user segment, elements of satellite based surveys, GPS observation methods and their advantages, sources of error GPS and limitations. | CLO 2, CLO 3, CLO 4 | 6 |
| ***Measurement and mapping:*** **Field work and measurement of land using total station, field work and measurement using GPS,** mapping fundamentals, digital surveying procedure, data reduction and demonstration of a digital land surveying and mapping of an area. | CLO 4, CLO 5 | 5 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- A Text Book of Surveying – M. A. Aziz and M. Shahjahan, Hafiz Book Center, Dhaka
- Elementary Surveying, an Introduction to Geomatics", P. Wolf & C. Ghilani, 14th edition, Prentice Hall.
- Survey Tutor – A. G. Khan, Enayetullah Khan, bagan Bari, Comilla
- Surveying – R.E. Davis and F.S. Foote, McGraw-Hill Book Co., London
- Digital Image Processing: A Systems Approach- W. B. Green, Van-Nostrand Pub. Co.

**Department of Food Technology & Rural Industries**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FTRI 3213 Food Science and Nutrition** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil. |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objectives of this course are to introduce students with the concepts and needs of foods and diets with respect to human health and the major areas when computation intervention are possible. Students will be familiar with foods, types, functions, causes of spoilage and principles of preservation. They will also familiar with diets, diet planning, adequacy and deficiency disorders and assessment of nutrient status.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Compare food, nutrients, diet and nutrition.
*CLO 2:* Understand the causes of food spoilage and principles of food preservation.
*CLO 3:* Understand the essential nutrients, deficiency disorders, balance diet, prepare diet plan of any persons.
*CLO 4:* Assess nutrient status of any persons.
*CLO 5:* Use computing in food composition, nutrient assessment and diet planning.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | | | | |
| *CLO 2* | | √ | | | | | | | | |
| *CLO 3* | | √ | | | | | | | | |
| *CLO 4* | | √ | | | | | | | | |
| *CLO 5* | | √ | | | | | | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to Food and Nutrition**: Concept of foods, classification of foods, functions of foods, composition of foods, their functions, sources, chemical characteristics & classification and biological importance (quality, requirements & deficiency sign and symptoms) in relation to human nutrition. | CLO 1 | 4 |
| **Principles and methods of food preservation:** Use of low temperature; use of high temperature. Chemical additives; irradiation of foods etc. Causes of Food Spoilage (chemical, biochemical and biological), infection and food intoxication and food poisoning | CLO 2 | 5 |
| **Diet and diet planning:** Concept of diet, balance diet, estimation of nutrients of diet, steps in diet planning and develop of diet plan of nutrient vulnerable people. | CLO 3 | 10 |
| **Assessment of nutritional status:** Aetiologic of nutritional disorder, parameters used for nutritional assessment (Anthropometric, Biochemical, Clinical and dietary assessment) | CLO 4 | 4 |
| **Computation in Food and Nutrition:** Preparation of Food Composition Table, User-friendly spreadsheet for diet planning and nutritional assessment and data handling | CLO 5 | 4 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Food Science by Potter
- Krause's Food, Nutrition, & Diet Therapy by Mathan L.K & Escott Stump, S
- Nutritional Assessment, R.S. Gibson

**Department of Food Technology & Rural Industries**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FTRI 3215 Computation in Food Quality and Safety** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | FTRI 32xx: Food Science and Nutrition |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objectives of this course is to give a comprehensive orientation about the principles of computing quality and safety parameters and to give a hands on training on available software used to calculate and interpret them.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Compute and interpret food quality parameters
*CLO 2:* Compute and interpret food safety parameters
*CLO 3:* Write algorithm for calculating the parameters and developing new software
*CLO 4:* Use commercial software in handling quality and safety data

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | | | | |
| *CLO 2* | | √ | | | | | | | | |
| *CLO 3* | | | | | √ | | | | | |
| *CLO 4* | | | | | √ | | | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Food Quality:**<br>Concept of food quality, computation involved in image analysis, sensory analysis, acceptance sampling, control charts, production and inventory controls. | CLO 1 | 6 |
| **Food Safety:**<br>Concept of food safety, Hazards & risk, risk assessment, computation involved in quantitative risk assessment (chemical and microbial) and HACCP. | CLO 2 | 8 |
| Algorithm and Commercial Software:<br>Writing algorithm for image analysis, sensory analysis, acceptance sampling, control charts, production and inventory controls and risk analysis. Practice with commercial software. | CLO 3, CLO 4 | 10 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Kramer and Twigg (1970) Quality Control for the Food Industry
- O'Mahony (1985) Sensory Evaluation of Food
- Granato and Ares (2017) Mathematical and Statistical Methods in Food Science and Technology

**Department of Genetics and Plant Breeding**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **GPB 3203: Organism and Evolutionary Biology** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil. |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course focuses on evolution and the origin of life in order to understand the principles that govern changes in populations of organisms over time and also consider the inter-relation between evolution and ecology.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Explain the forces that drive evolutionary change in populations
*CLO 2:* Compare key characteristics and adaptations of bacteria, archaea, plants, fungi and animals
*CLO 3:* Discuss the basic of ecology and how it changes in ecosystems
*CLO 4:* Interpret the role of evolutionary change in speciation

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction:** Concepts, introduction to evolutionary biology | CLO 1 | 2 |
| **History :** Evolutionary thought, evidence of evolution, Evolution since Darwin, structure of evolution in time and space | CLO 1 CLO,2 | 4 |
| **Evolutionary genetics:** Natural selection, the genetics of populations, evolutionary processes and genetic variation, phylogenetic trees, history of life on earth | CLO 2 | 4 |
| **Adaptation, development and evolution:** Relationship between developmental and evolutionary biology, adaptive evolution from genes to traits, adaptation and co-evolution. | CLO 2, CLO 3 | 4 |
| **Eukaryotic Cells:** Plant Structure and Function, Plant Reproduction | CLO 2 | 2 |
| **Human evolution, sex and behavior:** Allometry, heterochrony, development and macroevolution, evolution of behavior, sexual selection and the hierarchy of social behavior concepts, human evolution, genetic structure and history of human population. | CLO 3 | 4 |
| **Ecosystem:** Ecosystem ecology, Conservation biology | CLO 3 | 4 |
| **Population level evolution and speciation:** concepts, mechanism, relationship to macroevolution, quantitative genetics and evolution of phenotypes. | CLO 3 CLO,4 | 4 |
| **Evolutionary regulation:** Regulation of Genome Activity, Role in speciation | CLO 4 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Timothy Barraclough (2019), "The Evolutionary Biology of Species", Latest Ed, Oxford series.
- Pierre Pontarotti (2010), "Evolutionary Biology - Concepts, Molecular and Morphological Evolution", latest Ed, Springer
- Francisco J. Ayala, John C. Avise (2014), "Essential Readings in Evolutionary Biology", Latest Ed, John Hopkins University Pr

**Department of Irrigation and Water Management**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **IWM 3223 Fluid Mechanics** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil. |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
To provide students with concepts of general mechanics applied to fluids. This course will furnish knowledge and skills to the students for understanding the behavior of fluids in motion and at rest that are necessary to solve engineering problems in their bachelor level studies.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Identify and calculate key fluid properties used in the analysis of fluid behavior and use the concepts of viscosity, surface tension and vapor pressure,
*CLO 2:* discuss the basic principles of hydrostatic pressure,
*CLO 3:* explain the basic concepts of manometers and calculate fluid pressure,
*CLO 4:* explain the development, uses and limitations of major fluid-flow equations, and
*CLO 5:* describe fundamentals of fluid flow and flow types.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | | | | | | √ | | | |
| *CLO 3* | | | | | | | √ | | | |
| *CLO 4* | | | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Fundamental properties of fluid**: Fluids, general properties of fluid | 1 | 7 |
| **Principles of hydrostatic pressure**: Pascal's law, free surface of a liquid, atmospheric, absolute and gauge pressures, variation of pressure with depth, pressure head, vapor pressure | 2 | 6 |
| **Fluid pressure measurement**: Manometry, mechanical and electronic pressure measuring devices | 3 | 6 |
| **Fundamentals of fluid flow**: Flow of fluids, path lines and stream tubes, types of fluid flow, potential function, stream function, orthogonality ofstreamlines and equipotential lines, continuity equation, momentum equation, flow of gases | 4 | 7 |
| **Fluid Dynamics**: Energy and head, Euler's equation, Bernoulli's equation, application of Bernoulli's equation | 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Hydraulics by H. W. King, C. O. Wisler, J. G. Woodburn; John Willey & Sons Inc., USA.
- Fundamentals of Fluid Mechanics byBruce R. Munson,Alric P. Rothmayer, Theodore H. Okiishi and Wade W. Huebsch, $7^{th}$ edition or later. Wiley.
- Fluid Mechanics with Engineering Applications by E. John Finnemore and Joseph B Franzini., 10 Edition, McGraw-Hill, USA.
- Hydraulics and Fluid Mechanics by E. H. Lewitt; Sir Isaac Pitman & Sons Ltd., UK.
- Engineering Fluid Mechanics by K. L. Kumar; Eurasia Publishing House (P) Ltd.
- A Text Book of Fluid Mechanics by S.R. Khurmi: S. Chand & Company Ltd., New Delhi, India.
- Fluid Mechanics & Hydraulics by Dr. Jagdish Lal; Metropolitan Book Co. Private Ltd., New Delhi, India.

**Department of Irrigation and Water Management**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **IWM 3224 Fluid Mechanics** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil. |
| Student | Elective for BSc in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
To provide students with hands-on trainings on measuring and problems solving skills on viscosity, surface tension, apply knowledge of the principles of hydrostatic pressure to measure pressure and solving practical fluid pressure problems, provide practical knowledge and skills on flow measurement.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* measure viscosity and surface tension and solve problems on fluid properties,
*CLO 2:* experiment and measure hydrostatic pressure using various techniques and instruments,
*CLO 3:* state principles of fluid flow measurements and measure fluid flow,
*CLO 4:* determine venturimeter coefficient, and
*CLO 5:* verify energy equations.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | ✓ | | | | | ✓ | | | |
| *CLO 2* | | ✓ | | | | | ✓ | | | |
| *CLO 3* | | | | | | | ✓ | | ✓ | |
| *CLO 4* | | | | | | | ✓ | | | |
| *CLO 5* | | | | | | | ✓ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Viscosity measurement | CLO 1 | 2 |
| Surface tension measurement | CLO 1 | 2 |
| Pressure measurement with manometers (piezometer, differential and micromanometers) | CLO 2 | 2 |
| Laboratory study of flow types | CLO 3 | 2 |
| Velocity measurement with pitot tube | CLO 3 | 2 |
| Flow measurement | CLO 3 | 2 |
| Determination of venturimeter coefficient | CLO 4 | 2 |
| Verification of Bernoulli's energy equation | CLO 5 | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Hydraulics by H. W. King, C. O. Wisler, J. G. Woodburn; John Willey & Sons Inc., USA.
- Fundamentals of Fluid Mechanics byBruce R. Munson,Alric P. Rothmayer, Theodore H. Okiishi and Wade W. Huebsch, 7th edition or later. Wiley.
- Fluid Mechanics with Engineering Applications by E. John Finnemore and Joseph B Franzini., 10 Edition, McGraw-Hill, USA.
- Hydraulics and Fluid Mechanics by E. H. Lewitt; Sir Isaac Pitman & Sons Ltd., UK.
- Engineering Fluid Mechanics by K. L. Kumar; Eurasia Publishing House (P) Ltd.
- A Text Book of Fluid Mechanics by S.R. Khurmi: S. Chand & Company Ltd., New Delhi, India.
- Fluid Mechanics & Hydraulics by Dr. Jagdish Lal; Metropolitan Book Co. Private Ltd., New Delhi, India.

**Department of Soil Science**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **SS 3203 Soil Informatics** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
In order for the use and management of soil for sustainable crop production students need to be familiar with fundamental concepts, functions, properties, fertility condition and carbon modelling of soils and how they affect landscape processes.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

- *CLO-1:* Explain soil formation
- *CLO-2:* Illustrate soil in terms of physico-chemical properties
- *CLO-3:* Interpret general soil types and agro-ecology of Bangladesh
- *CLO-4:* Gain knowledge about soil fertility and plant nutrition
- *CLO-5:* Advance knowledge on soil resource management

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction**: Concept of soil, major components of soil | CLO 1 | 2 |
| **Weathering -** physical and chemical weathering; Soil forming factors and processes<br>The soil profile | CLO 2 | 5 |
| **Soil properties:** Physical –soil particles, soil texture, soil structure, particle density, bulk density, porosity; pedotransfer functions for estimating soil physical properties<br>Chemical – soil pH, ion exchange in soil;<br>Soil organic matter – sources and biochemical functions and composition;<br>Soil water: Importance, classification, soil water constants, evapotranspiration, estimating soil water and nutrient flow using mathematical models, water balance, Soil properties relevant to engineering use. | CLO 1,<br>CLO 3 | 13 |
| **Soil fertility and plant nutrition**: Plant nutrients – criteria of essentiality, sources, and available forms. | CLO 4 | 3 |
| **Agro ecological Zones (AEZ)**<br>Principles of AEZ, description of different AEZs | CLO 3 | 4 |
| Microbial community structure dynamics in soil, water and environment; soil carbon modeling at field scales | CLO 5 | 5 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Brady N.C. and Raymond C. Weil R.C. 2012. The Nature and Properties of Soils, 14th Edition. Pearson.
- Hillel, D. 1980. Fundamental of Soil Physics. Acad. Press, New York, US.
- Hillel D. 2003. Introduction to Environmental Soil Physics, Acad. Press, USA.
- Havlin J.L., and Tisdale S.L., 2004. Soil Fertility and Fertilizers: An Introduction to Nutrient Management, 7th edition. Pearson.
- Lorenz K. J. and Rattan Lal. 2018. Carbon Sequestration in Agricultural Ecosystems. Springer International Publishing AG, Switzerland.
- Ivanov V. 2015. Environmental Microbiology for Engineers, CRC Press, 2nd Edition

**Department of Soil Science**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **SS 3204 Soil Informatics** |
| Level & Semester | L-3, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
Students need to know how to exploit informatics approaches to integrate, translate and improve soil data to advance their knowledge of soil.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

- *CLO-1:* Analyze soil samples for various physicochemical properties
- *CLO-2:* Evaluate soil quality on the basis of soil organic matter content and plan for sustainable techniques of managing soil fertility
- *CLO-3:* Estimate the moisture status of soil in different conditions
- *CLO-4:* Interpret functions of soil properties using soil data
- *CLO-5:* Classify soil into different textural types

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Study of soil profile | CLO 3 | 1 |
| Determination of soil density | CLO 1 | 2 |
| Determination of soil organic carbon by wet oxidation method | CLO 2 | 2 |
| Particle size analysis of soil by hydrometer method | CLO 5 | 2 |
| Determination of soil water at saturation and field capacity by gravimetric method | CLO 3 | 1 |
| Assessment of pedotransfer functions for estimating soil water retention curves | CLO 4 | 2 |
| Determination of cation exchange capacity of soil by sodium saturation method | CLO 1 | 2 |
| Determination of soil pH by glass electrode pH meter | CLO 1 | 1 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Page, A.L., Miller, R.H. and Keeney, D.R. 1982. Methods of Soil Analysis Part 3, Chemical methods, SSSA, Madison, Inc. Pub., Wis., USA
- Singh, R.A. 1997. Soil Physical Analysis. Varun Exports, India.
- Singh, D. Chhonkar, P.K. and Pandey, R.N. 1999. Soil Plant Water Analysis- A Methods Manual. ICAR, New Delhi.
- Klute, A. 1986. Methods of Soil Analysis, Part 1. Amer. Soc. Agron., Inc. Pub. Madison, Wis., USA
- Y. Pachepsky Y., and W.J. Rawls W., J. 2004. Development of Pedotransfer Functions in Soil Hydrology, Imprint: Elsevier Science. 1st edition.

