PONDICHERRY UNIVERSITY
(A CENTRAL UNIVERSITY)
SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE

REGULATIONS, CURRICULUM & SYLLABUS
(For Affiliated Colleges)

B.Sc. (Honors) DEGREE PROGRAMME

B.Sc. Cyber and Digital Sciences
(Honors with Research)

B.Sc. Cyber and Digital Sciences
(Honors)

(Under the National Education Policy 2020)
Effective from the Academic Year (2023 - 2024)

November 2023

Contents

1. PREAMBLE

B.Sc. Cyber & Digital Science is an exceptional undergraduate degree program that caters to the ever-increasing demand for cybersecurity experts in today's digital era. This specialized course aims to provide students with a comprehensive understanding of the complex world of Cybersecurity and its application in safeguarding digital assets and information systems. As technology continues to advance, the demand for Cybersecurity professionals is soaring, making this degree program an attractive choice for individuals passionate about combating cyber threats and making a meaningful impact in the digital age. The course highlights a well-structured curriculum designed to equip students with in-depth knowledge and practical skills to address the complex challenges of Cybersecurity and digital technologies. The main objectives of the course are to:

- Develop technical proficiency in Cybersecurity, covering areas such as Network Essentials, Open Source Intelligence, Network Traffic Analysis, Ethical Hacking, Fundamentals of Cryptography, Cyber Law, and more.
- Nurture critical thinking, problem-solving, and innovation to empower the graduates to adapt and thrive in the ever-changing Cybersecurity industry.
- Introduce students to the niche areas of Cybersecurity and keep them abreast of the developments in the Cybersecurity industry.
- Prepare students for successful careers in Cybersecurity by offering practical hands-on experiences and opportunities for professional growth.
- Cultivate an interest for lifelong learning to ensure that our graduates remain at the forefront of technological advancements throughout their careers.
- Enable holistic, multidisciplinary, and skill-oriented knowledge development in the students.

2. PROGRAMME OUTCOMES:

Upon completion of the programme the following aspects would be inculcated in the students in the field of Cyber and Digital Sciences:

1. **Engineering knowledge:** Apply the knowledge of mathematics, computer science, engineering fundamentals and be able to develop cyber security solution for protecting organizations.
2. **Problem analysis:** Identify cybersecurity related vulnerabilities, threats , attacks and provide suitable counter measures.
3. **Design and development of solutions:** Design efficient solutions for handling cybersecurity attacks.

4. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern cybersecurity tools for handling cyberattacks.
5. **Create New Solutions:** Using the discipline knowledge, problem-solving, solution designing and tools usage skill set to create novel and innovative Cyber and Digital Systems.
6. **Communication**: Develop effective communication skills, both in oral and written forms, to facilitate clear and concise interaction.
7. **Holistic, multidisciplinary, and skill-oriented knowledge development** : enable students to obtain knowledge and skills in a multidisciplinary flavor constituting for holistic development.
8. **Ethics on Profession, Environment, and Society**: Exhibit professional ethics to maintain integrity in a working environment and demonstrate concern for societal impacts resulting from IT-based solutions for problems.
9. **Commitment to Lifelong Learning**: Cultivate the ability to become an independent learner and nurture a "Learn-Unlearn-Relearn" mindset to adapt with the evolving technologies and methodologies.
10. **Motivation for Higher Studies**: Develop inspiration and motivation to pursue higher education in the field of Information Technology, advancing knowledge and expertise.

Upon completing the programme, student can expect a plethora of promising career prospects and job opportunities in the cybersecurity domain. The cybersecurity industry is witnessing rapid growth and offers diverse roles across various sectors, making it an attractive field for aspiring professionals. Some of the prominent career paths and job opportunities for B. Sc. Cyber and Digital Science graduates include:

- Cybersecurity Analyst
- Information Security Officer
- Network Security Engineer
- Ethical Hacker
- Digital Forensics Analyst
- Cybersecurity Consultant
- Cloud Security Specialist
- Etc.

3. DEFINITIONS

Terms used in the NEP Regulations shall have the meaning assigned to them as given below unless the context otherwise requires:

A. Credit: A credit is the number of hours of instruction required per week for the given subject in a given semester of 16-18 weeks. One credit is equivalent to 15 hours of teaching (lecture or tutorial) or 30 hours of practice or field work or community engagement and service per Semester.

B. Academic Year: Means the year starting on 1st day of July and ends on the 30th day of June succeeding year.

C. Residence time: Means the time a student spends for attending classes in the College/Institution (either Online/Offline) as a full-time student and enrolled in any Academic programme of the Institution.

D. **Semester:** Means 18 weeks (90 Working days) of teaching-learning session of which two weeks shall be set apart for examinations and evaluation.

E. Grade: Means a letter grade assigned to a student in a course for his/her performance at academic sessions as denoted in symbols of: O(Outstanding), A+(Excellent), A(Very good), B+(Good), B(Above average), C(Average), P(Pass), F(Fail) and Ab(Absent) with a numeric value of O=10, A+=9, A=8, B+=7, B=6, C=5, P=4, and F=0, Ab=0.

F. Grade Point Average (GPA): Means an average of the Grades secured by a student in all courses in a given academic session duly weighted by the number of credits associated to each of the courses.

G. Cumulative GPA (CGPA): Means the weighted average of all courses the student has taken in the entire programme of study.

H. Common courses: Means the set of courses that all students who are admitted are required to study; these courses include, Languages (English- Modern Indian languages), NEP specific courses viz. Understanding India, Environmental sciences/Education, Health and wellbeing/Yoga, and Digital & Technological solutions.

I. Major Discipline Courses: Means the core subjects mandatory for the Computer Science discipline. These courses are common across all specializations of Computer Science.

J. Minor Discipline Courses: Means allied/elective/specialization specific subjects of Computer Science discipline. Based on the set of Minor Discipline Courses the candidate study, specialization

in Computer Science will be awarded. Eg: B.Sc. (Computer Science) with minor discipline courses in Artificial Intelligence and Machine Learning will be awarded B.Sc. Computer Science with Specialization in AI&ML.

K. Credit Requirements: For a Degree/Diploma/Certificate Programme means the minimum number of credits that a student shall accumulate to achieve the status of being qualified to receive the said Degree, Diploma/Certificate as the case may be.

L. Exit option: Means the option exercised by the student, to leave the Programme at the end of any given Academic year.

M: Lateral entry: Means a student being admitted into an ongoing Programme of the University otherwise than in the 1st year of the programme.

N: Vocational Studies/Education: Means set of activities for participation in an approved project or practical or lab, practices of application of scientific theories, studio activities involving students in creative artistic activities, workshop-based activities, field-based shop-floor learning, and Community engagement services, etc. **(These courses are expected to enable students to incorporate the learned skills in daily life and start up entrepreneurship.)**

O: Skill-based learning/project: Means activities designed to understand the different socio-economic contexts, first-hand understanding of the policies, regulations, organizational structures, processes, and programmes that guide the development process.

P: Work-based internship: Means structured internships with Software Companies, Research and Higher Educational Institution Laboratories, Corporate offices, etc. which will further improve employability.

4. AWARD OF UG DEGREE/DIPLOMA/CERTIFICATE

Four years B.Sc. Degree Programme shall have options for earning a Certificate / Diploma / UG Degree / UG Degree with Honors based on the exit option exercised by the candidates.

4.1 Degree and Nomenclature:

Candidates who complete Eight semesters and earn a minimum of 160 credits will be awarded either of the following degrees after successful completion of the other requirements.

- B.Sc. Cyber and Digital Sciences (Honors with Research) *
- B.Sc. Cyber and Digital Sciences (Honors) **

* for candidates who complete a research project work in the Eighth Semester

** for candidates who complete 3 theory courses (MJD 21, MJD 22, and MJD 23) instead of the research project work in the Eighth Semester

4.2 Degree with Specialization:

Out of the above said 160 credits the candidates shall earn 111 credits from the Hardcore courses and the remaining 49 credits shall be earned from the subjects they choose to study from the list of softcore courses. These 49 credits are assigned across 13 courses as listed below:

Courses	Credits per course	Total Credits
MID 1 to MID 8	4	8 x 4 = 32 Credits
MJD 19 & MJD 20	4	2 x 4 = 08 Credits
SEC 1, SEC 2 & SEC 3	3	3 x 3 = 09 Credits
	Total Credits	**49 Credits**

The 13 courses under the above said categories are chosen from the specialization of Cyber and Digital Sciences.