**Level- 4, Semester- 1**

**Department of Biotechnology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **BTECH 4101 Bioinformatics methods and applications** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course covers advanced and applied knowledge of Bioinformatics.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Discuss areas of research and internet resources related to bioinformatics
*CLO 2:* Explain application of genomics and proteomics
*CLO 3:* Apply knowledge related to microarray and phylogeny construction

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | √ | | √ | | √ | √ |
| *CLO 2* | | √ | | | √ | | √ | | | √ |
| *CLO 3* | | √ | | | √ | | √ | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Introduction: definition, scope, areas of bioinformatics research; gene bank, data, genome, annotation, DNA assemble | CLO 1 | 3 |
| Internet resources: NCBI, ENSEMBLE, PUBMED, OMIM,SWISS PROT, UCSC | CLO 2 | 3 |
| DNA sequencing methods, Contigs, Scaffold, DNA assembly, Assembly problems, Raw data quality control | CLO 2 | 4 |
| Gene structure Annotation: reading frames, exon, intron, upstream and downstream gene prediction, Gene ontology | CLO 2 | 4 |
| Homology and similarity: Sequence alignment, Local alignment, global alignment, algorithm, Scoring matrix, PAM and Blosum Matrices, Multiple alignment, FASTA, FASTAQ, Blast, crustal W, TCoffee | CLO 2 | 5 |
| RNA structure analysis: RNA, RNA secondary structure prediction, co-variance model | CLO 2 | 2 |
| An introduction to proteomics: Protein, Protein structure, Proteomics, Approaches to identify protein-protein interactions, prediction of 3D structure of protein, In-silico model quality evaluation, Ramachandran plot, Steric hindrance | CLO 2 | 3 |
| Phylogenetic Prediction: relationship of phylogenetic analysis to alignments, the concepts of evolutionary trees<br>Methods of building a phylogenetic tree: distance based (UPGMA, Neighbour-Joining) and character based methods (Maximum Parsimony, Maximum Likelihood), Reliability of phylogenetic predictions, complications from phylogenetic analysis | CLO 3 | 4 |
| Microarray: concept, application, procedure and data analysis | CLO 3 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme J. Mitchison (1998) Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids (1st Edition). Cambridge University Press
- Michael Agostino. (2012). Practical Bioinformatics. Taylor & Francis Inc. 394p. ISBN: 9780815344568.
- S.C. . Rastogi, Namita Mendiratta, Parag Rastogi () Bioinformatics: Methods And Applications: (Genomics, Proteomics and Drug Discovery). PHI Learning Pvt. Ltd., 2013 M05 22 - 648 pages
- Paul M. Selzer, Richard J. Marhöfer, Oliver Koch (2018). Applied Bioinformatics (2nd Edition): An Introduction, Springer
- Daniel McGuire 2019. Bioinformatics: Design, Sequencing and Gene Expression
- Christina Marshall 2019. Bioinformatics and Functional Genomics

**Department of Biotechnology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **BTECH 4102 Bioinformatics methods and applications** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | BTECH 4102 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
This course covers advanced and applied knowledge of bioinformatics methods.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Provide hands-on practice on internet resources related to bioinformatics
*CLO 2:* Predict RNA, gene and protein structure
*CLO 3:* Find homology and sequence similarity using available database
*CLO 4:* Construct phylogeny tree
*CLO 5:* Demonstrate DNA profiling using microarray data

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | √ | | √ | | √ | √ |
| *CLO 2* | | √ | | | √ | | √ | | | √ |
| *CLO 3* | | √ | | | √ | | √ | | | √ |
| *CLO 4* | | √ | | | √ | | √ | | | |
| *CLO 5* | | √ | | | √ | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Hands-on practice on Internet resources: NCBI, ENSEMBLE, PUBMED, OMIM,SWISS PROT, UCSC | CLO 1 | 2 |
| Predict Gene structure: reading frames, exon, intron, upstream and downstream genes, and RNA secondary structure | CLO 2 | 3 |
| Homology and similarity: Sequence alignment, Local alignment, global alignment, Multiple alignment, FASTA, FASTAQ, Blast, crustal W, TCoffee | CLO 3 | 3 |
| Proteomics: predict 3D structure of protein, In-silo model quality evaluation, Ramachandran plot, Steric hindrance | CLO 2 | 3 |
| Phylogenetic Prediction:<br>Methods of building a phylogenetic tree: distance based (UPGMA, Neighbour-Joining) and character based methods (Maximum Parsimony, Maximum Likelihood), Reliability of phylogenetic predictions, complications from phylogenetic analysis | CLO 4 | 3 |
| DNA profiling using micro-array data | CLO 5 | 1 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme J. Mitchison (1998) Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids (1st Edition). Cambridge University Press
- P aul M. Selzer, Richard J. Marhöfer, Oliver Koch (2018) Applied Bioinformatics (2nd Edition): An Introduction, Springer
- Christina Marshall 2019. Bioinformatics and Functional Genomics

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4121 Machine Learning** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | CSM 1123 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The objectives of this course are to develop a broad understanding of machine learning and to apply the knowledge of machine learning in agriculture, biology, robotic control, data mining, autonomous navigation, speech recognition, and text and web data processing.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Develop an appreciation for what is involved in learning models from data.
- *CLO 2:* Understand a wide variety of learning algorithms.
- *CLO 3:* Understand how to evaluate models generated from data.
- *CLO 4:* Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | √ | √ | | | | | √ |
| *CLO 2* | √ | | √ | √ | √ | | | | | √ |
| *CLO 3* | √ | | √ | √ | √ | | | | | √ |
| *CLO 4* | √ | | √ | √ | √ | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction:** What is ML; Problems, data, and tools; Visualization. | CLO 1, CLO 2 | 4 |
| **Learning Models:** Linear regression; SSE; gradient descent; closed form; normal equations; features. Overfitting and complexity; training, validation, test data. | CLO 1, CLO 2 | 4 |
| **Classification:** Classification problems; decision boundaries; nearest neighbor methods. Probability and classification, Bayes optimal decisions. Naive Bayes and Gaussian class-conditional distribution. Linear classifiers. Bayes' Rule and Naive Bayes Model. Logistic regression, online gradient descent, Neural Networks, Decision tree. | CLO 2, CLO 3, CLO 4 | 4 |
| **Ensemble Methods:** Bagging, random forests, boosting. A more detailed discussion on Decision Tree and Boosting. | CLO 2, CLO 3, CLO 4 | 4 |
| **Unsupervised learning:** Clustering, k-means, hierarchical agglomeration. | CLO 2, CLO 3, CLO 4 | 8 |
| **Advanced Classification:** VC-dimension, structural risk minimization; margin methods and support vector machines (SVM). | CLO 2, CLO 3, CLO 4 | 8 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- R.S. Michalski, J.G. Carbonell, T.M. Mitchell (2013): "Machine Learning: An Artificial Intelligence Approach", 2nd edition or later. Springer.
- Ethem Alpaydin (2014): "Introduction to Machine Learning", 3rd or later Edition. Prentice Hall.
- Stephen Marsland (2014): "Machine Learning: An Algorithmic Perspective", 2nd or later Edition. Chapman and Hall/CRC.
- Christopher M. Bishop (2011): "Pattern Recognition and Machine learning", 2nd edition. Springer.

- Shai Shalev-Shwartz, Shai Ben-David (2014): "Understanding Machine Learning: From Theory to Algorithms", 1st edition. Cambridge University Press.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4122 Machine Learning** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | CSM 4121 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The objectives of this course are to provide hands on experience on machine learning and to apply the knowledge of machine learning in agriculture, biology, robotic control, data mining, autonomous navigation, speech recognition, and text and web data processing.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Develop an appreciation for what is involved in learning models from data.
- *CLO 2:* Apply a wide variety of learning algorithms.
- *CLO 3:* Understand how to evaluate models generated from data.
- *CLO 4:* Implement the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | √ | √ | | | | | √ |
| *CLO 2* | √ | | √ | √ | √ | | | | | √ |
| *CLO 3* | √ | | √ | √ | √ | | | | | √ |
| *CLO 4* | √ | | √ | √ | √ | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Introduce ML tools and models. | CLO 1 | 3 |
| Apply Linear regression, SSE and gradient descent;<br>Use training, validation and test data. | CLO 1,<br>CLO 2 | 3 |
| Implement classification algorithms. | CLO 2,<br>CLO 3 | 2 |
| Implement ensemble Methods. | CLO 2,<br>CLO 3 | 2 |
| Develop and compare unsupervised learning models. | CLO 4 | 3 |
| Develop and compare supervised learning models. | CLO 4 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- R.S. Michalski, J.G. Carbonell, T.M. Mitchell (2013): "Machine Learning: An Artificial Intelligence Approach", 2nd edition or later. Springer.
- Ethem Alpaydin (2014): "Introduction to Machine Learning", 3rd or later Edition. Prentice Hall.
- Stephen Marsland (2014): "Machine Learning: An Algorithmic Perspective", 2nd or later Edition. Chapman and Hall/CRC.
- Christopher M. Bishop (2011): "Pattern Recognition and Machine learning", 2nd edition. Springer.
- Shai Shalev-Shwartz, Shai Ben-David (2014): "Understanding Machine Learning: From Theory to Algorithms", 1st edition. Cambridge University Press.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4124 Computer Aided design** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | Nil. |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of this course is to familiarize the students with visualization and construction of different circuits and cheapest design. They will employ the AutoCAD software to use "constructive solid measures" to build the parts and assemblies. They will use the software drafting tools to prepare dimensioned microcontroller and embedded system drawings that would allow the student to build the parts. Sample parts will printed in 3-D to illustrate that ability. The main objective of the course is to demonstrate mastery of the CAD by applying it to a group project and presenting written and oral reports on that project.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Demonstrate basic concepts of the AutoCAD software.
- *CLO 2:* Understand the use of Blocks, Design Center, and Tool Palettes.
- *CLO 3:* Understand and demonstrate different connections and moving.
- *CLO 4:* Develop different database for AutoCAD.
- *CLO 5:* Design registers and flip-flops.
- *CLO 6:* Create 2D and 3D models.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | √ |
| *CLO 2* | √ | | | | | | | | | √ |
| *CLO 3* | √ | | | | | | | | | √ |
| *CLO 4* | √ | | | | | | | | | √ |
| *CLO 5* | √ | | | | | | | | | √ |
| *CLO 6* | √ | | | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Basics: Introduction to Electrical CAD interface, Electrical Components and Wires, Design Methodologies, Project Files, Project Manager | CLO 1, CLO 2 | 2 |
| Schematics 1: Wires, Ladders, Signal Arrows, Overlapping Signals | CLO 1, CLO 3 | 2 |
| Schematics 2: Multiplexer, Demultiplexer, Cascade Circuit Design | CLO 1, CLO 3 | 2 |
| Circuits and Cables: Cable Markers, Fan In/Out, Insert Saved Circuits, Circuit Builder | CLO 2, CLO 4 | 1 |
| Panels: Panel Drawings, Insert Footprint, Edit Footprint, Insert Jumpers | CLO 1, CLO 3 | 2 |
| Wiring: Point-to-Point wiring drawings, Insert Connectors, Edit Connectors | CLO 3 | 1 |
| Database and Plotting: AutoCAD Databases, Project Databases, Catalog Databases, Footprint Lookup Databases, PLC Databases, Plot Project, Export to Spreadsheet, Update from Spreadsheet, Copy project | CLO 4 | 2 |
| Microcontroller Design: Port Design, Input Output Design, Register and Flip flop design | CLO 5 | 2 |
| Plugin Development: Design and develop new menu and submenu for efficient use of AutoCAD | CLO 6 | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Bill Fane (2016): "AutoCAD for Dummies", 3rd edition. Wiley.
- George Omura and Brian C. Benton (2017): "Mastering AutoCAD 2018 and AutoCAD LT 2018", Latest edition. Wiley.
- Cheryl R. Shrock and Steve Heather (2016): "Beginning AutoCAD 2017: Exercise Workbook", First Edition, Industrial Press Inc.
- Munir Hamad (2017): "AutoCAD 2018 3D Modeling", 1st edition. Mercury Learning & Information.
- James Leach, Shawna Lockhart, Eric Tilleson (2017): "AutoCAD 2018 Instructor", 1st edition. SDC publications.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4130 Proposal Writing and Seminar** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | Depends on the approval by the Board of Studies (BOS) and Project Supervisor. |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The project course will provide experience in carrying out a significant project from conception to completion with minimal supervision and assistance.

**Course Learning Outcome (CLO)**
Upon completion of this course, the student will be able to:

*CLO 1:* Identify the scope of a project.
*CLO 2:* Specify functional requirements of the project.
*CLO 3:* Design a model of the project in details.
*CLO 4:* Implement the model of the project.
*CLO 5:* Prepare draft version of the report.
*CLO 6:* Demonstrate the implemented system.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | √ | √ | √ |
| *CLO 2* | √ | | | | | | | √ | √ | √ |
| *CLO 3* | √ | | | | | | | √ | √ | √ |
| *CLO 4* | √ | | | | | | | √ | √ | √ |
| *CLO 5* | √ | | | | | | | √ | √ | √ |
| *CLO 6* | √ | | | | | | | √ | √ | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Each student should work on a particular topic approved by the Board of Studies (BOS) of the Department and under the guidance of a Departmental teacher. | CLO 1<br>CLO 2,<br>CLO 3,<br>CLO 4,<br>CLO 5,<br>CLO 6 | 15 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Gabe T. Wang and Keumjae Park (2016), "Student Research and Report Writing: From Topic Selection to the Complete Paper", 2nd edition. Wiley.
- Colin Robson (2016), "How to do a Research Project: A Guide for Undergraduate Students", 3rd edition. Wiley.
- Eric Carlson (2016), "Project Management: From Conception to Practice", 2nd edition. CreateSpace Independent Publishing.
- Michael Michalko (2006), "Thinkertoys: A Handbook of Creative-Thinking Techniques", 2nd or later Edition. Rodale Publisher.

**Department of Farm Power and Machinery**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FPM 4161 Engineering Management** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B. Sc. Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
Enabling student with fundamental principles of engineering management such as elements of organization, economics and financial analysis, linear programming, network analysis, queuing models, inventory models, transportation and distribution problem and purchasing function in the field of Bioinformatics.