4.2.1 Exit Options

Candidates can exercise the following exit options and obtain the said certificate or diploma or degree, if the minimum required credits are earned and other conditions are met.

Exit after 2nd Semester: Certificate in Cybersecurity Fundamentals will be awarded for candidates who exit the course at the end of 2nd semester and earned a minimum of 40 credits and have completed a Summer Internship of 4 credits for 4 - 6 weeks duration, during the summer vacation post 2nd semester.

Exit after 4th Semester: Diploma in Cyber and Digital Sciences will be awarded for candidates who exit the course at the end of 4th semester and earned a minimum of 80 credits and have completed a Summer Internship of 4 credits for 4 – 6 weeks duration, during the summer vacation post 4th semester.

Exit after 6th Semester: UG Degree in Cyber and Digital Sciences (B.Sc. (CDS)) will be awarded for candidates who exit the course at the end of 6th semester and earned a minimum of 120 credits and have completed a Summer Internship of 4 - 6 weeks duration, during the summer vacation post 4th semester.

Exit after	Credits and other requirements	Awards
2nd Semester	Min: 40 Credits, Internship 4-6 weeks	Certificate in Cybersecurity Fundamentals
4th Semester	Min: 80 Credits, Internship 4-6weeks	Diploma in Cyber and Digital Sciences
6th Semester	Min: 120 Credits, Internship 4-6 weeks	B.Sc. Cyber and Digital Sciences

5. PEDAGOGICAL APPROACHES

COURSE TYPES	APPROACH
a) Lecture Courses	Regular classroom lectures by qualified / experienced Expert Teachers • These Lectures may also include classroom discussion, demonstrations, case analysis • Use of Models, Audio-Visual contents, Documentaries, PPTs may supplement.
b) Tutorial Courses	Problem solving Exercise classes guided discussion, supplementary readings vocational training, etc.
c) Practical / Lab work	Practical Lab activity with Theoretical support Mini projects, Activity based engagement, Program executions, Data processing and presentation exercise.
d) Seminar Course	A course requiring student to design and participate in discussions, Group Discussions, Elocution and Debate, Oral Communication Paper presentations, Poster Presentation, Role play participation, Quiz competitions, Business plan preparation/presentation, etc.
e) Internship course	Courses requiring students to *Learn by Doing* in the workplace external to the educational Institutions. Internships involve working in Software Companies, Research and Higher Educational Institution Laboratories, Corporate Offices, etc. All Internships should be properly guided and inducted for focused learning.

f) Research Project	Students need to study and analyze the recent research publications from indexed/peer reviewed journals in their area of specialization. Outcome of the study and analysis need to be presented as a thesis or research report with necessary experimental results.

6. ACADEMIC AUDIT OF COURSES

Internal Quality Assurance Cell (IQAC) at every is expected to supervise the implementation of NEP Regulations in these programmes. Availability of required number of Classrooms, Faculty rooms, Labs, Library facilities, Computer Centre and recruitment of Faculty members, allocation of funds for running the Science Labs/Computer Centre etc., is the responsibility of Principal / College Administration.

7. ADMISSIONS & LATERAL ENTRY

7.1 Admissions Eligibility:

For Affiliated Colleges: The candidates for admission to this programme shall be required to have passed 10+2 / 10+3 system of examinations or equivalent with mathematics / business mathematics / equivalent as one of the subjects of study.

Students shall be admitted to this programme based on admissions criteria fixed by the University / Government of Puducherry from time to time.

7.2 Lateral Entry:

As per NEP, students have a choice of exit and entry into the programme multiple number of times. UGC specifies that about 10% of seats over and above the sanctioned strength shall be allocated to accommodate the Lateral Entry students.

Candidates seeking entry at the second, third and fourth year, should meet the necessary eligibility criteria with respect to the certificate / diploma / degree they possess, with necessary minimum credits banked in the Academic Bank of Credits (ABC). Such students who get admitted in later years, other than first year will be guided by the following clauses:

- that the University shall notify the admission process and number of vacancies open for lateral entry.
- that the Lateral entrants shall be admitted only after such transparent screening process and such procedure that the University may prescribe from time to time. University may prescribe different methods of screening for different programmes depending on the circumstances prevailing in each case.

- Lateral entry shall be permissible only in the beginning of years 2, 3, 4 of the Under Graduate / Honors programme; provided that the students seeking lateral entry shall have obtained the minimum pass marks / grades fixed by the University in their previous academic years.

8. EVALUATION (INTERNAL & END SEMESTER ASSESSMENT) AND GRADES

All Credit courses are evaluated for 100 marks. Internal Assessment component is for 25 marks and the End Semester University exam is for 75 marks for theory courses. In case of practical courses, research project work etc., Internal Assessment component is for 50 marks and the End Semester University exam is for 50 marks.

Internal Test Scheme: Principal of the College schedules the Mid-Semester Exam for all courses during 8/9th week of start of classes. Mid-Semester exam for 90 minutes' duration need to be conducted for all these theory courses. The evaluated marks need to be uploaded to Controller of Examinations of University. The answer books of Mid-Semester exams need to be preserved until the declaration of results by the University.

8.1 INTERNAL ASSESSMENTS (for Courses up to 6th Semester)

8.1.1 Internal Assessment Marks for Theory subjects

Total Internal Assessment mark for a theory subject is 25 marks. The breakup is as follows:

Evaluation Component	Marks
A. Mid Semester Exam (one)	20
B. Percentage of Attendance	05
Total	**25**

8.1.2 Internal Assessment marks for Practical / Internships subjects

Faculty member in-charge of Lab practical shall evaluate the practical subjects for 50 marks. The breakup is as follows:

Evaluation Component	Marks
A. Mid-Semester Practical Exam (one) / Viva-voce	20
B. Practical Record / Internship Report	25
C. Percentage of Attendance	05
Total	**50**

8.1.3 Internal Assessment marks for Research Project Work

There shall be a faculty member assigned as a Project Guide for each candidate doing the Research Project. Progress of the candidate can be assessed once in a month in a project review meeting. Three project review meetings shall be conducted for Internal Assessment.

Project review committee may be constituted and the committee shall organize project review meetings and evaluate the progress and to award the Internal Assessment marks. Internal Assessment component for the Research Project is 50 Marks. The breakup is as follows:

Evaluation Component	Marks
A. Monthly Review (3 Reviews – 10 Marks each)	30
B. Project Report	10
C. Project Presentation and viva-voce	10
Total	**50**

8.1.4 Internal Assessment marks for Theory Subjects with Practical Components

Faculty member in-charge of Theory Subjects with Practical Component shall evaluate the candidates both for their performance in theory and practical. Internal Assessment marks for Theory Subjects with Practical Components is 25 marks. The break up is as follows:

Evaluation Component	Marks
A. Mid Semester Exam (one)	15
B. Observation Note / Practical Record	05
C. Percentage of Attendance	05
Total	**25**

8.1.5 Marks for Attendance is as follows

Attendance %	Marks
Below 75%	0
75% - 80%	1
80% - 85%	2
85% - 90%	3
90% - 95%	4
95% - 100%	5

8.2 END SEMESTER ASSESSMENT [ESA] (for Courses upto 6th Semester)

Controller of Examinations (COE) of Pondicherry University schedules the End-Semester exams for all theory and practical subjects based on university calendar. For Theory courses with Practical components, End semester exams shall be conducted separately for Theory and Practical.

A detailed Exam Time Table shall be circulated at least 15 days before the start of exams, mostly during 15/16th week of the Semester. Question Papers shall be set externally based on BoS approved syllabus. All students who have a minimum of 70% attendance are eligible to attend the end-semester exams. Attendance percentage shall be calculated for each course to decide the eligibility of the candidate for writing the end-semester examination.

8.2.1 Breakup of End Semester Marks

8.2.1 Breakup of End Semester Marks

(All End Semester Exams shall be conducted by the Pondicherry University)

The question paper shall be set as per the Bloom's Taxonomy. Various levels along with it's description and sample questions are as follows:

Knowledge: Recall or remember previously learned information.
Example: List the basic data types in Python

Comprehension: Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating the main ideas.
Example: Explain how a stack data structure works.