**Course Learning Outcome (CLOs)**

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

- *CLO 1:* Explain principles of engineering management.
- *CLO 2:* Analyze linear programming, queuing problem, inventory problem, transportation and distribution problem.
- *CLO 3:* Utilize engineering management tools in food factory operation and management.
- *CLO 4:* Evaluate economic and financial components of a projects.
- *CLO 5:* Apply project planning cycle, purchasing function and plant location theories in food factory site selection and establishment.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | | √ | √ | |
| *CLO 2* | | | | | | | | √ | √ | |
| *CLO 3* | | | | | | | | √ | √ | |
| *CLO 4* | | | | | | | | √ | √ | |
| *CLO 5* | | | | | | | | √ | √ | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Organization and management:** Meaning of organization and management, elements of management, function of a good manager, organization for management, company organization structure, process of delegation, responsibility and authority and personnel selection and recruitment of employee. | CLO 1 | 3 |
| **Economic and financial analysis:** Net present value (NPV), internal rate of return (IRR), break-even analysis, payback period, cost-benefit ratio, economic of farm machinery operation and economic comparison between investment alternatives; | CLO 4, CLO 5 | 5 |
| **Linear programming:** Formulation of linear programing models, graphical solution, simplex method, duality theory, sensitivity analysis and application in resource optimization. | CLO 1, CLO 2, CLO 3 | 6 |
| **Network analysis:** Meaning of network analysis, network constructing convention (Fulkerson's rule), shortest-route problems, minimal spanning tree problems, maximal flow, PERT and CPM and application of network analysis in project scheduling. | CLO 1, CLO 2, CLO 3 | 5 |
| **Transportation and distribution problem:** Transportation matrix, formulation and solution of transportation and assignment problem and application of transportation models. | CLO 1, CLO 2, CLO 3 | 3 |
| **Inventory and risk management:** Inventory, different inventory models and application of inventory models. | CLO 1, CLO 2, CLO 3 | 3 |
| **Queuing theory:** Queue and waiting line, queuing characteristics, different queuing models and applications. | CLO 1, CLO 2, CLO 3 | 2 |
| **Purchasing function:** Aim and objectives of purchase, methods of purchase, interactions between supplier/contractor and the purchasing department, tender and quotation and introduction to PPR 2008. | CLO 5 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Introduction to Operations Research (10th Edition) by F. S. Hillier and G. J. Lieberman, McGraw Hill Publishing.
- Engineering Economy (6th Edition) by E. P. DeGrarmo, J. R. Canada and W. G. Sullivan, MacMillan Publishing Co.
- Engineering Organization and Management by B. S. Blanchard, Prentice-Hall, New Delhi
- Introduction to Management Science by D. R. Anderson, D. J. Sweeney and T. A. Williams, West Publishing Company.
- Operations Research by H. A. Taha, Collier MacMillian, New York
- Production and Operations Management (2nd Edition) by S. A. Kumar and N. Suresh, New Age International Publishers
- Website of Ministry of Planning or Ministry of Finance, GoB: www. imed.gov.b

**Department of Irrigation and Water Management**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **IWM 4119 GIS and Remote Sensing** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B. Sc. Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**

This course is designed to give students with basic understanding of the geographical information system (GIS) in order to make students competent in analyzing spatial data for various applications, producing maps, and wirelessly locating and monitoring distant devices/instruments. The remote sensing part of the course will give students basic understanding of the remote sensing, ability to retrieve and process various remotely sensed data and ability to employ these data in practical applications.

**Course Learning Outcome (CLOs)**

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

- *CLO 1:* describe and apply GIS and cartographic principles, scale, projection, coordinate systems, data management to a problem of geographic nature,
- *CLO 2:* work with commonly available GIS software to perform geospatial analysis, create and analyze raster and vector geospatial data,
- *CLO 3:* define data models and data structures and perform spatial analysis of georeferenced data,
- *CLO 4:* describe physical principles of remote sensing, photogrammetry, and digital image processing as a tool for mapping, and
- *CLO 5:* Integrating remote sensing with GIS and apply geospatial skill solving practical problems.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | ✓ | | | | | | ✓ | | | |
| *CLO 2* | | | | | | | | | | ✓ |
| *CLO 3* | | | | | ✓ | | | | | |
| *CLO 4* | ✓ | | | | | | ✓ | | | |
| *CLO 5* | | | ✓ | | | | | | | ✓ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Scope, digital cartography, components of GIS. | CLO 1 | 1 |
| Map projections and coordinate systems. | CLO 1 | 2 |
| Spatial data models: Vector and raster data models, attribute & tables, data quality and metadata. | CLO 3 | 3 |
| Maps and data inputs – map types and spatial analysis, data classification, metadata, editing. | CLO 3 | 3 |
| Data integration in GIS. | CLO 2, CLO 3 | 2 |
| Geo-data visualization: scale, visual variable (graphic attributes), symbology, map design. | CLO 5 | 2 |
| Data queries: Attribute, spatial and raster data queries. | CLO 2 | 2 |
| Vector and raster data analysis: buffering and overlay, local, neighborhood, zonal and global operations. | CLO 2, CLO 3 | 2 |
| GPS data collection and database development: Field Surveys, GPS, Aerial Imagery, Creating Metadata. | CLO 2 | 2 |
| Remote sensing: Concepts, aerial photography and photogrammetry. | CLO 4 | 2 |
| Visual image interpretation. | CLO 4 | 2 |
| Characteristics of various sensing systems (e.g., multispectral, thermal, hyperspectral, microwave, lidar, etc.). | CLO 4 | 3 |
| Digital image processing techniques and pattern recognition. | CLO 4 | 3 |
| Applications of GIS and Remote Sensing in the field of Bioinformatics Engineering. | CLO 5 | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- GIS Fundamentals A First Text on Geographic Information Systems – Paul Bolstad. Eider Press Minnesota, USA, 2012.
- Geographic Information Systems in Water Resources Engineering – Lynn E. Johnson. CRC Press, Taylor and Francis Group, 2009.
- Introduction to Remote Sensing – James B. Campbell, The Guilford Press.
- Remote Sensing Digital Image Analysis – an Introduction – John A. Richards and Xiuping Jia, fifth edition, Springer Verlag., 2012.
- GIS A Computing Perspective – Michael F. Worboys. Taylor and Francis, 1997.
- Introduction to Geographic Information Systems – K. T. Chang, 2009 (5th edition).
- Introduction to Remote Sensing – Campbell, J.B., 2006. Fourth Edition, Guilford Publication,New York.
- Remote Sensing and Image Interpretation – Lillesand, T.M., R.W. Kiefer and J.W. Chipman, 2004, Fifth Edition. J. Wiley & Sons, Inc., New York.

**Department of Irrigation and Water Management**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **IWM 4120 GIS and Remote Sensing** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Compulsory for B. Sc. Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
This course is designed to provide students with hands-on training on application of GIS using software. The students will query data, analyze, and learn to use different tools and techniques so that they can apply these skills for solving real world problems. Students will be introduced with map design, geodatabases, geocoding, digitizing, spatial analysis, editing, vector and raster analysis, image processing, spectral analysis, etc.

**Course Learning Outcome (CLOs)**

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

*CLO 1:* analyze spatial data and prepare various types of maps,
*CLO 2:* query and retrieve data, perform various geospatial analyses using raster and vector data,
*CLO 3:* gain skills in image analysis and interpretation in preparing thematic maps,
*CLO 4:* develop and execute a project requiring GIS as a management, analytical, and/or visualization tool, and
*CLO 5:* GPS data collection and database development: Field surveys, GPS, aerial imagery, and creating metadata.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | ✓ | | | ✓ |
| *CLO 2* | | | | | ✓ | | | | | ✓ |
| *CLO 3* | | | | | | | | | | ✓ |
| *CLO 4* | | | ✓ | | | | | | | ✓ |
| *CLO 5* | ✓ | | | | | | ✓ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introducing ArcGIS**: ArcCatalog, ArcMap, ArcGIS desktop help; Digitizing and data structure; Map projections; Map design; | CLO 1, CLO 2 | 2 |
| **Queries**: Tabular, spatial, vector and raster data. | CLO 2 | 1 |
| **Spatial analysis:** Boolean algebra, dissolve, buffering, overlay, network analysis, geoprocessing, georeferencing and editing, etc. | CLO 2 | 2 |
| **Raster Operations**: Local, focal, zonal and global operations. | CLO 2 | 1 |
| **Vector Operations**: Field calculations, vector overlay, calculating attribute statistics, buffering vector features, creating vector data subsets. | CLO 2 | 1 |
| **Surface Analysis**: DEM (Spatial interpolation, Inverse distance-weighted and spline), analyzing surfaces (slope analysis and contour mapping). | CLO 1 | 2 |
| Digital Image Processing. | CLO 3 | 2 |
| Working with Google; Web mapping; QGIS; Additional platforms and software. | CLO 2 | 2 |
| Field visits and GPS data collection: Field Surveys, GPS, Aerial Imagery, and Creating Metadata. | CLO 5 | 2 |
| Project | CLO 4 | 1 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- GIS Fundamentals A First Text on Geographic Information Systems – Paul Bolstad. Eider Press Minnesota, USA, 2012.
- Geographic Information Systems in Water Resources Engineering – Lynn E. Johnson. CRC Press, Taylor and Francis Group, 2009.
- Introduction to Remote Sensing – James B. Campbell, The Guilford Press.
- Remote Sensing Digital Image Analysis – an Introduction – John A. Richards and Xiuping Jia, fifth edition, Springer Verlag., 2012.
- GIS A Computing Perspective – Michael F. Worboys. Taylor and Francis, 1997.
- Introduction to Geographic Information Systems – K. T. Chang, 2009 (5th edition).
- Introduction to Remote Sensing – Campbell, J.B., 2006. Fourth Edition, Guilford Publication,New York.
- Remote Sensing and Image Interpretation – Lillesand, T.M., R.W. Kiefer and J.W. Chipman, 2004, Fifth Edition. J. Wiley & Sons, Inc., New York.

**Department of Agribusiness and Marketing**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **AM 4123 Financial and Managerial Accounting** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
Studying this course, the students will able to explain the concept and role of accounting and financial reporting in the modern market economy; explain the regulatory framework for the operation of accounting activities; understand the basic accounting concepts, accounting principles and techniques of posting basic business changes and explain the structure and content of financial statements.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Discuss accounting, journal, ledger, double-entry accounting system etc.
*CLO 2:* Identify the accounting rules required for business enterprises and determining financial results.
*CLO 3:* Describe financial statement, income statement and balance sheet
*CLO 4:* Analyze CVP relationship and decision making
*CLO 5:* Plan companies' long-term financial potentiality

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | √ | | | |
| *CLO 2* | | | | | | | √ | √ | | |
| *CLO 3* | | | | | | | √ | √ | | |
| *CLO 4* | | | | | | | √ | √ | √ | |
| *CLO 5* | | | | | | | √ | √ | √ | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Fundamental concepts of Accountancy. Debit, Credit (Cr), Transaction, Business Transaction, Leger Posting, Accounting concepts and conversions. | CLO 1, CLO 2 | 5 |
| Double entry system of Accounting and Accounting Cycle. Accounts and its classifications. Cash Book, Classification of Assets and Liabilities, Financial Accounts with adjustments. Single Proprietorship business and bill of exchange. | CLO 1, CLO 2 | 5 |
| Financial reporting. T-accounts, Bookkeeping vs Accounting, Chart of Accounts, Structure and content of financial statements in general. | CLO 2, CLO 3 | 5 |
| Balance Sheet - Statement of financial position at the end of the period, Income Statement, Cash Flow Statement. | CLO 3 | 5 |
| Definition of Management Accounting and Its Relation with Financial and Cost Accounting, Management Accounting and Decision Making, | CLO 1 | 8 |
| Cost Concepts and Classifications: General Cost Classifications- Cost Classifications on Financial Statements, Preparation of cost sheet of a manufacturing company. Cost-Volume-Profit Relationships: CVP Analysis: Computing the Break-Even Point (BEP), Operating Leverage, Margin of Safety, Contribution Margin and Gross Margin. | CLO 3 | 4 |
| Establishment of companies, Long-term (noncurrent) assets, Depreciation, Current assets - Accounts Receivable. | CLO 4 | 5 |
| Fundamental concepts of Accountancy. Debit, Credit (Cr), Transaction, Business Transaction, Leger Posting, Accounting concepts and conversions. | CLO 5 | 5 |

**Teaching Strategy**

Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Walter T. Harrison, Charles T. Horngren, C. William Thomas and Wendy M. Tietz (2016): "Financial Accounting", 11th edition or later. Pearson.
- Carl S. Warren, James M. Reeve and Jonathan Duchac (2017): "Accounting", 27th edition or later. South-Western College Pub.
- Ray H Garrison, Eric Noreen and Peter C. Brewer Professor (2012): "Managerial Accounting", 16th edition or later. McGraw-Hill Education.
- Greg Shields (2017): "Accounting: The Ultimate Guide to Accounting for Beginners – Learn the Basic Accounting Principles". CreateSpace Independent Publishing Platform.
- Vernon Richardson and Rod E. Smith (2013): "Accounting Information Systems", 1st edition or later. McGraw-Hill Education.

**Department of Biochemistry and Molecular Biology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **BMB 4103 Recombinant DNA Technology** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
This course will develop the practical skill on various biochemical methods and techniques to facilitate acquiring skills for carrying out various biochemical analyses.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Acquire basic knowledge about the fundamentals and role of biomolecules in Recombinant DNA technology.
*CLO 2:* Enrich the quest on applications including gene cloning, cloning vectors and expression vectors.
*CLO 3:* Know about the concepts of cell transformation due to the changes in genetic material, and cell cloning.
*CLO 4:* Understand the creation of gene libraries and the procedure of transformation and transfection methods.
*CLO 5:* Learn about the advent of Polymerase Chain Reaction and PCR based mutagenesis and gene silencing techniques its impact on molecular biology.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Cloning and rDNA Technology :** Introduction to cloning and rDNA technology, Recombinant DNA, Cloning DNA, Cloning vectors: Plasmids (pUC 18 and Ti plasmids), Bacteriophages, Plasmids, Cosmids , SV40, retrovirus and Artificial Chromosomes (BAC, YAC), Amplification of Recombinant DNA. | CLO 1, CLO 2 | 5 |
| **Gene Cloning:** Strategies in gene cloning: restriction enzymes, ligase, insertion into vector, cloning, transformation into host cell, Enzymology of Recombinant DNA. Screening for recombinant (Insertional inactivation, Colony/in situ hybridization, radioactive antibody test, Xgal, complementation and physical methods). | CLO 2 | 6 |
| **Genome Sequencing:** Methods of gene transfer and genome sequencing:CaPO4 mediated gene transfer, liposomes, electroporation, electro fusion, micro-injection, particle bombardment. DNA sequencing (Sanger and Coulson method; Maxam and Gilbert method and Automated method) – Chromosomal walking, transposons, construction of genomic and cDNA libraries; molecular markers- RAPD, RFLP. | CLO 4 | 6 |
| **Transgenic Plants:** Transgenic plants: Definitions, types, benefits, public concern and future. Genetically modified crops: High yielding, salt, draught, herbicide, disease resistant., Transgenic animals –for improved livestock production. Biosafety and ethical issues related to genetically modified organism. | CLO 3, CLO 5 | 6 |
| **rDNA In Medicine:** rDNA in medicine: Recombinant DNA Therapy in Medicine, Vaccines, enzymes, blood factors, interferon, gene therapy. DNA fingerprinting and its applications in forensic sciences, Application of Recombinant Technology – Gene mapping, Diagnosis of Molecular disease, Application in forensic medicine. | CLO5 | 6 |
| Molecular Biology laboratory visit | CLO4, CLO5 | 1 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Primrose (2002): "Principles of genetic manipulation", 6th or later edition. Blackwell Science publication.
- Keya Chaudhuri (2013): "Recombinant DNA Technology", 1st edition or later. The Energy and Resources Institute (TERI).
- T. A. Brown (1995): "An Introduction to Gene Cloning", 3rd or later edition. Chapman and Hall publications.
- Sardul Singh Sandhu (2010): "Recombinant DNA Technology". 1st edition or later. I. K. International Pvt Ltd.
- Monika Jain (2012): "Recombinant DNA Techniques: A Textbook", 1st edition. Alpha Science International.
- D. Peter Snustad and Michael J. Simmons (2012): "Principles of genetics", 6th or later edition. John Wiley & Sons, Inc.
- David Clark (2009): "Molecular Biology", 2nd edition. Elsevier Academic Press.