Application: Apply knowledge and concepts to solve problems in new situations. Use learned information in a different context.
Example: Write a Python program to solve the deadlock problem.

Analysis: Break down information into parts and examine the relationships between the parts. Identify motives or causes.
Example: Analyse the efficiency of two sorting algorithms and compare their advantages and disadvantages.

Synthesis: Create a new whole by combining elements in novel ways. Use creativity to produce something original.

Example: Design a web application that can generate a time table of a school.

Distribution of questions at various levels are as indicated.

Course Components	Max. Marks	End-Sem Exam Duration
A. Theory subjects: Sec A: 10 Questions of 2 Marks each (20 Marks) *(Knowledge : 3, Comprehension : 2, Application : 3, Analysis:2)* Sec B: 5 out of 7 Questions of 5 Marks each (25 Marks) *(Knowledge : 1, Comprehension : 2, Application : 1, Analysis:3)* Sec C: 2 Either/OR choice questions of 15 Marks each (30 Marks) *(Application : 1, Analysis:1)* **Questions from all units of Syllabus equally distributed.**	75 Marks	3 Hours
B. Skill Enhancement/ Practical/Internship/Project Work subjects: **Skill Enhancement / Practical Subjects:** Based on Practical Exams conducted by CoE of University **Internship / Research Project Work:** Presentation of the work / Report / Viva-voce examinations	50 Marks	3 Hours --
C. Theory Subjects with Practical Components: **i. Theory Component:** Sec A: 5 Questions of 2 Marks each (10 Marks) *(Knowledge : 3, Comprehension : 2, Application : 3, Analysis:2)* Sec B: 5 out of 7 Questions of 4 Marks each (20 Marks) *(Comprehension : 2, Application : 3, Analysis:2)* Sec C: 2 Either or type questions of 10 Marks each (20 Marks) *(Analysis / Synthesis)*	50 Marks	3 Hours

Questions from all units of Syllabus equally distributed. **ii. Practical Component:** Based on Practical Exams / Presentation / Viva-voce with external examiner appointed by the University Controller of Examinations, and schedules exclusively prepared for such practical examinations by the University Examination Section. **The examination shall be conducted for 50 Marks and reduced to 25 Marks.** **Total Marks: 75 (Theory: 50 Marks + Practical: 25 Marks)**	25 Marks	3 Hours

8.3 CONSOLIDATION OF MARKS AND PASSING MINIMUM

Controller of Examinations of the University consolidates the Internal Assessment marks uploaded by the Colleges and marks secured by students in End-Semester examinations. The total marks will be converted into letter grades. The passing minimum is 40% marks (Internal Assessment + End Semester Assessment put together) and students who secure between 40% and 49% will be awarded 'P' (Pass Grade).

8.3.1 Arrear Exam

A student who secures less than 40% marks in aggregate is declared as ***Fail*** and that student is eligible to take up supplementary examination by registering to the failed course in the following Semester. All other candidates who failed due to shortage of attendance and those who are seeking to improve the grade shall repeat the course.

8.3.2 Letter Grades and Calculation of CGPA

Total marks secured by a student in each subject shall be converted into a letter grade. UGC Framework has suggested a Country wide uniform letter grades for all UG courses. The following table shows the seven letter grades and corresponding meaning and the grade points for calculation of CGPA.

Equivalent Letter Grade	Meaning	Grade Points for Calculation of CGPA
O	Outstanding	10
A+	Excellent	9
A	Very Good	8
B+	Good	7
B	Above Average	6
C	Average	5
P	Pass	4
F	Fail	0
Ab	Absent	0

In order to work out the above letter grades, the marks secured by a student (Total of Internal Assessment and End Semester Assessment) would be categorized for relative grading.

The range of marks for each grade would be worked as follows:

- Highest marks in the given subject: X
- Cut of marks for grading purpose: 50 marks
- Passing minimum: 40
- Number of grades (except P - Pass) (O, A+, A, B+, B, C): G = 6
- Range of marks: K = (X - 50) / G

(i) If $K \geq 5$, then the grades shall be awarded as given in the following table .

Range of Marks in %	Letter Grade Points for	Grade Points for
X to (X-K) + 1	O	10
(X-K) to (X-2K) + 1	A+	9
(X-2K) to (X-3K) + 1	A	8
(X-3K) to (X-4K) + 1	B+	7
(X-4K) to (X-5K) + 1	B	6
(X-5K) to 50	C	5
40 – 49	P	4
Below 40	F	0
Absent (Lack of Attendance)	Ab	0

(ii) If $K< 5$, then the grades shall be awarded as given in the following table.

Range of Marks in %	Letter Grade Points for	Grade Points for

80-100	O	10
71-79	A+	9
66-70	A	8
61-65	B+	7
56-60	B	6
50-55	C	5
40-49	P	4
Below 40	F	0
Absent (lack of attendance)	Ab	0

8.3.3 Calculation of Semester Grade Point Average and Cumulative Grade Point Average

Semester Grade Point Average (SGPA) is calculated by taking a weighted average of all grade points secured by a candidate from all subjects registered by him/her in the given Semester. The weights being the number of credits that each subject carries.

Cumulative Grade Point Average (CGPA) shall be calculated as the weighted average of credits that course carries and the value of Grade points averaged for all subjects.

8.3.4 Computation of SGPA and CGPA

The following procedure shall be followed to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):
The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student to the sum of the number of credits of all the courses undergone by a student, i.e. SGPA $(S_i) = \Sigma(C_i \times G_i) / \Sigma C_i$

where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

(i) Example for Computation of SGPA where candidate has not failed in any course

Semester	Course	Credit	Letter Grade	Grade point	Credit Point (Credit x Grade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	B	6	3 X 6 = 18
I	Course 4	3	O	10	3 X 10 = 30
I	Course 5	3	C	5	3 X 5 = 15

I	Course 6	4	B	6	4 X 6 = 24
		20			139
				SGPA	**139/20=6.95**

(ii) Example for Computation of SGPA where candidate has failed in one course

Semester	**Course**	**Credit**	**Letter Grade**	**Grade point**	**Credit Point** (Credit x Grade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	B	6	3 X 6 = 18
I	Course 4	3	O	10	3 X 10 = 30
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	F	0	4 X 0 = 00
		20			115
				SGPA	**115/20=5.75**

(iii) Example for Computation of SGPA where candidate has failed in two courses

Semester	**Course**	**Credit**	**Letter Grade**	**Grade point**	**Credit Point** (Credit x Grade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	F	0	3 X 0 = 00
I	Course 4	3	B	6	3 X 6 = 18
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	F	0	4 X 0 = 00
		20			85
				SGPA	**85/20=4.25**

The CGPA shall also be calculated in similar way as shown in examples (i), (ii) and (iii) of SGPA for all subjects taken by the students in all the semesters. However, if any student fails more than once in the same subject, then while calculating CGPA, the credit and grade point related to the subject in which the student fails in multiple attempts will be restricted to one time only. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

In case of audit courses offered, the students may be given (P) or (F) grade without any credits. This may be indicated in the mark sheet. Audit courses will not be considered towards the calculation of CGPA.

8.3.5 Declaration of Results

Controller of Examinations (COE) of the University shall declare the results of given UG programme following the CGPA secured by students by the end of 6th Semester and 8th Semester.

8.3.6 Classification of Divisions

Range of CGPA	Result
9.0 – 10	First Class with distinction#
6.0 - 8.99	First Class
5.0 - 5.99	Second Class
4.0 - 4.99	Pass Class

Distinction will be awarded ONLY to those who have cleared ALL subjects in the first attempt.

8.4 INTERNAL ASSESSMENT / END-SEMESTER ASSESMENT / PASSING MINIMUM / GRADES (FOR 7th & 8th SEMESTERS)

Regulations to be notified in the next Revision after the confirmation from University NEP committee.

9 MINIMUM CREDIT REQUIREMENTS

S.No	Component	3-year UG			4-year UG (Honors / Honors with Research)		
		Credits	Courses	Cr/Course	Credits	Courses	Cr/Course
1	Major Disciplinary/ Interdisciplinary Courses	56	14	4	76	19	4
2	Minor Disciplinary/ Interdisciplinary Courses	24	6	4	32	8	4
3	Multi-Disciplinary Courses	9	3	3	9	3	3
4	Ability Enhancement Courses	8	4	2	8	4	2
5	Skill Enhancement Courses	9	3	3	9	3	3
6	Value-added courses	8	4	2	8	4	2
7	Summer Internship (MJD 11)	4	1	4	4	1	4
8	Community Engagement and Service	2	1	2	2	1	2
9	Research Project/Dissertation	--	--	--	12	Project or 3 Courses##	
Total		**120**			**160**		

##Note: Honors students not undertaking research will do 3 courses for 12 credits in lieu of a research project/Dissertation.

- MJD: Major Disciplinary (Compulsory – Hardcore Subjects)
- MID: Minor Disciplinary (Specialization Specific – Softcore Subjects)
- MLD: Multi-Disciplinary
- AEC: Ability Enhancement Courses
- SEC: Skill Enhancement Courses
- VAC: Value Added Courses
- SG: Specialization Group
- Course Code: CD1MJ01(E) (CD-B.Sc. Cyber and Digital Sciences, 1-Semester, MJ-Component, 01-Course Number in the respective component, E - Elective)

ANNEXURE I – SPECIALIZATION IN CYBER AND DIGITAL SCIENCES CURRICULUM

FIRST SEMESTER								
S.No	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 1	CD1MJ01	Digital Logic Fundamentals	H	4	3		2
2	MID 1	CD1MI01	Networks Essentials	S	4	3		2
3	MLD 1		One course from the MLD streams 1 to 10 (Table 15)	H	3	4		
4	AEC 1	CD1AE01	English I	H	2	2		2
5	SEC 1		S.No. 1 or 2 from Table 7	S	3	2		2
6	VAC 1	CD1VA01	Understanding India	H	2	4		0
7	VAC 2	CD1VA02	Environmental Sciences/ Education/ Higher Order Thinking	H	2	4		0
				Total	20	30 Hours		

SECOND SEMESTER								
S.No	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 2	CD2MJ02	Problem Solving & Programming Fundamentals	H	4	3		2
2	MID 2	CD2MI02	Fundamentals of Cybersecurity	S	4	3		2
3	MLD 2		One course from the MLD streams 1 to 10 except the stream chosen in MLD1(Table 15)	H	3	4		
4	AEC 2	CD2AE02	Indian Language I	H	2	2		2
5	SEC 2		S.No. 3 or 4 from Table 7	S	3	2		2
6	VAC 3	CD2VA03	Health & Wellness/Yoga Education/ Universal Human Values	H	2			4
7	VAC 4	CD2VA04	Digital Technologies	H	2	3		
				Total	20	29 Hours		

THIRD SEMESTER								
S.No	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 3	CD3MJ03	Mathematical Foundations of CS	H	4	4	1	
2	MJD 4	CD3MJ04	Data Structures	H	4	3		2
3	MID 3	CD3MI03	Ethical Hacking	S	4	3		2
4	MLD 3		One course from the MLD streams 1 to 10 except the streams chosen in MLD1 and MLD2(Table 15)	H	3	4		
5	AEC 3	CD3AE03	English II	H	2	2		2
6	SEC 3		S.No. 5 or 6 from Table 7	S	3	2		2
				Total	20	27 Hours		

FOURTH SEMESTER								
S.No	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 5	CD4MJ05	Computer System Architecture	H	4	3		2
2	MJD 6	CD4MJ06	Design and Analysis of Algorithms	H	4	3		2
3	MJD 7	CD4MJ07	Object Oriented Programming	H	4	3		2
4	MID 4	CD4MI04	Fundamentals of Cryptography	S	4	3		2
5	AEC 4	CD4AE04	Indian Language II	H	2	2		2
6	Project	CD4CS01	Community Engagement and Service	H	2			6
				Total	20	30 Hours		

FIFTH SEMESTER								
S.No	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 8	CD5MJ08	Operating Systems	H	4	3		2
2	MJD 9	CD5MJ09	Database Management Systems	H	4	3		2
3	MJD 10	CD5MJ10	Management Strategies & Concepts	H	4	4		
4	MID 5	CD5MI05	Network Security	S	4	3	2	
5	MJD 11	CD5MJ11	Summer Internship	H	4			6
				Total	20	25 Hours		

SIXTH SEMESTER								
S.No	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 12	CD6MJ12	Computer Networks	H	4	3		2
2	MJD 13	CD6MJ13	Software Engineering Theory and Practise	H	4	3		2
3	MJD 14	CD6MJ14	System Modelling & Simulation	H	4	3		2
4	MJD 15	CD6MJ15	Web Engineering	H	4	3	2	
5	MID 6		Any one course from Table 1	S	4	3		2
				Total	20	25 Hours		

SEVENTH SEMESTER								
S.No	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 16	CD7MJ16	Software Testing and Quality Assurance	H	4	3		2
2	MJD 17	CD7MJ17	Distributed Systems	H	4	3		2
3	MJD 18	CD7MJ18	Wireless Communication Networks (5G)	H	4	3		2
4	MID 7		Any one course from Table 2	S	4	3		2
5	MID 8		Any one course from Table 3	S	4	3		2

Total	**20**	**25 Hours**

EIGHTH SEMESTER – B.Sc. Cyber and Digital Sciences (Honors)								
S.No	**Component**	**Course Code**	**Title of the Course**	**H/S**	**Credits**	**Hours/Week**		
						L	**T**	**P**
1	**MJD 19**		**Any one course from Table 4**	**S**	**4**	**3**		**2**
2	**MJD 20**		**Any one course from Table 5**	**S**	**4**	**3**		**2**
3	**MJD 21**	**CD8MJ21**	**Cyber Security Risk Management**	**H**	**4**	**3**		**2**
4	**MJD 22**	**CD8MJ22**	**Information Systems Audit**	**H**	**4**	**3**		**2**
5	**MJD 23**	**CD8MJ23**	**SDN**	**H**	**4**	**3**		**2**
Total					**20**	**25 Hours**		

EIGHTH SEMESTER – B.Sc. Cyber and Digital Sciences (Honors with Research)								
S.No	**Component**	**Course Code**	**Title of the Course**	**H/S**	**Credits**	**Hours/Week**		
						L	**T**	**P**
1	**MJD 19**		**Any one course from Table 4**	**S**	**4**	**3**		**2**
2	**MJD 20**		**Any one course from Table 5**	**S**	**4**	**3**		**2**
3	**MJD 21**	**CD8MJ24**	**Research Project**	**H**	**4**			**5**
4	**MJD 22**	**CD8MJ25**	**Project Report**	**H**	**4**			**5**
5	**MJD 23**	**CD8MJ26**	**Project Viva-voce**	**H**	**4**			**5**
Total					**20**	**25 Hours**		

Table 1: MID 6 – SIXTH SEMESTER								
S.No	**Component**	**Course Code**	**Title of the Course**	**H/S**	**Credits**	**Hours/Week**		
						L	**T**	**P**
1	**MID 6**	**CD7MI06E1**	**Information Security Management**	**S**	**4**	**3**		**2**
2	**MID 6**	**CD7MI06E2**	**IoT & Security**	**S**	**4**	**3**		**2**

Table 2: MID 7 – SEVENTH SEMESTER								
S.No	**Component**	**Course Code**	**Title of the Course**	**H/S**	**Credits**	**Hours/Week**		
						L	**T**	**P**
1	**MID 7**	**CD7MI07E1**	**Mobile and Digital Forensics**	**S**	**4**	**3**		**2**
2	**MID 7**	**CD7MI07E2**	**Malware Analysis**	**S**	**4**	**3**		**2**

Table 3: MID 8 – SEVENTH SEMESTER								
S.No	**Component**	**Course Code**	**Title of the Course**	**H/S**	**Credits**	**Hours/Week**		
						L	**T**	**P**
1	**MID 8**	**CD7MI08E1**	**Machine Learning for Cybersecurity**	**S**	**4**	**3**		**2**
2	**MID 8**	**CD7MI08E2**	**Adversarial AI**	**S**	**4**	**3**		**2**
3	**MID 8**	**CD7MI08E3**	**Software Testing and Quality Assurance**	**S**	**4**	**3**		**2**

Table 4: MJD 19 – EIGHTH SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 19	CD8MJ19E1	Blockchain Technologies	S	4	3		2
2	MJD 19	CD8MJ19E2	Cyber Laws	S	4	3		2