**Department of Biotechnology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **BTECH 4103 Genetic Engineering and Biotechnology** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | Nil. |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
The purpose of this course is to equip the students with advanced knowledge about the basic molecular biological concepts and techniques that are used in the fields of biotechnology and genetic engineering.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Gain an understanding of basic molecular biology concepts and techniques.
*CLO 2:* Acquire knowledge on current experimentation in biotechnology and genetic engineering.
*CLO 3:* Identify, analyze and validate transgenes in GMO.
*CLO 4:* Apply genetic engineering in plant and animal improvement, medicine and industries.
*CLO 5:* Evaluate biosafety issues and ethics in producing GMO.
*CLO 6:* Discuss basic concept on bioinformatics Retrieve biological sequences

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |
| *CLO 6* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction:**<br>Concept, scope and importance of Genetic Engineering. | CLO 1 | 2 |
| **Gene Manipulation**: Principles of genetic engineering, vectors, methods for gene delivery, selection of recombinants, site specific recombination/mutagenesis. | CLO 2 | 6 |
| **Molecular Techniques:**<br>Nucleic acid and protein purification, Electrophoresis, PCR, Southern, Northern and Western blotting; DNA sequencing, cDNA library. | CLO 1,<br>CLO 2 | 6 |
| **Gene Expression:**<br>Regulation of transcription in prokaryotes and eukaryotes, promoter, terminator, splicing and processing of RNAs, translation, Operon concept. | CLO 1 | 5 |
| **Application of Genetic Engineering:**<br>*Plants:* Biotic and abiotic stress resistance. Nutritional quality improvement: Provitamin A, iron, protein etc. Edible vaccines in food products.<br>*Fish and Animals:* Production of transgenic animal and fish; feed quality improvement; dairy products and milk quality, recombinant protein<br>*Medicine and Industry:* Commercial synthesis of hormones, vaccines, gene therapy, disease diagnosis, monoclonal antibodies, genome mapping, DNA fingerprinting, forensic medicine; enzymology, immunotechnology. | CLO 2,<br>CLO 4 | 5 |
| Biosafety and GMO: Biosafety and environmental issues. Biosafety guidelines & regulations. Ethics and issues regarding GM organisms. Religious and social acceptance of GMOs. | CLO 3,<br>CLO 5 | 4 |
| Bioinformatics: Model for Sequence related information, usage of IT in biotechnology, internet browsing for retrieval and dissemination of biological information. | CLO 6 | 3 |

**Teaching Strategy**

Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Primrose, S. B., R. M. Twyman and R. W. Old. 2003. Principles of Gene Manipulation. 6th Edition. Blackwell Pub. Com., Germany.
- Freifelder, D. 2004. Molecular Bilogy. 2nd Edition. Jones and Bartlett Pub., Inc., USA.
- James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine and Richard Losick. 2004. Molecular Biology of the gene. Fifth Edition. Cold Spring Harbor Laboratory Press
- Jocelyn E. Krebs., Elliott S. Goldstein and Stephen T. Kilpatrick. 2017. Lewin's Genes XII. Jones and Bartlett Learning.
- Christina Marshall 2019. Bioinformatics and Functional Genomics

**Department of Biotechnology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **BTECH 4104 Genetic Engineering and Biotechnology** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | BTECH 4103. |
| Student | Elective for BSc in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
The aim of this course is to provide hands on knowledge on different advanced aspects of biotechnology

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Design a biotechnology laboratory
*CLO 2:* Prepare media for bacterial culture
*CLO 3:* Prepare media, buffers, explants for tissue culture
*CLO 4:* Extract DNA from different organisms
*CLO 5:* Extract plasmid DNA
*CLO 6:* Amplification, restriction digestion and separation of DNA
*CLO 7:* Prepare E. coli competent cell for genetic transformation
*CLO 8:* Data retrieval and alignment

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | | | √ | | | |
| *CLO 2* | | √ | | | | | √ | | | |
| *CLO 3* | | √ | | | | | √ | | | |
| *CLO 4* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |
| *CLO 5* | | √ | | | | | √ | | | |
| *CLO 6* | | √ | | | | | √ | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Biotechnology Laboratory design and requirements | CLO 1 | 1 |
| Media preparation, aseptic manipulation, explants preparation and tissue culture techniques | CLO 2, CLO 3 | 4 |
| Isolation of genomic DNA from bacteria/plant/fish/ animal tissues. | CLO 4 | 2 |
| Isolation of plasmid DNA from bacteria | CLO 5 | 1 |
| Agarose gel electrophoreses | CLO 5, CLO 6 | 1 |
| Polymerase Chain Reaction (PCR) | CLO 6 | 1 |
| *E. coli* competent cell preparation and transformation | CLO 7 | 2 |
| Restriction digestion and ligation of DNA | CLO 6 | 1 |
| DNA/ protein sequences retrieval and alignment | CLO 8 | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Freifelder, D. 2004. Molecular Bilogy. 2nd Edition. Jones and Bartlett Pub., Inc., USA.
- Michael R. Green, and Joseph Sambrook. 2012. Molecular Cloning: a laboratory mannual. Three volume set (4th edition). Cold Spring Harbor Laboratory Press
- Primrose, S. B., R. M. Twyman and R. W. Old. 2003. Principles of Gene Manipulation. 6th Edition. Blackwell Pub. Com., Germany.
- Christina Marshall 2019. Bioinformatics and Functional Genomics

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4125 Wireless Networks** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | CSM 3123 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
The main objective of this course is to introduce the students higher layer protocol design and analysis for wireless networks, detailed introduction to the design and analysis of protocols for power control, medium access, routing, and congestion control that form the fundamental basis for a wide range of wireless data networks, from cellular networks, to mobile ad-hoc network, to sensor networks.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Understand the architecture and applications of current and next generation wireless networks.
*CLO 2:* Understand the key concepts and techniques underlying modern physical layer wireless and mobile communications.
*CLO 3:* Design and analyze various medium access and resource allocation techniques.
*CLO 4:* Design and analyze network layer routing protocols, along with key component mechanisms.
*CLO 5:* Design and analyze transport layer protocols.
*CLO 6:* Evaluate MAC and network protocols using network simulation software tools.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | √ |
| *CLO 2* | √ | | | | | | | | | √ |
| *CLO 3* | √ | | | | | | | | | √ |
| *CLO 4* | √ | | | | | | | | | √ |
| *CLO 5* | √ | | | | | | | | | √ |
| *CLO 6* | √ | | | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Introduction to wireless network architectures: cellular networks, wireless local area networks, multi-hop networks. Radio propagation models, Narrowband digital modulation and Coding under wireless fading environments. | CLO 1, CLO 2 | 5 |
| Basics of CDMA and OFDM, Diversity and MIMO, Equalization. Randomized medium access 1: Unslotted and Slotted Aloha. System throughput analysis and two-user saturation rate region analysis. Randomized medium access 2: CSMA. System throughput analysis and two-user rate region analysis for p-persistent CSMA. Bianchi's Markov chain analysis of throughput for the IEEE 802.11 CSMA protocol. Other window adaptation mechanisms. | CLO 2, CLO 3 | 6 |
| Graph coloring and its application to channel allocation in (TDMA/FDMA/CDMA-based) wireless networks under the protocol model. Integer Linear Programming formulation of channel allocation for both protocol and SINR interference models. Extensions to other objective functions such as non-homogeneous channel preferences, throughput maximization and fairness. Introduction to wireless network simulator (NS-2/QualNet). | CLO 2, CLO 3, CLO 4, CLO 6 | 6 |
| Introduction to multi-hop wireless network routing. The AODV and OLSR protocols for mobile ad-hoc networks. Link estimation and neighbor management. Geographic routing: greedy routing and different solutions for avoiding routing holes. Routing in intermittently connected mobile networks. Theory and Practice of Dynamic Backpressure Routing. Theory: Lyapunov drift minimization yielding the centralized maximum weight independent set matching solution. | CLO 1, CLO 5 | 9 |
| Opportunistic routing and Cooperative Routing: ExOR, Flash flooding, Barrage relay. TCP over wireless networks. Congestion sharing (IFRC, WCAP). Centralized and distributed explicit and precise rate control (RCRT, WRCP). Optimization-based rate control with Lagrange duality and with queue | CLO 5, CLO 6 | 6 |

| | | |
|---|---|---|
| backpressure. | | |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Andrea Goldsmith (2005): "Wireless Communications", 3rd edition. Cambridge University Press.
- Cory Beard and William Stallings (2015): "Wireless Communication Networks and Systems", 2nd edition. Pearson.
- David Tse and Pramod Viswanath (2005): "Fundamentals of Wireless Communication", 3rd edition. Cambridge University Press.
- Larry Peterson and Bruce Davie (2011): "Computer Networks: A Systems Approach", 3rd or later Edition. Morgan Kaufmann.
- James F. Kurose and Keith W. Ross (2016): "Computer Networking: A Top-Down Approach Featuring the Internet", 7th or later Edition. Pearson.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4127 Human Computer Interaction** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | Nil. |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to introduce the students with the basic concepts of human-computer interaction. It will cover the basic theory and methods that exist in the field. The course will unfold by examining design and evaluation. The students will gain principles and skills for designing and evaluating interactive systems.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Understand the basics of human and computational abilities and limitations.
*CLO 2:* Understand basic theories, tools and techniques in HCI.
*CLO 3:* Understand the fundamental aspects of designing and evaluating interfaces.
*CLO 4:* Practice a variety of simple methods for evaluating the quality of a user interface.
*CLO 5:* Apply appropriate HCI techniques to design systems that are usable by people.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | √ |
| *CLO 2* | √ | | | | | | | | | √ |
| *CLO 3* | √ | | | | | | | | | √ |
| *CLO 4* | √ | | | | | | | | | √ |
| *CLO 5* | √ | | | | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to HCI:** Introduction to Human-Computer Interaction. Task-centered system design: task-centered process, development of task examples, evaluation of designs through a task-centered walk-through. | CLO 1, CLO 2 | 5 |
| **User-centered design and prototyping:** Assumptions, participatory design, methods for involving the user, prototyping, low fidelity prototypes, medium fidelity prototypes, wizard of Oz examples. | CLO 2 | 6 |
| **Methods for evaluation of interfaces with users:** Goals of evaluation, approaches, ethics, introspection, extracting the conceptual model, direct observation, constructive interaction, interviews and questionnaires, continuous evaluation via user feedback and field studies, choosing an evaluation method. | CLO 2, CLO 3 | 6 |
| **Psychology of everyday things:** Psychopathology of everyday things, examples, concepts for designing everyday things. Beyond screen design: characteristics of good representations, information visualization, Tufte's guidelines, visual variables, metaphors, direct manipulation. | CLO 3, CLO 4 | 9 |
| **Graphical screen design:** Graphical design concepts, components of visible language, graphical design by grids. Design principles and usability heuristics: design principles, principles to support usability, golden rules and heuristics, HCI patterns. | CLO 4, CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Alan Dix, Janet E. Finlay, Gregory D. Abowd and Russell Beale (2004): "Human-Computer Interaction", 3rd edition or later. Pearson.
- Jenny Preece, Helen Sharp and Yvonne Rogers (2015): "Interaction Design: Beyond Human-Computer Interaction", 4th edition or later. Wiley.
- Ben Shneiderman and Catherine Plaisant (2016): "Designing the User Interface", 6th edition or later. Addison Wesley.
- Solis Tech (2016): "Human-Computer Interaction: The Fundamentals Made Easy", 3rd edition. Create Space Independent Publishing Platform.

- Scott MacKenzie (2013): "Human-Computer Interaction: An Empirical Research Perspective", 1st edition or later. Morgan Kaufmann.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4131 Neural Networks and Fuzzy Systems** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | CSM 1123 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
The main objective of this course is to give a basic understanding of Fuzzy Logic, Neural Networks, and Neural-Fuzzy Systems. Several applications of artificial neural networks will be studied including computer vision, cognitive information processing, control, and signal analysis.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Understand the basics of neural networks.
*CLO 2:* Explain different network architectures and how these are used in current applications.
*CLO 3:* Understand the basics of fuzzy associative memories.
*CLO 4:* Implement, train, and evaluate neural networks using existing software libraries.
*CLO 5:* Present and critically assess current research on neural networks and their applications.
*CLO 6:* Plan and apply neural networks to solve real world problems.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | | | | | √ |
| *CLO 6* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Neural Networks and Fuzzy Systems:** Neural and Fuzzy Machine Intelligence, Fuzziness as Multivalence, Dynamical-Systems Approach to Machine Intelligence, Intelligent Behavior as Adaptive Model- Free Estimation. | CLO 1, CLO 3 | 5 |
| **Neural Dynamics:** Activations and Signals; Neurons as Functions, Signal Monotonicity, Biological Activations and Signals, Neuron Fields, Neuronal Dynamical Systems, Common Signal Functions, Pulse-Coded Signal Functions. Activation Models: Neuronal Dynamical Systems, Additive Neuronal Dynamics, Additive Neuronal Feedback, Additive Bivalent Models, BAM Connection Matrices, Additive Dynamic and the Noise-Saturation Dilemma, General Neuronal Activations: Cohen-Grossberg and Multiplicative Models. | CLO 2, CLO 4 | 6 |
| **Synaptic Dynamics:** Unsupervised Learning; Learning as Encoding, Change, and Quantization, Four Unsupervised Learning Laws, Probability Spaces and Random Processes, Stochastic Unsupervised Learning and Stochastic Equilibrium, Signal Hebbian Learning, Competitive Learning, Differential Hebbian Learning, Differential Competitive Leering. Supervised Learning: Supervised Function Estimation, Supervised Learning as Operant Conditioning, Supervised Learning as Stochastic Pattern Learning with known Class Memberships, Supervised Learning as stochastic Approximation, The Back propagation Algorithm. | CLO 4, CLO 5, CLO 6 | 6 |
| **Fuzziness Versus Probability:** Fuzzy Sets and Systems, Fuzziness in a Probabilistic World, Randomness vs. Ambiguity: Whether vs. How much, The Universe as a Fuzzy Set, The Geometry of Fuzzy Set, The geometry of Fuzzy Sets: Sets as Points. The Fuzzy Entropy Theorem, The Subsethood theorem. The Entropy-Subsethood Theorem. | CLO 3 | 9 |
| **Fuzzy Associative Memories:** Fuzzy Systems as Between-Cube Mappings, Fuzzy and Neural Function Estimators, Fuzzy Hebb FAMs, Adaptive FAMs: Product-Space Clustering in FAM Cells. | CLO 3 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Bark Kosko (1994): "Neural Networks & Fuzzy Systems", 3rd edition. Prentice Hall India.
- Bark Kosko (1997): "Fuzzy Engineering",2nd edition. Prentice Hall India.
- Mohamad H Hassoum (1995): "Fundamentals of Artificial Neural Networks", 5th edition. MIT Press.
- Hagan and Beale (2003): "Neural network Design". 3rd edition. Vikas Publishing House.
- Hans-Jürgen Zimmermann (2013): "Fuzzy Set Theory & its Application",3rd edition. Allied Published Ltd.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4134 R Programming** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | CSM 1221 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
The main objective of this course is to provide hands on experiences about the concepts and basic definitions in programming, arrays, matrices and data frames, the usage and definitions of procedures, functions and packages, vectorization, loops, control structures (if, while, for), importing data, visualization of data, simulation studies.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Use and program in the programming language R.
- *CLO 2:* Implement simple algorithms in R independently.
- *CLO 3:* Have developed good habits in programming in R to ensure efficient and safe code in order to facilitate collaborations.
- *CLO 4:* Apply data visualization techniques in R.
- *CLO 5:* Use R to solve statistical problems, including data handling and data analysis.
- *CLO 6:* Understand the foundations of and be able to design and describe simulation studies.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | | | | | √ |
| *CLO 6* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to R:** Overview of R, R data types and objects, reading and writing data. | CLO 1 | 2 |
| **Expressions:** Control structures, functions, scoping rules, dates and times. | CLO 1, CLO 2 | 3 |
| **Conditional & Iterations:** Loop functions, debugging tools, Data Manipulation (dplyr, reshape2 packages). | CLO 3 | 3 |
| **String, Packages and Data Visualization:** String Operations (stringr package); Packaging, Debugging and Object Oriented Programming; Data Visualization (ggplot2 package). | CLO 4 | 4 |
| **Data Analytics:** Clustering, Regression and Classification, Data Analytics Case Study. | CLO 5, CLO 6 | 4 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Norman S Matloff, (2011): "The art of R programming: tour of statistical software design", 1st edition. San Francisco: No Starch Press.
- Garrett Grolemund and Hadley Wickham (2016): "R for Data Science", 2nd edition. O'Reilly Media.
- Roger D. Peng (2012): "R Programming for Data Science", 2nd edition. Lulu.
- Hadley Wickham (2017): "Advanced R", 5th edition. Taylor & Francis Limited.
- John Verzani (2004): "Using R for Introductory Statistics", 6th edition. Chapman & Hall/CRC.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4136 Assembly Language Programming** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to familiarize students with practical knowledge on assembly language concepts, data representation, programming model, data movement & manipulation instructions, branch instructions, complex data types, procedures and specialized instructions.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Define the elements of an assembly language program.
*CLO 2:* Apply assembly language directives and operators to effectively express code and data in an assembly language program.
*CLO 3:* Create and employ assembly language macros and object libraries.
*CLO 4:* Create branching and looping in assembly code.
*CLO 5:* Design programs that interact directly with hardware through both port I/O and memory mapped hardware.
*CLO 6:* Design programs that manipulate the file structures of the operating system directly.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | √ | | | | | √ |
| *CLO 2* | √ | | | √ | √ | | | | | √ |
| *CLO 3* | √ | | | √ | √ | | | | | √ |
| *CLO 4* | √ | | | √ | √ | | | | | √ |
| *CLO 5* | √ | | | √ | √ | | | | | √ |
| *CLO 6* | | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Assembly Language Fundamentals – basic elements of assembly language assembling, linking and burning programs. | CLO 1 | 2 |
| Defining Data, Symbolic Constants, Data Transfers, Addressing and Arithmetic Data Transfer Instructions, Addition and Subtraction. Data-related Operators and Directives Indirect Addressing, Branch and Loop Instruction. | CLO 2, CLO 4 | 3 |
| Procedures – linking to an external library, stack operations, defining and using procedures. Conditional Processing – Boolean and comparison instruction, conditional jumps. | CLO 2 | 3 |
| Integer Arithmetic – shift and rotate instructions, shift and rotate applications, multiplication and division instructions, extended addition and subtraction, ASCII and Packed Decimal Arithmetic. Structures and Macros – structures, macros, conditional-assembly directives. | CLO 3 | 4 |
| Advanced Procedures Local Variables, Stack Parameters, Stack Frames. Strings and Arrays – string primitive instructions, selected string procedures, two- dimensional arrays. | CLO 4 | 2 |
| High-level Language Interface Inline Assembly Code, Linking to C++ Programs. Disk Fundamentals – disk storage systems, files systems, disk directory. | CLO 3, CLO 5, CLO 6 | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Kip R. Irvine (2014): "Assembly Language for x86 Processors", 7th edition or later. Pearson.
- Daniel Kusswurm (2014): "Modern X86 Assembly Language Programming: 32-bit, 64-bit, SSE, and AVX", 6th edition. Apress.
- Jeff Duntemann (2009): "Assembly Language Step-by-Step: Programming with Linux", 3rd edition or later. Wiley.
- Bruce Smith (2013): "Raspberry Pi Assembly Language RASPBIAN Beginners: Hands On Guide", 3rd edition or later. CreateSpace Independent Publishing Platform.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4137 Bioinformatics Databases** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | Nil. |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
The main objective of this course is to familiarize students with database concepts, molecular biology data types, primary sequences databases, derived sequence database and structural Database to apply in the field of Bioinformatics.

**Course Learning Outcome (CLOs)**

Upon completion of this course, the student will be able to:
*CLO 1:* Know the basic database concepts, types, advantages and disadvantages.
*CLO 2:* Understand the management of database and also concepts to improve database integrity in the case of biological data.
*CLO 3:* Understand specialized genome databases developed for the model organisms in order to compare the species related evolution.
*CLO 4:* Access and retrieve the protein structure to understand the mechanism of disease.
*CLO 5:* Apply molecular biology databases in drug discovery and designing

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | √ | | √ | √ | | | | |
| *CLO 2* | | | √ | | √ | √ | | | | |
| *CLO 3* | | | √ | | √ | √ | | | | |
| *CLO 4* | | | √ | | √ | √ | | | | |
| *CLO 5* | | | √ | | √ | √ | | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Database Concepts:** Database in general – definitions and examples – Computerized databases – advantages and disadvantages – need for database models and systems – examples of logical models – hierarchical, network and relation models – RDBMS – objected oriented models – primary and secondary (derived) database – structure and sequences database – growth of databases, Gene Ontology classifications. | CLO 1, CLO 2 | 2 |
| **Molecular Biology Data Types:** Brief descriptions of the various types of data used in modern Molecular Biology and how they are obtained, stored, represented and retrieved – organisms – genome maps – DNA, RNA and protein sequences – RNA secondary structure – protein secondary and tertiary structure – DNA and protein sequence motifs – protein and RNA structure motifs – RNA and protein-protein interaction data – mutations and polymorphisms in sequences and structures – tissues and cells – populations. | CLO 3 | 6 |
| **Primary Sequences Databases:** DNA sequence databases – GenBank, EMBl, DBJ – details of structure of GenBank – Difference with and links to other databases – protein sequence databases – Swissprot, PIR – details of arrangement of data in Swissprot – differences and links to other databases – TrEMBL database. | CLO 3, CLO 4, CLO 5 | 6 |
| **Derived Sequence Database:** Sub-collections of data – Flybase – AceDB, Wormbase – comprehensive microbial genome, omniome – organelle genome database, GOBASE – eukaryotic promoter database – Codon usage table database – Exon-Intron database – examples of protein sequence sub collections – GPCR sequence database – human unidentified gene – encoded large protein sequence database; HUGE – CluSTr and COGS – database of protein sequence patterns and motifs - PRINTS, ROSITE, Pfam, ProDom. | CLO 3, CLO 4, CLO 5 | 6 |
| **Structural Database:** Nature of structural data – coordinate systems – primary structure database – PDB,CSD – details of arrangement of data in PDB with examples – access to PDB and CSD – derived structure database, NDB – structural patterns and motifs – SCOP – CATH – FSSP – PALI – DSSP, Drug bank, ligand depot, Querying chemical database. | CLO 3, CLO 4, CLO 5 | 6 |
| High-level Language Interface Inline Assembly Code, Linking to C++ Programs. Disk Fundamentals – disk storage systems, files systems, disk directory. | CLO 3, CLO 5, CLO 6 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- D. Higgins and W.Taylor (2008): "Bioinformatics: Sequences, Structures and Databanks", 2nd edition. Oxford University Press.
- N. Gautham (2006): "Bioinformatics: Databases and Algorithms", 2nd edition. Alpha Science.
- V. R. Srinivas (2005): "Bioinformatics: A Modern Approach", 1st or later edition. PHI Learning Pvt. Ltd.
- Stanley I. Letovsky (2006): "Bioinformatics: Databases and Systems", 2nd edition. Kluwer Academic Publisher.
- Jake Chen, Amandeep S. Sidhu (2008): "Biological Database Modeling", 1st edition. Artech Hous.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4138 Bioinformatics Databases** |
| Level & Semester | L-4, S-1 (January-June) |
| Pre-requisite course | CSM 4137 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to familiarize students with practical knowledge on database concepts, molecular biology data types, primary sequences databases, derived sequence database and structural Database to apply in the field of Bioinformatics .

**Course Learning Outcome (CLOs)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Know the basic database concepts, types, advantages and disadvantages.
- *CLO 2:* Understand the management of database and also concepts to improve database integrity in the case of biological data.
- *CLO 3:* Understand specialized genome databases developed for the model organisms in order to compare the species related evolution.
- *CLO 4:* Access and retrieve the protein structure to understand the mechanism of disease.
- *CLO 5:* Apply molecular biology databases in drug discovery and designing.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | √ | | √ | √ | | | | |
| *CLO 2* | | | √ | | √ | √ | | | | |
| *CLO 3* | | | √ | | √ | √ | | | | |
| *CLO 4* | | | √ | | √ | √ | | | | |
| *CLO 5* | | | √ | | √ | √ | | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Installation of different database systems. | CLO 1, CLO 2 | 2 |
| Handle molecular biology data types. | CLO 3, CLO 5 | 2 |
| Use primary sequences databases. | CLO 4, CLO 5 | 2 |
| Use derived sequence database. | CLO 4, CLO 5 | 4 |
| Apply structural database. | CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- D. Higgins and W.Taylor (2008): "Bioinformatics: Sequences, Structures and Databanks", 2nd edition. Oxford University Press.
- N. Gautham (2006): "Bioinformatics: Databases and Algorithms", 2nd edition. Alpha Science.
- V. R. Srinivas (2005): "Bioinformatics: A Modern Approach", 1st or later edition. PHI Learning Pvt. Ltd.
- Stanley I. Letovsky (2006): "Bioinformatics: Databases and Systems", 2nd edition. Kluwer Academic Publisher.
- Jake Chen, Amandeep S. Sidhu (2008): "Biological Database Modeling", 1st edition. Artech Hous.

**Level- 4, Semester- 2**

**Department of Biotechnology**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **BTECH 4202 Biological sequence analysis** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | CSM 1123, CSM 1221 and STAT 2205. |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
This course covers advance hands-on knowledge on Biological sequence analysis.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Retrieve biological sequences
*CLO 2:* Predict gene, RNA, ribosome structure
*CLO 3:* Analyze RNA and Chip seqdata
*CLO 4:* Design primer and analyze restriction mapping
*CLO 5:* Evaluate sequence homology and similarity
*CLO 6:* Analyze DNA- marker based, Microarray, and gene expression data
*CLO 7:* Provide hands-on knowledge on metagenomics

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | √ | | | √ | | √ | | | √ |
| *CLO 2* | | √ | | | √ | | √ | | | √ |
| *CLO 3* | | √ | | | √ | | √ | | | √ |
| *CLO 4* | | √ | | | √ | | √ | | | √ |
| *CLO 5* | | √ | | | √ | | √ | | | |
| *CLO 5* | | √ | | | √ | | √ | | | |
| *CLO 6* | | √ | | | √ | | √ | | | √ |
| *CLO 7* | | √ | | | √ | | √ | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Concept of Biological sequences: DNA, RNA and Protein | CLO 1 | 1 |
| Gene, RNA structure and Ribosome binding site prediction, RNA seq | CLO 2, CLO 3 | 2 |
| Restriction mapping and genetic engineering: restriction enzyme, restriction enzyme mapping, Generating reverse stand sequence, DNA translation, Finding open reading frames, Primer design | CLO 4 | 3 |
| Genomics: FASTA, FASTAQ, sequence alignment: BLAST and Clustal W, Phylogeny | CLO 5 | 2 |
| DNA marker based population genetic structure analysis: RAPD, SSR, RFLP and SNP | CLO 6 | 3 |
| Microarray: Data structure, Analysis | CLO 6 | 2 |
| Gene expression analysis: PCR and RT qPCR data analysis | CLO 6 | 1 |
| ChiPseq: experimental application and association analysis methodology | CLO 3 | 1 |
| Metagenomics: concept, approach and 16S sequencing | CLO 7 | 1 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme J. Mitchison (1998) Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids (1st Edition). Cambridge University Press
- Paul M. Selzer, Richard J. Marhöfer, Oliver Koch (2018) Applied Bioinformatics (2nd Edition): An Introduction, Springer
- Christina Marshall 2019. Bioinformatics and Functional Genomics