Table 5: MJD 20 – EIGHTH SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 20	CD8MJ20E1	Database and Application Security	S	4	3		2
2	MJD 20	CD8MJ20E2	Data Privacy	S	4	3		2

Table 6: MJD 21 / MJD 22 / MJD 23 – EIGHTH SEMESTER								
S.No	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 21	CD8MJ21	Cyber Security Risk Management	H	4	3		2
2	MJD 22	CD8MJ22	Information Systems Audit	H	4	3		2
3	MJD 23	CD8MJ23	SDN	H	4	3		2

Table 7: SEC 1 / SEC 2 / SEC 3 – I / II / III SEMESTERs								
S.No	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	SEC 1	CD1SE01E1	Python Programming	S	3	3		2
2	SEC 1	CD1SE01E2	Linux Programming	S	3	3		2
3	SEC 2	CD2SE02E1	Network Traffic Analysis	S	3	3		2
4	SEC 2	CD2SE02E2	Open Source Intelligence	S	3	3		2
5	SEC 3	CD3SE03E1	Vulnerability Analysis	S	3	3		2
6	SEC 3	CD3SE03E2	Black Hat Python	S	3	3		2

Table 8: List of Major Disciplinary Courses				
S.No	Component	Course Code	Title of the Course	H/S
1.	MJD 1	CD1MJ01	Digital Logic Fundamentals	H
2.	MJD 2	CD2MJ02	Problem Solving & Programming Fundamentals	H
3.	MJD 3	CD3MJ03	Mathematical Foundations of Computer Science	H
4.	MJD 4	CD3MJ04	Data Structures	H
5.	MJD 5	CD4MJ05	Computer System Architecture	H
6.	MJD 6	CD4MJ06	Design and Analysis of Algorithms	H
7.	MJD 7	CD4MJ07	Object Oriented Programming	H
8.	MJD 8	CD5MJ08	Operating Systems	H

9.	**MJD 9**	**CD5MJ09**	Database Management Systems	**H**
10.	**MJD 10**	**CD5MJ10**	Management Strategies & Concepts	**H**
11.	**MJD 11**	**CD5MJ11**	Summer Internship	**H**
12.	**MJD 12**	**CD6MJ12**	Computer Networks	**H**
13.	**MJD 13**	**CD6MJ13**	Software Engineering Theory and Practice	**H**
14.	**MJD 14**	**CD6MJ14**	System Modeling & Simulation	**H**
15.	**MJD 15**	**CD6MJ15**	Web Engineering	**H**
16.	**MJD 16**	**CD7MJ16**	Software Testing and Quality Assurance	**H**
17.	**MJD 17**	**CD7MJ17**	Distributed Systems	**H**
18.	**MJD 18**	**CD7MJ18**	Wireless Communication Networks (5G)	**H**
19.	**MJD 19**		Blockchain Technologies / Cyber Laws	**S**
20.	**MJD 20**		Database and Application Security / Data Privacy	**S**

Table 9: List of Minor Disciplinary Courses

S.No	Component	Course Code	Title of the Course	H/S
1.	**MID 1**	**CD1MI01**	Networks Essentials	**S**
2.	**MID 2**	**CD2MI02**	Fundamentals of Cybersecurity	**S**
3.	**MID 3**	**CD3MI03**	Ethical Hacking	**S**
4.	**MID 4**	**CD4MI04**	Fundamentals of Cryptography	**S**
5.	**MID 5**	**CD5MI05**	Network Security	**S**
6.	**MID 6**		Information Security Management / IoT & Security	**S**
7.	**MID 7**		Mobile and Digital Forensics / Malware Analysis	**S**
8.	**MID 8**		Machine Learning for Cybersecurity / Adversarial AI/ Software Testing and Quality Assurance	**S**

Table 10: List of Multi-disciplinary Courses

S.No	Component	Course Code	Title of the Course	H/S
1.	**MLD 1**	**CD1ML01**	Natural Sciences	**H**
2.	**MLD 2**	**CD2ML02**	Physical Sciences	**H**
3.	**MLD 3**	**CD3ML03**	Humanities & Social Sciences	**H**

Table 11: List of Ability Enhancement Courses

S.No	Component	Course Code	Title of the Course	H/S
1.	**AEC 1**	**CD1AE01**	English I	**H**
2.	**AEC 2**	**CD2AE02**	Indian Language I	**H**
3.	**AEC 3**	**CD3AE03**	English II	**H**
3.	**AEC 4**	**CD4AE04**	Indian Language II	**H**

Table 12: List of Skill Enhancement Courses				
S.No	**Component**	**Course Code**	**Title of the Course**	**H/S**
1.	**SEC 1**	**CD1SE01E1**	Python Programming	**S**
2.	**SEC 1**	**CD1SE01E2**	Linux Programming	**S**
3.	**SEC 2**	**CD2SE02E1**	Network Traffic Analysis	**S**
4.	**SEC 2**	**CD2SE02E2**	Open Source Intelligence	**S**
5.	**SEC 3**	**CD3SE03E1**	Vulnerability Analysis	**S**
6.	**SEC 3**	**CD3SE03E2**	Black Hat Python	**S**

Table 13: List of Value-Added Courses				
S.No	**Component**	**Course Code**	**Title of the Course**	**H/S**
1.	**VAC 1**	**CD1VA01**	Understanding India	**H**
2.	**VAC 2**	**CD1VA02**	Environmental Sciences / Education / Higher Order Thinking	**H**
3.	**VAC 3**	**CD2VA03**	Health & Wellness / Yoga Education / Universal Human Values	**H**
4.	**VAC 4**	**CD2VA04**	Digital Technologies	**H**

Table 14: Project (WP/ Internship)				
S.No	**Component**	**Course Code**	**Title of the Course**	**H/S**
1.	**Project**	**CD4CS01**	Community Engagement and Service	**H**

*Table 15: MLD 1 / MLD 2 / MLD 3 in Sem 1 / Sem 2 / Sem 3				
S.No	**Streams**	**Course Code**	**Title of the Course**	**H/S**
1.	**Natural Science**		**Biology**	**H**
2.			**Botany**	**H**
3.			**Zoology**	**H**
4.			**Biotechnology**	**H**
5.			**Biochemistry**	**H**
6.	**Physical Sciences**		**Chemistry**	**H**
7.			**Physics**	**H**
8.			**Biophysics**	**H**
9.			**Astronomy**	**H**
10.			**Astrophysics**	**H**
11.			**Earth and Environmental Sciences**	**H**
12.	**Social Sciences**		**Political Sciences**	**H**
13.			**History**	**H**

14.			**Social work**	**H**
15.			**Sociology**	**H**
16.	**Humanities**		**Anthropology**	**H**
17.			**Psychology**	**H**
18.			**Economics**	**H**
19.	**Computer Science & Applications**	**CD1SE01E1 (ODD)**	**Python Programming**	**H**
20.		**CD2MI02 (EVEN)**	**Fundamentals of Cybersecurity**	**H**

*Courses will be announced after the approval of the respective boards.