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4221 Big Data Mining** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | CSM 1123, CSM 1221 and STAT 2205. |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
The main objectives of this course are to enable students to understand and implement classical algorithms in data mining and big data, to learn how to analyze the data, how to identify the problems, and how to choose the relevant algorithms to apply, and to be able to assess the strengths and weaknesses of the algorithms and analyze their behavior on real datasets. They also acquire knowledge on how to use tools for acquiring, cleaning, analyzing, exploring, and visualizing data; making data-driven inferences and decisions; and effectively communicating results.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Understand the functionality of the various data mining and big data components.
*CLO 2:* Identify the strengths and limitations of various data mining and big data models.
*CLO 3:* Compare the various approaches to data warehousing and big data implementations.
*CLO 4:* Identify and explain fundamental mathematical and algorithmic ingredients that constitute a Recommendation Engine and build their own recommendation system using existing components.
*CLO 5:* Describe and utilize a range of techniques for designing data warehousing and big data systems for real-world applications.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | √ | | | | | | √ |
| *CLO 2* | √ | | √ | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | √ | | | | | | √ |
| *CLO 5* | √ | | √ | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to data warehousing:** Evolution of decision support systems; Modeling a data warehouse, granularity in the data warehouse. **Data Warehouse life cycle:** Data warehouse life cycle, building a data warehouse, Data Warehousing Components. Data Warehousing Architecture; On Line Analytical Processing, Categorization of OLAP Tools. | CLO 1 | 4 |
| **Introduction to Data mining and knowledge discovery:** Relation to Statistics, Databases; Data Mining Functionalities; Steps In Data Mining Process, Architecture of a Typical Data Mining Systems; Classification of Data Mining Systems; Overview of Data Mining Techniques. | CLO 2, CLO 3, CLO 4 | 4 |
| **Data Preprocessing:** Data Preprocessing, Data Cleaning; Data Integration, Data Transformation and Data Reduction; Data Generalization and Summarization Based Characterization. | CLO 2, CLO 3, CLO 4 | 4 |
| **Feature Generation and Feature Selection**: Extracting Meaning From Data; Motivating application: user (customer) retention; Feature Generation (brainstorming, role of domain expertise, and place for imagination); Feature Selection algorithms ; Filters; Wrappers; Decision Trees; Random Forests. | CLO 2, CLO 3, CLO 4, CLO 5 | 4 |
| **Classification and Prediction:** Mining Association Rules In Large Databases; Issues Regarding Classification and Prediction; Classification By Decision Tree Induction; Bayesian Classification; Other Classification Methods; Prediction; Clusters Analysis; Types of Data In Cluster Analysis; Categorization of Major Clustering Methods; Partitioning Methods; Hierarchical Methods. | CLO 1 | 4 |
| **Recommendation Systems and Mining Social-Network Graphs:** Building a User-Facing Data Product; Algorithmic ingredients of a Recommendation Engine; Dimensionality Reduction; Singular Value Decomposition; Principal Component Analysis; Mining Social-Network Graphs: Social networks as graphs; Clustering of graphs; Direct discovery of communities in graphs; | CLO 2, CLO 3, CLO 4, CLO 5 | 4 |

| | | |
|---|---|---|
| Partitioning of graphs; Neighborhood properties in graphs. | | |
| **Introduction to Big Data:** The 3 V's, their challenges and application domains. Collection of Big Data: Eventual Consistency and NoSQL systems MongoDB, Google BigTable. Large-Scale Data Analytics Systems: Auto-Parallel Data Programming; MapReduce, Hive, and Parallel Databases. Basic Statistical Analysis: Fruad and Benfords Law, Bayesian Introduction, Heteroskedasticity. Machine Learning Systems for Big Data. Graph Analytics: Graph structures (diameter, connectivity, centrality), PageRank, Triangle counting. Sentiment Analysis. Data Visualization: Data types and dimensions; Visual encoding and perception | CLO 2, CLO 3, CLO 4, CLO 5 | 6 |
| **Applications of Data Mining:** Social Impacts of Data Mining; Mining WWW; Mining Text Database; Mining Spatial Databases. | CLO 2, CLO 3, CLO 4 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Cathy O'Neil and Rachel Schutt (2014): "Doing Data Science, Straight Talk from The Frontline", 2nd edition. O'Reilly.
- Jure Leskovek, Anand Rajaraman and Jeffrey Ullman (2014): "Mining of Massive Datasets", 2nd edition. Cambridge University Press.
- Kevin P. Murphy (2013): "Machine Learning: A Probabilistic Perspective", 1st edition. MIT Press.
- Foster Provost and Tom Fawcett (2013): "Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking", 2nd edition. O'Reilly.
- Trevor Hastie, Robert Tibshirani and Jerome Friedman (2009): "Elements of Statistical Learning", 2nd or later Edition. Springer.
- Avrim Blum, John Hopcroft and Ravindran Kannan (2017): "Foundations of Data Science", 1st edition. Abe Books.
- Mohammed J. Zaki and Wagner Miera Jr. (2014): "Data Mining and Analysis: Fundamental Concepts and Algorithms", 1st edition. Cambridge University Press.
- Jiawei Han, Micheline Kamber and Jian Pei (2011): "Data Mining: Concepts and Techniques", 3rd or later Edition. Elsevier.
- Mohammed Guller (2015): "Big Data Analytics with Spark: A Practitioner's Guide to Using Spark for Large Scale Data Analysis", 1st edition or later. Apress.
- Rajat Mehta (2017): "Big Data Analytics with Java: Data analysis, visualization & machine learning techniques", 1st edition. Packt Publishing.
- Holden Karau, Andy Konwinski, Patrick Wendell and Matei Zaharia (2015): "Learning Spark: Lightning-Fast Big Data Analysis", 1st edition or later. O'Reilly Media.
- Alan Anderson and David Semmelroth (2015): "Statistics for Big Data for Dummies", 2nd edition. O'Reilly Media.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4222 Big Data Mining** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | CSM 4221 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 |
| Total Mark | 100 |

**Rationale**
The main objectives of this course are to enable students to understand and implement classical algorithms in data mining and big data, to learn how to analyze the data, how to identify the problems, and how to choose the relevant algorithms to apply, and to be able to assess the strengths and weaknesses of the algorithms and analyze their behavior on real datasets. They also acquire knowledge on how to use tools for acquiring, cleaning, analyzing, exploring, and visualizing data; making data-driven inferences and decisions; and effectively communicating results.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Understand the functionality of the various data mining and big data components.
*CLO 2:* Identify the strengths and limitations of various data mining and big data models.
*CLO 3:* Compare the various approaches to data warehousing and big data implementations.
*CLO 4:* Identify and explain fundamental mathematical and algorithmic ingredients that constitute a Recommendation Engine and build their own recommendation system using existing components.
*CLO 5:* Describe and utilize a range of techniques for designing data warehousing and big data systems for real-world applications.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | √ | √ | | | | | | √ |
| *CLO 2* | √ | | √ | √ | | | | | | √ |
| *CLO 3* | √ | | √ | √ | | | | | | √ |
| *CLO 4* | √ | | √ | √ | | | | | | √ |
| *CLO 5* | √ | | √ | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Demonstration of skill sets that are needed for a data scientist;<br>Design and develop models using probability distributions. | CLO 1 | 2 |
| Implement and evaluate different data preprocessing algorithms. | CLO 2,<br>CLO 4 | 2 |
| Implement and evaluate different plots, graphs and summary statistics of EDA;<br>Case Study: Real Direct (online real estate firm);<br>Implement and evaluate different machine learning algorithms. | CLO 2,<br>CLO 3,<br>CLO 4 | 2 |
| Implementation and evaluation of different feature selection algorithms. | CLO 3,<br>CLO 4 | 2 |
| Implement and evaluate different classification and prediction algorithms including Association Rules in Large Databases, Decision Tree Induction, Bayesian Classification, and Clustering. | CLO 2,<br>CLO 3,<br>CLO 4 | 2 |
| Building a User-Facing Data Product for recommendation systems. | CLO 3,<br>CLO 4,<br>CLO 5 | 2 |
| Implement and evaluate basic principles, ideas and tools for data visualization;<br>create your own visualization of a complex dataset;<br>Discussion on ethical Issues, privacy and security. | CLO 2,<br>CLO 3,<br>CLO 4,<br>CLO 5 | 2 |
| Identify Big Data, Eventual Consistency and NoSQL systems MongoDB, Google BigTable.<br>Practice Auto-Parallel Data Programming; MapReduce, Hive, and Parallel Databases. | CLO 2,<br>CLO 3,<br>CLO 4,<br>CLO 5 | 2 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- W. H. Inmon (2005): “Building the Data Warehouse”, 3rd or later edition. Wiley
- Anahory and Murray (2010): “Data warehousing in the real world”, 2nd edition. Pearson Education/Addison Wesley.
- Margaret Dunham (2006): “Data Mining: Introductory and Advanced Topics”, 3rd edition. Prentice Hall.
- Jiawei Han and Micheline Kamber (2002): “Data Mining: Concepts and Techniques”, 4th edition. Morgan Kaufmann Publishers.
- Alex Berson and Stephen J. Smith (2004): “Data Warehousing, Data Mining, & OLAP”, 4th edition. Tata Mcgraw- Hill.
- George M Marakas (2003): “Modern Data Warehousing, Mining and Visualization”, 3rd edition. Pearson Education.
- Cathy O'Neil and Rachel Schutt (2014): "Doing Data Science, Straight Talk from The Frontline", 2nd edition. O'Reilly.
- Jure Leskovek, Anand Rajaraman and Jeffrey Ullman (2014): "Mining of Massive Datasets", 2nd edition. Cambridge University Press.
- Kevin P. Murphy (2013): "Machine Learning: A Probabilistic Perspective", 1st edition. MIT Press.
- Foster Provost and Tom Fawcett (2013): "Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking", 2nd edition. O'Reilly.
- Trevor Hastie, Robert Tibshirani and Jerome Friedman (2009): "Elements of Statistical Learning", 2nd or later Edition. Springer.
- Avrim Blum, John Hopcroft and Ravindran Kannan (2017): "Foundations of Data Science", 1st edition. Abe Books.
- Mohammed J. Zaki and Wagner Miera Jr. (2014): "Data Mining and Analysis: Fundamental Concepts and Algorithms", 1st edition. Cambridge University Press.
- Jiawei Han, Micheline Kamber and Jian Pei (2011): "Data Mining: Concepts and Techniques", 3rd or later Edition. Elsevier.
- Mohammed Guller (2015): "Big Data Analytics with Spark: A Practitioner's Guide to Using Spark for Large Scale Data Analysis", 1st edition or later. Apress.
- Rajat Mehta (2017): "Big Data Analytics with Java: Data analysis, visualization & machine learning techniques", 1st edition. Packt Publishing.
- Holden Karau, Andy Konwinski, Patrick Wendell and Matei Zaharia (2015): "Learning Spark: Lightning-Fast Big Data Analysis", 1st edition or later. O'Reilly Media.
- Alan Anderson and David Semmelroth (2015): "Statistics for Big Data for Dummies", 2nd edition. O'Reilly Media.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4230 Project Work and Report** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | CSM 4130 |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 03 |
| Contact hours | 06 |
| Total Mark | 100 |

**Rationale**
The project course will provide experience in carrying out a significant project from conception to completion with minimal supervision and assistance.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Identify the scope of a project.
*CLO 2:* Specify functional requirements of the project.
*CLO 3:* Design a model of the project in details.
*CLO 4:* Implement the model of the project.
*CLO 5:* Prepare final version of the report.
*CLO 6:* Demonstrate the implemented system.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | √ | √ | √ |
| *CLO 2* | √ | | | | | | | √ | √ | √ |
| *CLO 3* | √ | | | | | | | √ | √ | √ |
| *CLO 4* | √ | | | | | | | √ | √ | √ |
| *CLO 5* | √ | | | | | | | √ | √ | √ |
| *CLO 6* | √ | | | | | | | √ | √ | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Each student should work on a particular topic approved by the Board of Studies (BOS) of the Department and under the guidance of a Departmental teacher | CLO 1, CLO 2, CLO 3, CLO 4, CLO 5, CLO 6 | |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Gabe T. Wang and Keumjae Park (2016), "Student Research and Report Writing: From Topic Selection to the Complete Paper", 2nd edition. Wiley.
- Colin Robson (2016), "How to do a Research Project: A Guide for Undergraduate Students", 3rd edition. Wiley.
- Eric Carlson (2016), "Project Management: From Conception to Practice", 2nd edition. CreateSpace Independent Publishing.
- Michael Michalko (2006), "Thinkertoys: A Handbook of Creative-Thinking Techniques", 2nd or later Edition. Rodale Publisher.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4232 ICT Industrial Attachment** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | NIl |
| Student | Compulsory for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | |
| Total Mark | 100 |

**Rationale**
The training course will provide hands-on experience in developing software from conception to completion on real world problems assigned by the concerned ICT industries (or ICT based industries) located in nationally or internationally.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Identify the scope of a project.
*CLO 2:* Specify functional requirements of the project.
*CLO 3:* Design a model of the project in details.
*CLO 4:* Implement the model of the project.
*CLO 5:* Prepare final version of the report.
*CLO 6:* Demonstrate the implemented system in country or overseas.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | √ | √ | √ |
| *CLO 2* | √ | | | | | | | √ | √ | √ |
| *CLO 3* | √ | | | | | | | √ | √ | √ |
| *CLO 4* | √ | | | | | | | √ | √ | √ |
| *CLO 5* | √ | | | | | | | √ | √ | √ |
| *CLO 6* | √ | | | | | | | √ | √ | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| The students undertake practical training in different ICT industries (or ICT based industries) for a period of 45 days in software developing on real world problems assigned by the concerned ICT industries (or ICT based industries). It will create opportunities for students to work with local and foreign industries to solve real-world problems. Students are required to submit reports after completion of the training in the ICT industries (or ICT based industries). | CLO 1, CLO 2, CLO 3, CLO 4, CLO 5, CLO 6 | |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Gabe T. Wang and Keumjae Park (2016), "Student Research and Report Writing: From Topic Selection to the Complete Paper", 2nd edition. Wiley.
- Colin Robson (2016), "How to do a Research Project: A Guide for Undergraduate Students", 3rd edition. Wiley.
- Eric Carlson (2016), "Project Management: From Conception to Practice", 2nd edition. CreateSpace Independent Publishing.
- Michael Michalko (2006), "Thinkertoys: A Handbook of Creative-Thinking Techniques", 2nd or later Edition. Rodale Publisher.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4223 Robotics Systems** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | CSM 3223 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objectives of this course are to familiarize the student about the concept of autonomous agents, to identify the key approaches developed for decision-making in autonomous systems, to develop a contemporary platform for programming agents and multi-agent systems, and to evaluate the key issues surrounding the development of autonomous robots and a contemporary platform for experimental robotics.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Explain concepts of model error, sensitivity and robustness, and frequency-domain multivariable analysis.
*CLO 2:* Evaluate and critically appraise real world scenarios where robotics and autonomous systems might be applied, make informed choices about the relative merits of their use, and explain associated social and ethical issues.
*CLO 3:* Compare different robotic configurations and systems, critically evaluate their advantages and disadvantages in open ended real world problems, derive and apply kinematic and dynamic models of robots.
*CLO 4:* Explain sensing and actuation systems applied to robotic systems, and the importance of using multiple sensors and of data fusion in robotic and autonomous systems.
*CLO 5:* Apply a high level of control to different robotic systems, critically compare different control architectures, explain the importance of high level versus low level control, and describe different software and hardware architectures used in mobile robotics.
*CLO 6:* Explain and apply algorithmic approaches for path planning, navigation and obstacle avoidance, and of the advanced concepts of probabilistic robotics and simultaneous localization and mapping (SLAM) and the practical implications of their application.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | | | | | √ |
| *CLO 6* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Introduction to robotics; brief history; types and applications of robotics; why robots are important; social and ethical issues. | CLO 2 | 4 |
| Kinematics and dynamics modelling; trajectory planning; sensing and actuation systems; control of flexible manipulators; healthcare and medical robotics; assistive and rehabilitation robotics. | CLO 1, CLO 2, CLO 3 | 6 |
| Autonomous systems: Autonomy and its classification; high-level and low-level control architectures; software and hardware architectures used in mobile robotics; algorithmic approaches to path planning, navigation and obstacle avoidance; multi-sensor data fusion | CLO 4, CLO 5 | 6 |
| Advanced concepts of probabilistic robotics and simultaneous localization and mapping (SLAM); co-operative and swarm robotics; decentralized control and agent methods. | CLO 5, CLO 6 | 10 |
| Introduction to robotics; brief history; types and applications of robotics; why robots are important; social and ethical issues. | CLO 2 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Michael Wooldridge (2009): “An Introduction to Multi-Agent Systems”, 2nd or later Edition. Wiley.
- Roland Siegwart, Illah Reza Nourbakhsh and Davide Scaramuzza (2011): “Introduction to Autonomous Mobile Robots”, 2nd or later Edition. MIT Press.
- Rafael H. Bordini, Jomi Fred Hubner and Michael Wooldridge (2007): “Programming Multi-agent Systems in AgentSpeak Using Jason”, 3rd edition. Wiley.
- Wei Lu (2016): “Beginning Robotics Programming in Java with Lego Mindstorms”.7th edition. APress / Springer.
- B. Siciliano and O. Khatib (2008): “The Springer Handbook of Robotics”, Springer.
- D. Floreano and C. Mattiussi (2008): “Bio-inspired artificial intelligence”, 4th edition. The MIT Press.
- D. K. Stoy Brandt and DJ Christensen (2010): “Self-reconfigurable robots: an introduction”, 6th edition. The MIT Press.
- S. Nolfi and D. Floreano (2004): “Evolutionary Robotics”, 1st edition. MIT Press.
- T. Samadand and J. Weyrauch (2000): “Automation, Control and Complexity –an integrated approach”, 2nd edition. John Wiley & Sons.
- M. Meystel and J. S. Albus (2002): “Intelligent Systems: architecture, design and control”, 4th edition. Wiley-Inter Science.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4224 Robotics Systems** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | CSM 4223 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The objectives of this course are to provide hands on experience on autonomous agents, to evaluate the key approaches developed for decision-making in autonomous systems, to develop a contemporary platform for programming agents and multi-agent systems and to analyze the key issues surrounding the development of autonomous robots and a contemporary platform for experimental robotics.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Evaluate real world scenarios practically where robotics and autonomous systems might be applied and make informed choices about the relative merits of their use.
- *CLO 2:* Experiment with different robotic configurations and systems, critically evaluate their advantages and disadvantages in open ended real world problems, derive and apply kinematic and dynamic models of robots.
- *CLO 3:* Apply sensing and actuation systems to robotic systems, and use multiple sensors and data fusion in robotic and autonomous systems.
- *CLO 4:* Apply a high level of control to different robotic systems, critically compare different control architectures.
- *CLO 5:* Implement algorithmic approaches for path planning, navigation and obstacle avoidance, and of the advanced concepts of probabilistic robotics and simultaneous localization and mapping (SLAM) and the practical implications of their application.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Implement and evaluate different kinematics and dynamics modelling systems such as trajectory planning, sensing and actuation systems, control of flexible manipulators, healthcare and medical robotics, assistive and rehabilitation robotics. | CLO 1, CLO 2, CLO 3 | 3 |
| Develop autonomous systems having high-level and low-level control architectures;<br>Develop software that are used in mobile robotics;<br>Design algorithmic approaches to path planning, navigation and obstacle avoidance. | CLO 4, CLO 5 | 3 |
| Design and develop different robots using advanced concepts of probabilistic, and simultaneous localization and mapping (SLAM) approaches;<br>Design and develop co-operative and swarm robots. | CLO 5 | 3 |
| Implement and evaluate different kinematics and dynamics modelling systems such as trajectory planning, sensing and actuation systems, control of flexible manipulators, healthcare and medical robotics, assistive and rehabilitation robotics. | CLO 1, CLO 2, CLO 3 | 3 |
| Develop autonomous systems having high-level and low-level control architectures;<br>Develop software that are used in mobile robotics;<br>Design algorithmic approaches to path planning, navigation and obstacle avoidance. | CLO 4, CLO 5 | 4 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Michael Wooldridge (2009): “An Introduction to Multi-Agent Systems”, 2nd or later Edition. Wiley.
- Roland Siegwart, Illah Reza Nourbakhsh and Davide Scaramuzza (2011): “Introduction to Autonomous Mobile Robots”, 2nd or later Edition. MIT Press.
- Rafael H. Bordini, Jomi Fred Hubner and Michael Wooldridge (2007): “Programming Multi-agent Systems in AgentSpeak Using Jason”, 3rd edition. Wiley.
- Wei Lu (2016): “Beginning Robotics Programming in Java with Lego Mindstorms”.7th edition. APress / Springer.
- B. Siciliano and O. Khatib (2008): “The Springer Handbook of Robotics”, Springer.
- D. Floreano and C. Mattiussi (2008): “Bio-inspired artificial intelligence”, 4th edition. The MIT Press.
- D. K. Stoy Brandt and DJ Christensen (2010): “Self-reconfigurable robots: an introduction”, 6th edition. The MIT Press.
- S. Nolfi and D. Floreano (2004): “Evolutionary Robotics”, 1st edition. MIT Press.
- T. Samadand and J. Weyrauch (2000): “Automation, Control and Complexity –an integrated approach”, 2nd edition. John Wiley & Sons.
- M. Meystel and J. S. Albus (2002): “Intelligent Systems: architecture, design and control”, 4th edition. Wiley-Inter Science.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4225 Object Oriented Design Patterns** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | CSM 1221 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The objectives of this course are to provide the hands-on experience in the architecture and design of object-oriented software systems and a review of best practices for the communication of that design, to analyze unit testing and test driven design, and to use design tools for object orientated analysis and design and conversant with a number of common design patterns.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Develop a full command of the UML and object-oriented design.
*CLO 2:* Object abstraction: objects, classes, inheritance and composition.
*CLO 3:* Analyze unit testing and Test Driven Design.
*CLO 4:* Design and develop a non-trivial system using best practices in software design and development.
*CLO 5:* Understand the benefits of object-oriented analysis and design, concepts and processes.
*CLO 6:* Use design tools for object orientated analysis and design and conversant with a number of common design patterns.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | | | | | √ |
| *CLO 6* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction:** Team Selection, Whatever happened to Design. Different styles of software development: coding trading strategies to developing large systems. Zachman Architecture Framework: Perspectives & Convergence and Divergence<br>Introduction to UML, Requirements Analysis in the 21st Century, Use Cases and User Stories | CLO 1 | 4 |
| **Review of OO Fundamentals:** Abstraction, Inheritance, Composition, Classes and Objects<br>CRC Cards, Multimedia Data, Classification, UML Static Modeling, Test Driven Development | CLO 2 | 6 |
| **Sockets and RMI:** Distribution Sockets and RMI, Concurrency<br>Messaging, Architectural Issues & UML Dynamic Modeling | CLO 3 | 6 |
| **Multithread:** Multithreaded Development, Best Practices in Database Design, Refactoring Design | CLO 4, CLO 6 | 10 |
| **Patterns:** Behavioral, interpreter, iterator, chain of responsibility, mediator, template method, observer, visitor, memento, command, state, strategy. | CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Horton (1999): “Beginning Java 2”, 2nd edition. Wrox Press.
- Bruce Eckel (1998): “Thinking in Java”, 3rd edition or later. Prentice Hall.
- Harold (1999): “Java I/O”, 4ht edition. O'Reilly Media.
- Evans et. al. (2012): “The Well-Grounded Java Developer”, 5th edition. Manning.
- Alexandrescu (2001): “Modern C++ Design: Generic Programming and Design Patterns Applied”, 2nd edition. Addison-Wesley.
- Koenig and Moo (2000): “Accelerated C++”, 4th edition. Addison-Wesley.
- Stroustrup (2009): “Programming: Principles and Practice Using C++”, 6th edition. Addison-Wesley.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4226 Object Oriented Design Patterns** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | CSM 4225 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The objectives of this course are to provide hands-on experience in the architecture and design of object-oriented software systems and a review of best practices for the communication of that design, to implement standard design patterns and describe design patterns nomenclature and jargon, to choose optimal design pattern to solve a problem, to present software projects and clearly express their ideas and motivations, and to evaluate pattern and typical use-case implementations.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Organize team work and share duties efficiently.
*CLO 2:* Implement standard design patterns and describe design patterns nomenclature and jargon.
*CLO 3:* Choose optimal design pattern to solve a problem.
*CLO 4:* Present software projects and clearly express their ideas and motivations.
*CLO 5:* Evaluate pattern and typical use-case implementations.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Implementation of OOD and OOP.<br>Evaluation of OO with other design and programming paradigms. | CLO 1 | 2 |
| Implementation and evaluation of OOP classes and dynamic allocation, OOP object-oriented inheritance and dynamic binding, OOP generic programming features. | CLO 2 | 2 |
| Design and implement Adapter, Wrapper, Factory Method, Bridge, Strategy, EG Reactor, Active Object, Acceptor, Connector. | CLO 3 | 3 |
| Evaluation of OO frameworks and class libraries. Implementation and documentation of OO frameworks with design patterns. | CLO 4 | 3 |
| Case Studies: Developing OO Applications using Patterns and Frameworks: | CLO 5 | 3 |
| Implement and evaluate different Patterns including Creational (Builder, abstract factory, factory method, prototype, singleton), Structural (Adapter, decorator, façade, composite, bridge, Proxy, flyweight) and Behavioral (Interpreter, iterator, chain of responsibility, mediator, template method, observer, visitor, Memento, command, state, strategy). | CLO 2, CLO 3, CLO 5 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- Horton (1999): “Beginning Java 2”, 2nd edition. Wrox Press.
- Bruce Eckel (1998): “Thinking in Java”, 3rd edition or later. Prentice Hall.
- Harold (1999): “Java I/O”, 4ht edition. O'Reilly Media.
- Evans et. al. (2012): “The Well-Grounded Java Developer”, 5th edition. Manning.
- Alexandrescu (2001): “Modern C++ Design: Generic Programming and Design Patterns Applied”, 2nd edition. Addison-Wesley.
- Koenig and Moo (2000): “Accelerated C++”, 4th edition. Addison-Wesley.
- Stroustrup (2009): “Programming: Principles and Practice Using C++”, 6th edition. Addison-Wesley.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4228 Perl, BioPerl and CGI Programming** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | CSM 1221 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The major objectives of this course are to provide a brief introduction to the language for students who want to add Perl to their toolbox, to give students hands-on experience writing, debugging, and revising Perl programs, and to acquire the knowledge on BioPerl and its modules and understand the usage of BioPerl in Bioinformatics research.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Acquire practical knowledge on basics in perl and more on usage of scalar, arrays and hashes.
- *CLO 2:* Understand the role of subroutines, regular expressions concepts, control structures, file handling and file management in perl and its major role in Bioinformatics.
- *CLO 3:* Understand the importance of perl modules in the advance programming skills.
- *CLO 4:* Acquire practical knowledge on BioPerl and its modules and understand the usage of BioPerl in Bioinformatics research.
- *CLO 5:* Gain knowledge on common gateway interface (CGI) and methods.
- *CLO 6:* Acquire knowledge on CGI connecting HTML and web pages.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | | | | | √ |
| *CLO 6* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction to Perl:** Introduction; Scalar Data- Numbers, Strings, Scalar Variables, Output with print, Getting User Input, The chomp operator, undef Value, defined function, The if and while control structures, Lists and Arrays:- Accessing elements of an array, Subroutines. | CLO 1 | 2 |
| **Expressions:** Input and Output; Input from Standard Input, Input from the diamond operator, Invocation arguments, Output to Standard Output, File handles, Opening a File handle, Expressions:- Matches with m//, Option Modifiers, Anchors, The Binding operator, =~, Interpolating into Patterns, The match Variables, General Quantifiers. | CLO 2 | 2 |
| **Control Structures:** Control Structures; The unless Control Structure, The until Control Structure, Expression, Modifiers, The Naked Block Control Structure, The elsif Clause, Auto increment and Auto decrement, The for Control Structure, Loop Controls, Logical Operators. | CLO 2 | 4 |
| **Files:** File Tests; File Test Operators, The stat and lstat functions, The local time function, Bitwise Operators, Using the Special Underscore File handle, Strings and Sorting:- Finding a Substring with index, Manipulating a Substring with substr, Formatting Data with sprint, Advanced Sorting, Perl Modules:- Finding Modules, Installing Modules, Using Simple Modules. | CLO 2, CLO 3 | 4 |
| **Introduction to Bioperl and CGI:** Introduction to Bioperl, Installing Bioperl, General Bioperl Classes, Sequences (Bio::Seq Class, Sequence Manipulation), Features and Location Classes (Extracting CDS), Alignments (AlignIO), Analysis (Blast, Genscan). Application of BioPerl Module, uses of BioPerl Module in biological analysis. Perl CGI introduction and its methods. | CLO 4, CLO 5, CLO 6 | 4 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Martin C Brown (2001): “Perl: The Complete Reference”, 2nd edition. Tata McGraw Hill.
- Erick Storm (1998): “Perl CGI Programming”,7th edition. BPB Publication.
- Steven Holzner (2007): “Per: Black Book”, 2nd or later Edition. Dreamtech Publication.
- Ed Peschko and Michele Dewolf (2000): “Perl Developer’s Guide”, 2nd edition. Tata McGraw Hill.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4233 Cloud Computing** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

The main objective of this course is to introduce the students about the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges; the basic ideas and principles in data center design; cloud management techniques and cloud software deployment considerations; different CPU, memory and I/O virtualization techniques that serve in offering software, computation and storage services on the cloud; Software Defined Networks (SDN) and Software Defined Storage (SDS);cloud storage technologies and relevant distributed file systems, NoSQL databases and object storage; the variety of programming models and develop working experience in several of them.