SYLLABUS
SEMESTER I

<table>
<tr><td>Year</td><td>I</td><td colspan="2">Course Code: CD1MJ01</td><td>Credits</td><td>4</td></tr>
<tr><td>Sem.</td><td>I</td><td colspan="2">Course Title: Digital Logic Fundamentals</td><td>Hours</td><td>75</td></tr>
<tr><td>Course Prerequisites, if any</td><td colspan="5">Nil</td></tr>
<tr><td>Internal Assessment Marks: 25</td><td colspan="2">End Semester Marks: 75</td><td colspan="3">Duration of ESA (Theory): 03 hrs.
Duration of ESA (Practical): 03 hrs.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">• Understand the postulates of Boolean algebra.
• Apply minimization techniques for combinational functions.
• Design and analyze combinational and sequential circuits.
• Analyze and apply techniques for the design of digital circuits.
• Create simple digital circuit designs and schematics.</td></tr>
<tr><td>Unit No.</td><td colspan="3">Course Content</td><td colspan="2">Hours</td></tr>
<tr><td colspan="6">Theory Component</td></tr>
<tr><td>Unit I</td><td colspan="3">Digital Systems and Binary Numbers
Digital Systems - Binary Numbers - Number-Base Conversions - Octal and Hexadecimal Numbers - Complements of Numbers - Signed Binary Numbers - Binary Codes - Binary Storage and Registers - Binary Logic - Axiomatic Definition of Boolean Algebra - Basic Theorems and Properties of Boolean Algebra - Boolean Functions
Canonical and Standard Forms - Other Logic Operations - Digital Logic Gates - Integrated Circuits</td><td colspan="2">9</td></tr>
<tr><td>Unit II</td><td colspan="3">Gate-Level Minimization
Introduction - The Map Method - Four-Variable K-Map - Product-of-Sums Simplification - Don’t-Care Conditions - NAND and NOR Implementation - Other Two-Level Implementations - Exclusive-OR Function - Hardware Description Language</td><td colspan="2">9</td></tr>
<tr><td>Unit III</td><td colspan="3">Combinational Logic
Introduction - Combinational Circuits - Analysis Procedure - Design Procedure - Binary Adder–Subtractor - Decimal Adder - Binary Multiplier - Magnitude Comparator – Decoders – Encoders – Multiplexers - HDL Models of Combinational Circuits.</td><td colspan="2">9</td></tr>
<tr><td>Unit IV</td><td colspan="3">Synchronous Sequential Logic
Introduction - Sequential Circuits - Storage Elements: Latches - Storage Elements: Flip-Flops - Analysis of Clocked Sequential Circuits - Synthesizable HDL Models of Sequential Circuits - State Reduction and Assignment - Design Procedure</td><td colspan="2">9</td></tr>
<tr><td>Unit V</td><td colspan="3">Registers and Counters
Registers - Shift Registers - Ripple Counters - Synchronous Counters - Other Counters - HDL for Registers and Counters</td><td colspan="2">9</td></tr>
<tr><td colspan="6">Practical Component</td></tr>
<tr><td></td><td colspan="3">1. Binary to Decimal and vice-versa in Python
2. Decimal to Hexadecimal and Vice-Versa in Python</td><td colspan="2">30</td></tr>
</table>

Exercises	3. Digital Logic Gates in Python 4. Simplification of Boolean Functions in Python 5. Combinational Logic Circuits in Python i. Code Converters ii. Arithmetic (Adders, Subtractors, Multipliers, Comparators) iii. Data Handling (Multiplexers, Demultiplexers, Encoders & Decoders) 6. Combinational Logic Circuit Design in Python 7. Binary Adder-Subtractor Simulation in Python 8. Decimal Adder Simulation in Python 9. Binary Multiplier Simulation in Python 10. Sequential Circuit Storage Elements: Flip-Flop Simulation in Python (Many more programs can be included related to programming the Digital logic in Python)	
Recommended Learning Resources		
Print Resources	1. M. Morris Mano , Michael D. Ciletti, Digital design With an Introduction to the Verilog HDL, Pearson, Fifth Edition, 2013, ISBN-13: 978-0-13-277420-8, ISBN-10: 0-13-277420-8. 2. M. Rafiquzzaman, Fundamentals of Digital Logic and Microcomputer Design, John Wiley & Sons, Inc., Fifth Edition, 2005.	

Year	I	Course Code: CD1MI01	Credits	4
Sem.	I	Course Title : NETWORK ESSENTIALS	Hours	75
Course Prerequisites, if any	NIL			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	● Understanding the basics of digital communication, network models and internetworking devices ● Learning about LAN, Internet, Intranet and Extranet ● Applying encryption techniques for secure data transmission ● Analyzing and resolving connectivity problems ● Evaluating the potential impact of new technologies on network design.			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Computer network and Models** History, application Standards, Transmission Media-Guided and Unguided- OSI Model- Physical layer, Data Link layer, Network layer, Transport layer, Session layer, Presentation layer, Application layer - TCP/IP Model – Physical layer, Network Interface layer, Internet layer, Transport Layer, Application layer- Internetworking devices.	9
Unit II	**LAN, Internet, Intranet and Extranet** LAN, Types of LAN, Understanding Internet, Protocol suite-TCP/IP protocols, IP address, Internet Services- Internet Applications- VoIP, Social networking, Education, Government, E-Commerce- privacy, Security, Safety- IPv6-Internet2- understanding Internets and Extranets	9
Unit III	**VPN and DSL Technologies** VPN-its characteristics and types, applications, standards, benefits and challenges-DSL-introduction on ADSL, its Operation and Modulation techniques, Advantages and Disadvantages, standards- HDSL-operations, varieties of HDSL, HDSL vs ADSL- RADSL vs ADSL-IDSL-VDSL vs ADSL.	9
Unit IV	**Optical and Wireless Networks** Introduction-Optical fiber-major optical components-WDM-Based Network, Passive Optical Networks, SONET, All-Optical networking, Free space optics, Applications. Fundamentals of wireless Networks, WLAN, WMAN, WWAN, WPAN- Cellular Technologies Features and Design-Satellite Networks- its types and components- Wireless Sensor Networks, Advantages and Disadvantages.	9
Unit V	**Emerging Technologies** Introduction about - Internet of Things- Big Data – Smart cities – Blockchain Technology – Cloud Computing – Fog computing – Edge	9

	Computing – Emerging 5G network, also discuss their Key benefits and Applications.	
Practical Component		
Exercises	1. Performing a study of the various transmission media and their properties. 2. Demonstrating the configuration of the network settings of a computer. 3. Demonstrating the creation of a LAN and configuring it. 4. Demonstrating the installation and configuration of an open source VPN. 5. Performing a comparison of HDSL, ADSL, RADSL, VDSL. 6. Performing a study of WLAN, WMAN, WWAN, WPAN and do a comparison of the same. 7. Performing a study of commercial / industrial deployments of SONET, Free Space Optical networks. 8. Performing a study of commercial / industrial deployments of Wireless Sensor Networks. 9. Performing a study of blockchain use cases. 10. Performing a study of big data and IoT applications use cases in the real world. 11. Performing a study of commercial / industrial deployment of fog, edge computing 12. Performing a study of 5G network properties and its advantages.	30
Recommended Learning Resources		
Print Resources	1. Matthew N. O. Sadiku Cajetan M. Akujuobi, "Fundamentals of Computer Networks", Springer Publication, 2022. 2. Behrouz A. Forouzan, "Data communication and Networking", 4th Edition, Mc Graw-Hill, India, 2017. 3. Tanenbaum, A. S. "Computer networks", Pearson Education India, 2022 4. Keiser, G. "Local area networks", Information Gatekeepers Inc., 1989 5. Kurose, Ross, "Computer Networking: A top-down approach", Pearson Education, India, 2010 6. Pahlavan, K., & Krishnamurthy, P. " Networking fundamentals: Wide, local and personal area communications", John Wiley & Sons, 2009. 7. Palmer, M., "Hands-on networking fundamentals", Cengage learning, 2012	

SKILL ENHANCEMENT COURSES

Year	I	**Course Code: CD1SE01E1**	**Credits**	3
Sem.	I	**Course Title : PYTHON PROGRAMMING**	**Hours**	60
Course Prerequisites, if any	Basic Knowledge in Programming Concepts			
Internal Assessment Marks: 50	End Semester Marks: 50	Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	• Understand the basics of writing Python code • Implement programs using lists, tuples and dictionaries • Understand the use of control structures • Implement programs using packages • Understand the file manipulation			

Unit No.	**Course Content**	**Hours**
	Theory Component	
Unit I	**Introduction, Data types** Introduction to Python – Advantages of using Python – Executing Python Programs – Python's Core data types – Numeric Types – String Fundamentals.	6
Unit II	**Lists, Tuples, Dictionaries** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension.	6
Unit III	**Control Flow, Functions, Modules** Python Statements: Assignments – Expressions – If condition – While and For Loops. Functions: Definition, Calls – Scopes – Arguments – Recursive Functions– Functional Programming tools. Classes and Object Oriented programming with Python - Modules and Packages: Purpose, using packages– Exception Handling with Python.	6
Unit IV	**Packages** Packages: NumPy, Pandas, Scikit learn - Machine learning with Python – Cleaning up, Wrangling, Analysis, Visualization - Matplotlib package – Plotting Graphs.	6

Unit V	**File Handling** Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions	6
Practical Component		
Exercises	1. Exchange the values of two variables 2. Finding minimum among n variables 3. Perform Simple sorting 4. Generate Students marks statement 5. Find square root, GCD, exponentiation 6. Sum the array of numbers 7. Perform linear search, binary search 8. Perform Matrix operations using NumPy 9. Perform Dataframe operations using Pandas 10. Use Matplotlib on dataset and visualise 11. Perform Word count, copy file operations	30
Recommended Learning Resources		
Print Resources	1. Mark Lutz, “Learning Python”, Fifth Edition, O’Reilly, 2013. 2. Daniel Liang, “Introduction to programming using Python”, Pearson, First edition, 2021. 3. Wes Mc Kinney, “Python for Data Analysis”, O’Reilly Media, 2012. 4. Tim Hall and J-P Stacey, “Python 3 for Absolute Beginners”, Apress, First Edition, 2009. 5. Magnus Lie Hetland, “Beginning Python: From Novice to Professional”, Apress, Second Edition, 2005.	