**Course Learning Outcome (CLOs)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Explain the core concepts of the cloud computing paradigm
- *CLO 2:* Apply fundamental concepts in cloud infrastructures to understand the tradeoffs in power, efficiency and cost, and then study how to leverage and manage single and multiple datacenters to build and deploy cloud applications that are resilient, elastic and cost-efficient.
- *CLO 3:* Discuss system, network and storage virtualization and outline their role in enabling the cloud computing system model.
- *CLO 4:* Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS.
- *CLO 5:* Analyze various cloud programming models and apply them to solve problems on the cloud.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction:** Definition and evolution of Cloud Computing; Enabling Technologies, Service and Deployment Models; Popular Cloud Stacks and Use Cases; Benefits, Risks, and Challenges of Cloud Computing; Economic Models and SLAs; Topics in Cloud Security. | CLO 1 | 4 |
| **Cloud Infrastructure:** Historical Perspective of Data Centers; Datacenter Components: IT Equipment and Facilities; Design Considerations: Requirements, Power, Efficiency, & Redundancy; Power Calculations, PUE and Challenges in Cloud Data Centers; Cloud Management and Cloud Software Deployment Considerations. | CLO 2 | 6 |
| **Virtualization:** Virtualization (CPU, Memory, I/O); Case Study: Amazon EC2; Software Defined Networks (SDN); Software Defined Storage (SDS). | CLO 3 | 6 |
| **Cloud Storage:** Introduction to Storage Systems; Cloud Storage Concepts; Distributed File Systems (HDFS, Ceph FS); Cloud Databases (HBase, MongoDB, Cassandra, DynamoDB); Cloud Object Storage (Amazon S3, OpenStack Swift, Ceph). | CLO 4 | 10 |
| **Programming Models:** Distributed Programming for the Cloud; Data-Parallel Analytics with Hadoop MapReduce (YARN); Iterative Data-Parallel Analytics with Apache Spark; Graph-Parallel Analytics with GraphLab 2.0 (PowerGraph). | CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Nayan B. Ruparelia (2016): "Cloud Computing", 1st edition. The MIT Press.
- Ray J Rafaels (2015): "Cloud Computing: From Beginning to End", 2nd edition. CreateSpace Independent Publishing.
- Ikram Hawramani (2017): "Cloud Computing for Complete Beginners: Building and Scaling High-Performance Web Servers on the Amazon Cloud", 1st edition. Independently Published.
- Michael J. Kavis (2014): "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)", 2nd edition. Wiley.
- Arshdeep Bahga and Vijay Madisetti (2014): "Cloud Computing: A Hands-On Approach", 1st edition. Prentice Hall.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4234 Cloud Computing** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | CSM 4233 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The main objective of the course is to provide hands on experience on cloud computing to students. Stimulate interest of students in researching and learning new method, new tools, or new way of applying existing rules, in cloud computing.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

- *CLO 1:* Configure various virtualization tools such as Virtual Box, VMware workstation
- *CLO 2:* Design and deploy a web application in a PaaS environment.
- *CLO 3:* Learn how to simulate a cloud environment to implement new schedulers.
- *CLO 4:* Install and use a generic cloud environment that can be used as a private cloud.
- *CLO 5:* Manipulate large data sets in a parallel environment.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |
| *CLO 4* | √ | | | √ | | | | | | √ |
| *CLO 5* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8. | CLO 1 | 1 |
| Install a C compiler in the virtual machine created using virtual box and execute Simple Programs | CLO 2 | 1 |
| Install Google App Engine. Create hello world app and other simple web applications using python/java. | CLO 3 | 1 |
| Use GAE launcher to launch the web applications. | CLO 4 | 3 |
| Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim. | CLO 4 | 2 |
| Find a procedure to transfer the files from one virtual machine to another virtual machine. | CLO 4 | 2 |
| Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version). | CLO 5 | 3 |
| Install Hadoop single node cluster and run simple applications like wordcount. | CLO 5 | 3 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Nayan B. Ruparelia (2016): "Cloud Computing", 1st edition. The MIT Press.
- Ray J Rafaels (2015): "Cloud Computing: From Beginning to End", 2nd edition. CreateSpace Independent Publishing.
- Ikram Hawramani (2017): "Cloud Computing for Complete Beginners: Building and Scaling High-Performance Web Servers on the Amazon Cloud", 1st edition. Independently Published.
- Michael J. Kavis (2014): "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)", 2nd edition. Wiley.
- Arshdeep Bahga and Vijay Madisetti (2014): "Cloud Computing: A Hands-On Approach", 1st edition. Prentice Hall.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4235 Cyber Law and Information Security** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**

This course is designed to provide fundamental skills needed to understand cyber law and information security concepts such as trademark, copyright, patents, digital rights, computer crimes, privacy issues, hacking and prosecution, intellectual property laws etc. Given the rapid changes in technology, and the corresponding changes in crime and the law, the course will regularly include discussions of current events.

**Course Learning Outcome (CLOs)**

Upon completion of this course, the student will be able to:

- *CLO 1:* Describe laws governing cyberspace and analyze the role of Internet Governance in framing policies for Internet security.
- *CLO 2:* Discuss different types of cybercrimes and analyze legal frameworks of different countries to deal with these cybercrimes.
- *CLO 3:* Explain the importance of jurisdictional boundaries and identify the measures to overcome cross jurisdictional cybercrimes.
- *CLO 4:* Illustrate the importance of ethics in legal profession and determine the appropriate ethical and legal behavior according to legal frameworks.
- *CLO 5:* Create information security policy to comply with laws governing privacy and develop the policies to ensure secure communication.
- *CLO 6:* Recognize the importance of digital evidence in prosecution and compare laws of different countries that govern Standard Operating Procedures (SOP) for handling evidence.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | | | | | | | | √ | √ | |
| *CLO 2* | | | | | | | | √ | √ | |
| *CLO 3* | | | | | | | | √ | √ | |
| *CLO 4* | | | | | | | | √ | √ | |
| *CLO 5* | | | | | | | | √ | √ | |
| *CLO 6* | | | | | | | | √ | √ | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Cyber Law: Definition, nature, scope, utility; Origin and development of Cyber Law and Internet. ICT Policy in Bangladesh | CLO 1 | 4 |
| The Evidence Act of 1872 Vs. ICT Act -2006, Electronic Evidence in Bangladesh; Legal Effects of Electronic Evidence. UNCITRAL Model Law on Electronic Evidence. | CLO 2, CLO 5, CLO 6 | 6 |
| Cyber Crime: Jurisdiction and Cyber Crime, Criminal Justice In Bangladesh and Implication on Cyber Crime: Cyber vandalism, Hacking, Malicious Spreading in Viruses, Password fraud, Cheating, Cyber Pornography, Child Pornography. | CLO 2, CLO 3, CLO 5 | 6 |
| Privacy: Invasion of Privacy, Constitutional Basis of Privacy, Security, Search and Seizure. E-mail: Unsolicited E-mail, Defamation, Harassment and E-mail abuse, Present Legal Protection. | CLO 5 | 6 |
| Human Rights Violation and Internet; The Information & Communication Technology Act, 2006: Objectives, Strengths & Weaknesses of the ICT Law. | CLO 4 | 6 |
| Regulation of Cryptography; International Cyber Law- India, Sri Lanka, Japan, Malaysia, Australia and the USA. International Conventions on Cyber Laws & Crime. | CLO 2, CLO 6 | 4 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- Ahmed Ehsanul Kabir and Shuvra Chowdhury (2017), "Media and Cyber Laws in Bangladesh", 1st edition. Sufi Prokashoni.
- Brian Craig (2012), "Cyberlaw: The Law of the Internet and Information Technology", 2nd edition. Pearson Education.
- Patricia Bellia and Paul Berman (2010), "Cyberlaw: Problems of Policy and Jurisprudence in the Information Age", 4th or later Edition, American Casebook Series.
- Gerald R. Ferrera and Margo E. K. Reder (2011), "CyberLaw: Text and Cases", 2nd edition. South-Western Cengage Learning.
- Jeffrey A. Helewitz (2003), "Cyberlaw: Legal Principles of Emerging Technologies", 3rd edition. Pearson/Prentice Hall.
- Richard E. Smith (2015): "Elementary Information Security", 2nd edition. Jones & Bartlett Learning.
- Mark Stamp (2011): "Information Security: Principles and Practice", 2nd edition. Wiley.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4237 Pattern Recognition** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | Nil |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The objective of this course is to introduce students to the fundamental models of decision making in order to prepare them for applying the associated concepts to information processing.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Understand the principles of pattern recognition techniques.
*CLO 2:* Solve real-world problems using pattern recognition techniques.
*CLO 3:* Evaluate pattern recognition techniques.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Pattern Recognition: introduction, importance; Statistical and Neural Pattern Recognition: Bayesian classifier, Bayes decision theory, discriminant functions and decision surfaces; Bayesian classifier for normal distributions; | CLO 1 | 4 |
| Linear classifiers: discriminant functions and decision hyperplanes, Perceptron algorithm and its variants, Kessler's construction; | CLO 1, CLO 2 | 4 |
| Nonlinear classifiers: two and three layer perceptrons, backpropagation algorithm and its variants; | CLO 1, CLO 2 | 4 |
| Template matching: optimal path searching techniques, dynamic programming methods, correlation based matching and 2D log search algorithm for image matching; | CLO 2, CLO 3 | 4 |
| Context dependent classification: Viterbi algorithm, channel equalization, observable and hidden Markov models, three problems of HMM and their application in speech recognition; | CLO 1, CLO 3 | 6 |
| Syntactic Pattern Recognition: introduction to Syntactic Pattern Recognition, grammar-based approach, parsing, graph-based approach; | CLO 2, CLO 3 | 5 |
| Unsupervised classification: basic concepts of clustering, proximity measures, categories of clustering algorithms, sequential clustering algorithms. | CLO 2, CLO 3 | 5 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- C H Chen (2016): "Handbook of Pattern Recognition and Computer Vision", 5th edition. World Scientific.
- Richard Duda, Peter Hart and David Stork (2000): "Pattern Classification", 2nd edition. John Wiley & Sons.
- K. Fukunaga (1990): "Introduction to Statistical Pattern Recognition", 2nd edition. Academic Press.
- Sergios Theodoridis and Konstantinos Koutroumbas (2006): "Pattern Recognition", 3rd edition. Academic Press.

**Department of Computer Science & Mathematics**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **CSM 4238 Pattern Recognition** |
| Level & Semester | L-4, S-2 (July-December) |
| Pre-requisite course | CSM 4237 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
The objective of this course is to introduce students to the fundamental models of decision making in order to prepare them for applying the associated concepts to information processing.

**Course Learning Outcome (CLOs)**
Upon completion of this course, the student will be able to:

*CLO 1:* Understand the principles of pattern recognition techniques.
*CLO 2:* Solve real-world problems using pattern recognition techniques.
*CLO 3:* Evaluate pattern recognition techniques.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | √ | | | | | | √ |
| *CLO 2* | √ | | | √ | | | | | | √ |
| *CLO 3* | √ | | | √ | | | | | | √ |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Data sets for pattern recognition.<br>Representations of Patterns and Classes. | CLO 1 | 4 |
| Classification of patterns using two and three layer perceptrons, backpropagation algorithm and its variants, and Kessler's construction. | CLO 1,<br>CLO 2 | 4 |
| Implement and evaluate optimal path searching techniques, dynamic programming methods, correlation based matching and 2D log search algorithm for image matching, Context dependent classification such as Viterbi algorithm, channel equalization, observable and hidden Markov models, three problems of HMM and their application in speech recognition, grammar-based approach, parsing, graph-based approach and sequential clustering algorithms | CLO 2,<br>CLO 3 | 8 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**


- C H Chen (2016): "Handbook of Pattern Recognition and Computer Vision", 5th edition. World Scientific.
- Richard Duda, Peter Hart and David Stork (2000): "Pattern Classification", 2nd edition. John Wiley & Sons.
- K. Fukunaga (1990): "Introduction to Statistical Pattern Recognition", 2nd edition. Academic Press.
- Sergios Theodoridis and Konstantinos Koutroumbas (2006): "Pattern Recognition", 3rd edition. Academic Press.

**Department of Farm Power and Machinery**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FPM 4261 Machine Vision** |
| Level & Semester | Level-4, Semester-2 (July-December) |
| Pre-requisite course | CSM 1123 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 02 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
Enabling the student with basic knowledge and skills on illumination, hardware of image acquisition system, image processing and feature extraction, and special image systems.

**Course Learning Outcomes (CLOs)**
Upon completion of this course, students will be able to:

CLO1: Identify basic concepts, terminology, theories, models and methods in the field of machine vision.
CLO2: Describe known principles of human visual system and illumination.
CLO3: Acquire fundamental knowledge of hardware of image processing systems and spatial image systems.
CLO4: Describe various methods of image processing and feature extraction.
CLO5: Develop a computer vision system for a specific problem.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | |
| *CLO 2* | √ | | | | | | | | | |
| *CLO 3* | √ | | | | | | | | | |
| *CLO 4* | √ | | | √ | | | | | | |
| *CLO 5* | √ | | | | | √ | | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| **Introduction:** What is machine vision? Machine vision and human vision, Optical properties of biological materials, Applications of machine vision systems in Bioinformatics field. | CLO 1 | 4 |
| **Illumination:** Fundamentals of illumination, Features on non-visible light, Light sources, Lighting techniques. | CLO 2 | 8 |
| **Hardware of image acquisition system:** Lens, Image sensors. | CLO 3, CLO 5 | 4 |
| **Image processing and feature extraction:** Color conversion, Image processing methods, Image feature extraction: Size, Volume, Shape, Textural features. | CLO 4, CLO 5 | 8 |
| **Special image systems:** Hyperspectral imaging, Multispectral Imaging, X-ray Imaging, Ultra violet Imaging, Fluorescence Imaging, Infrared Imaging, Terahertz Imaging. | CLO 4, CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- E. R. Davies, P. G. Farrell and J. R. Forrest (2014): "Machine Vision: Theory, Algorithms, and Practicalities", 1st edition or later. Academic Press.
- Rafael C. Gonzalez and Richard E. Woods (2017): "Digital Image Processing", 4th edition or later. Pearson.
- Ian T. Young, Jan J. Gerbrands, and Lucas J. van Vliet (1995): "Fundamentals of Image Processing", 1st edition or later. Delft University of Technology.

**Department of Farm Power and Machinery**
Bangladesh Agricultural University, Mymensingh
**Course Profile**

| | |
|---|---|
| Course No. & Title | **FPM 4262 Machine Vision** |
| Level & Semester | Level-4, Semester-2 (July-December) |
| Pre-requisite course | FPM 4261 |
| Student | Elective for B.Sc. in Bioinformatics Engineering |
| Number of Credit | 01 |
| Contact hours | 02 hours per week, 16 weeks |
| Total Mark | 100 |

**Rationale**
Enabling the student with hands-on experience and skills on illumination, hardware of image acquisition system, image processing and feature extraction, and special image systems.

**Course Learning Outcomes (CLOs)**
Upon completion of this course, students will be able to:

CLO1: Gain hands-on experience about the terminology, theories, models and methods in the field of machine vision.
CLO2: Implement known principles of human visual system and illumination.
CLO3: Acquire practical knowledge of hardware of image processing systems and spatial image systems.
CLO4: Evaluate various methods of image processing and feature extraction.
CLO5: Create computer vision-based systems for solving real world problems.

**Mapping CLO with PLO**

| PLO / CLO | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *CLO 1* | √ | | | | | | | | | |
| *CLO 2* | √ | | | | | | | | | |
| *CLO 3* | √ | | | | | | | | | |
| *CLO 4* | √ | | | √ | | | | | | |
| *CLO 5* | √ | | | | | √ | | | | |

**Summary of course content**

| Course Content | Aligned CLO | No. of Lectures |
|---|---|---|
| Implement and evaluate different machine vision and human vision systems | CLO 1 | 4 |
| Implement and evaluate different light sources and Lighting techniques. | CLO 2 | 8 |
| Design and develop image acquisition system using lens and image sensors. | CLO 3, CLO 5 | 4 |
| Application of image processing and feature extraction techniques | CLO 4, CLO 5 | 8 |
| Design and develop special image processing systems using Hyperspectral imaging, Multispectral Imaging, X-ray Imaging, Ultra violet Imaging, Fluorescence Imaging, Infrared Imaging, and Terahertz Imaging. | CLO 4, CLO 5 | 6 |

**Teaching Strategy**
Lectures and discussion, Demonstration by video, Self-study, Case Studies, Practice, and Group Studies

**Assessment Strategy**
Question & answer (QA), Assignment, Quiz, and Observation

**Recommended Books**

- E. R. Davies, P. G. Farrell and J. R. Forrest (2014): "Machine Vision: Theory, Algorithms, and Practicalities", 1st edition or later. Academic Press.
- Rafael C. Gonzalez and Richard E. Woods (2017): "Digital Image Processing", 4th edition or later. Pearson.
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