Year	I	Course Code: CD1SE01E2	Credits	3
Sem.	I	Course Title : Linux Shell Programming	Hours	60
Course Prerequisites, if any	Basic knowledge of computers and programming			
Internal Assessment Marks: 50	End Semester Marks: 50	Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	● Learning commands of linux operating system ● Understanding the concepts of shell programming ● Understanding the use of quotes, backslash, command substitution and passing arguments ● Learning to understand to work with decisions and loops ● Creating shell programs to Demonstrate the Reading and printing of data			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction to Linux Commands and Shell** Basic commands, working with files, working with directories, file name substitution, file name nuances, Standard input / Output and I/O redirection, pipes, standard error, advanced commands – kernel and the utilities, login shell, typing commands to the shell, the shell's responsibilities	6
Unit II	**Regular Expressions, Commands, Command files and Variables** Various ways of forming regular expressions, cut, paste, sed, tr, grep sort, uniq commands and their various options, command files, variables – displaying values of variables, undefined variables, file name substitution and variables, $ construct, built-in integer arithmetic	6
Unit III	**Use of Quotes, Backslash, command substitution and passing argume** Single quote, double quote, backslash, command substitution, passing arguments, example programs, shift command	6
Unit IV	**Decisions and Loops** Exit Status, test command, else construct, exit command, elif construct, case command, Null Command, && and || constructs – for, while and util loops, advanced loops, getopts commands	6
Unit V	**Reading and Printing data and Interactive and Non-standard shell features** Read command, printf command, getting the right shell, the ENV file, command-line editing, Command history, vi line edit mode, emacs line edit mode, accessing history, functions, integer arithmetic, alias command, arrays, job control, miscellaneous features	6
	Practical Component	
	1. Demonstrating the use of all linux commands 2. Demonstrating the use of typing commands to the shell.	30

Exercises	3. Demonstrating the formation of regular expressions using various options 4. Using cut, paste, sed, tr, grep, sort and uniq commands 5. Demonstrating the use of variables, and built-in arithmetic 6. Demonstrating the use of single, double quotes, backslash, commands substitution 7. Demonstrating the passing of arguments 8. Creating shell programs to demonstrate the use of decision commands 9. Creating shell programs to demonstrate various kinds of loops 10. Creating shell programs to Demonstrate the Reading and printing of data 11. Demonstration of Command-Line editing, command history, vi and emacs line edit mode, history command, alias command, etc.	
Recommended Learning Resources		
Print Resources	1. Stephen J. Kochan, Patrick Wood, "Shell programming in Unix, Linux and OS X", Addison Wesley publication, 2017 2. Mark G. Sobell, "Linux, Commands, Editors, Shell Programming", Third edition, Prentice Hall, 2012	

SEMESTER II

Year	I	Course Code: CD2MJ02	Credits	4
Sem.	II	Course Title: Problem Solving & Programming Fundamentals	Hours	75
Course Prerequisites, if any	NIL			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	• Understand the basic concepts of programming languages, including syntax and semantics. • Apply programming constructs like loops, conditionals, and functions in practical scenarios. • Analyse code to identify and fix errors using debugging techniques. • Create modular programs using functions and procedures, emphasizing good programming practices.			
Unit No.	**Course Content**		**Hours**	
Theory Component				
Unit I	**Introduction to Computer Problem-Solving** The Problem-solving Aspect - Top-down Design - Implementation of Algorithms - Program Verification - The Efficiency of Algorithms - The Analysis of Algorithms		9	
Unit II	**Basic programming constructs** Basic Data types (Numerical, String) – Variables – Expressions – I/O statements – Compile and Run - Debugging.		9	
Unit III	**Decision Making – Branching & Looping** Decision making – Relational Operators - Conditional statement, Looping statement - Nested loops - Infinite loops - Switch statements.		9	
Unit IV	**Array Techniques** Array Manipulation - Different operations - one dimensional array - two-dimensional array - multi-dimensional array - Character Arrays and Strings.		9	
Unit V	**Modular solutions** Introduction to functions – Importance of design of functions – Arguments – Parameters – return values – local and global scope – Recursion.		9	
Practical Component				
Exercises	1. Program to array counting, array order reversal & find the maximum number in a set. 2. Program for removal of duplicates from an ordered array & to partition an array. 3. Program to find the k^{th} smallest element. 4. Program to exchange the values of two variables without using a third variable. 5. Program that takes a list of numbers as input and counts the total number of elements in the list. 6. Program to calculate the sum of a set of numbers entered by the user. 7. Program to compute the factorial of a given integer. 8. Program to compute the sine of an angle (in degrees) using a series expansion.		30	

	9. Program to generate the Fibonacci sequence up to a specified limit. 10. Program that takes an integer as input and reverses its digits. 11. Program that converts a number from one base to another (e.g., binary to decimal, decimal to binary).	
Recommended Learning Resources		
Print Resources	1. R. G. Dromey, "How to solve it by Computer", Pearson Education, 2007. 2. E. Balaguruswamy, "Programming In ANSI C", 4th edition, TMH Publications, 2007. 3. Yashwant Kanetkar, "Let Us C", 13th Edition, PHP, 2013. 4. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.	

Year	I	Course Code: CD2MI02	Credits	4
Sem.	II	Course Title: Fundamentals of Cybersecurity	Hours	75
Course Prerequisites, if any	Computer Networks			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	● Learning the basic concepts of cybersecurity ● Understanding user authentication and access control ● Comprehending the basics of cryptography ● Obtaining a basic knowledge of cyber laws and regulations ● Understanding operating system and network security principles			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction to Computer and Information Security** Foundation of Computer and Information Security: Definition and its needs, Triad and Parkerian Hexad security models and issues- Attacks and its types – Threats, vulnerabilities and Risk - risk management – Incident response and Defense in depth.	9
Unit II	**User Authentication and Access Control** Understanding Identification, Authentication and Authorization, Identity verification, Falsifying Identification – Authentication factors – Multifactor and Mutual authentication – Common Identification and Authentication methods – ACL and its capabilities – Access Control Models – DAC, RBAC, ABAC, MAC – Physical Access control - Auditing and Accountability – Non Repudiation, Deterrence, IDS and IPS, Logging, Monitoring and audit with assessments.	9
Unit III	**Cryptography** History of Cryptography-Caesar Cipher, Cryptographic Machines, kerckhoffs's Principles – Modern Tools – Cipher, OTP, Symmetric and Asymmetric cryptography, Hash Function, Digital Signature, Certificate – Protecting data at Rest, in Motion, and in Use.	9
Unit IV	**Compliance, Laws, regulation and Operation security** Types of compliance and is Consequences – Achieving and maintaining compliance with control, Government and Industry related regulatory – Adopting compliance frameworks, Compliance and technological changes in cloud, Blockchain and cryptocurrencies - Process of operation security, its effect in personal lives and origins, Laws of Operation security.	9
Unit V	**Network and Operating System Security** Human element Security – Gathering information for Social Engineering Attacks and its types, building security awareness – Physical threat Identification and control, Protecting- people, data and equipment – Designing secure network using firewall and IDS – Protecting Network traffic using network security tools – OS hardening – Protecting against	9

	Malware – OS security tools for scanning and assessment of vulnerability – Mobile, Embedded, IoT and application Security.	
Practical Component		
Exercises	1. Performing a survey of various malware attacks that have happened in the last 3 years. 2. Identifying some open source malware creation tools (virus, worms, etc. creation tools) and creating the malware. 3. Studying the various authentication methods and comparing them. 4. Providing use case scenarios of the various authentication methods that are used in real life. 5. Using online cryptography tools, create ciphers using symmetric and symmetric cryptography. 6. Create message digest using online hash function, create a digital certificate online 7. Performing a study of cybersecurity laws in India, USA and UK and compare them. 8. Performing a study of open source firewall and IDS tools 9. Installing and working with tcpdump commands in linux 10. Demonstrating OS hardening. 11. Prepare a list of instructions for creating security awareness to the common public.	30
Recommended Learning Resources		
Print Resources	1. Jason Andress, “Foundations of Information Security - A Straightforward Introduction” , William Pollock Publisher, 2019. 2. Atul Kahate, , “Cryptography and Network Security”, McGraw Hill Education, 2019’ 3. Harish Chander and Gagandeep Kaur, “Cyber Laws and IT Protection”, PHI Publication, 2022 4. Alan Calder, “Implementing Information security based on ISO 27001/ISO 27002 (Best Practice)”, Van Haren Publishing, 2009.	

Skill Enhancement Courses

Year	I	**Course Code: CD2SE02E1**	**Credits**	3
Sem.	II	**Course Title : Network Traffic Analysis**	**Hours**	60
Course Prerequisites, if any	Basic understanding of Computers and Networks			
Internal Assessment Marks: 50	End Semester Marks: 50	Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	• Understanding the basics of network traffic capture and filtered view of packets • Being able to install and configure network traffic analysis tool • Learning to interpret network traffic from packets • Obtaining knowledge of display filters and packet reassembling • Analyzing TCP/IP protocols traffic viz., DNS, ARP, ICMP, DHCP, TCP, UDP, HTTP and Email traffic			

Unit No.	**Course Content**	**Hours**
	Theory Component	
Unit I	**IP Addressing and TCP/IP protocols** Logical Addressing, IPV4 Addresses, Classful addressing, subnetting, supernetting, Classless addressing, Hierarchy, Network Address Translation, Network Layer Protocols – TCP, UDP, ICMP, ARP, RARP, DHCP, Application Layer Protocols – DNS, SMPT, POP and IMAP	6
Unit II	**Capturing, Viewing and Interpreting Traffic** Introduction to Network Analysis, Introduction to Wireshark, Capturing traffic, Creating and applying packet filters, defining global and personal preferences, Colorizing traffic, defining time values and interpreting summaries, interpreting basic trace file statistics.	6
Unit III	**Display Filter and Packet Reassembling** Creating and applying display filters, Following streams and reassembling data, customizing Wireshark profiles, customizing profiles	6
Unit IV	**TCP IP Protocols Analysis - I** TCP/IP Analysis overview, Analyzing DNS traffic, ARP traffic, IPV4 traffic, ICMP traffic	6
Unit V	**TCP IP Protocols Analysis - II** Analyzing UDP traffic, TCP traffic, DHCP traffic, HTTP traffic, Email traffic	6
	Practical Component	
	1.Perform hands-on exercises relating to IP addressing, subnetting, supernetting,	30

Exercises	2. Perform hands-on exercises relating to capturing traffic, packet filters 3. Perform hands-on exercises on setting preferences colorizing traffic and defining time values 4. Perform hands-on exercises on interpreting summaries and interpreting basic trace file statistics 5. Perform hands-on exercises relating to Creating and and applying display filters, 6 .Perform hands-on exercises on Following streams and reassembling data 7. Perform hands-on exercises on customizing wireshark profiles, customizing profiles 8. Perform hands-on exercises relating to Analyzing DNS traffic, ARP traffic ,IPV4 traffic, ICMP traffic 9. Perform hands-on exercises relating to Analyzing UDP traffic 10. Perform hands-on exercises relating to Analyzing TCP traffic 11. Perform hands-on exercises relating to Analyzing DHCP traffic, HTTP traffic 12. Perform hands-on exercises relating to Analyzing Email traffic	
Recommended Learning Resources		
Print Resources	1. Behrouz A. Forouzan, "Data Communications and Networking", Mc Graw Hill Education, 2017. 2. Laura Chappell, "Wireshark Network Analysis – The official Wireshark Certified Network Analyst Study Guide", Chappell University Publishing, 2012. 3. Chris Sanders, "Practical Packet Analysis – Using Wireshark to solve real world network problems", No Starch Press Publishing, 2011	

Year	I	Course Code: CD2SE02E2	Credits	3
Sem.	II	Course Title: Open Source Intelligence	Hours	60
Course Prerequisites, if any	Basic knowledge of computer networks			
Internal Assessment Marks: 50	End Semester Marks: 50	Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	● Understanding the basics of Open Source Intelligence, Online Threats and its Countermeasures ● Gaining knowledge on underground Internet and using search engine techniques to gather required information ● Being able to perform social medial intelligence, using people search engines, and searching public records ● Analyzing possible information from online maps ● Creating Technical footprinting			
Unit No.	**Course Content**		**Hours**	
Theory Component				
Unit I	**Introduction to Open Source Intelligence, Online Threats and Countermeasures** Open Source information categories, OSINT Types, OSINT organizations, parties interested in OSINT, Information Gathering types, Benefits of OSINT, challenges of OSINT, legal and ethical constraints - Online Threats, security software, securing the operating system, General privacy settings, Online tracking techniques, Secure online browsing, Secure online communication, online anonymity, encryption techniques		6	
Unit II	**Underground Internet and Search Engine Techniques** Layers of the internet, Darknet users, using Tor, Searching the Tor network – Key discovery and research, Using search engine to locate information, Web directories, web directories, Translation services, website history and website capture, website monitoring services, news search, searching for digital files		6	
Unit III	**Social Media intelligence, people search engines and public records** Social media intelligence, social media content types, classification of social media platforms, popular social networking sites, investigating social media sites, general resources for locating information on social media sites, other social media sites, Pastebin sites, social media psychological analysis, people search engine, public records, examples, searching for personal details – general, online registries, vital records, criminal and court search, property records, tax and financial records, SSN search, username check, email search, data compromised repositories, phone number search, employee profiles and job websites, other public records.		6	
Unit IV	**Online Maps** The basics of geolocation tracking, finding GPS coordinates of any location on a map, finding geo coordinates from a mailing address – general geospatial research tools – commercial satellites, date/time		6	

	around the world, location based social media, YouTube, Facebook, Twitter, other social media platforms, conducting location searches on social media, country profile information, transport tracking, package tracking, webcams, digital file metadata	
Unit V	**Technical Footprinting** Investigating the target website, investigate the Robot.txt file, mirror the target website, extract the links, checking the target website's backlinks, monitor the website updates, checking the website archived contents, identifying the technologies used, web scraping tools, investigating the target website's File metadata, website certification search, website statistics and analytics tools, website reputation checker tools, passive technical reconnaissance activities – WHOIS lookup, subdomain discovery, DNS reconnaissance, IP address tracking	6
Practical Component		
Exercises	1. Demonstrating securing of operating system 2. Demonstrating privacy settings and online tracking 3. Demonstrating secure online browsing, secure online communication and online anonymity 4. Demonstrating the use encryption techniques 5. Demonstrating with suitable examples the use of searching the Tor network, Key discovery and research, 6. Demonstrating the Use of search engine to locate information, 7. Demonstrating the Use of search engine to locate Web directories, Translation services, website history and website capture 8. Demonstrating the website monitoring services, news search, searching for digital files. 9. Demonstrating with suitable examples - investigation of social media sites, locating information on social media sites, social media psychological analysis. 10. Demonstrating with suitable examples people search engine, searching public records, searching for personal details, general details , searching online registries, vital records, performing criminal and court search, searching property records, tax and financial records, performing SSN search, username check, email search, data compromised repositories, phone number search, employee profiles and job websites, other public records search. 11. Demonstrating with suitable examples of finding GPS coordinates of any location on a map, finding geo-coordinates from a mailing address conducting location searches on social media, finding country profile information, performing transport tracking, package tracking, searching webcams, digital file metadata. 12. Demonstrating the following for various websites – Investigating the target website, mirroring the target website, extracting the links in the website, checking the target website's backlinks, monitoring the website updates, checking the website archived contents, identifying the technologies used in the website.	30

	13. Demonstrating the use of web scraping tools to investigate the target website's File metadata, performing website certification search 14. Demonstrating the use of website statistics and analytics tools, website reputation checker tools 15. Performing passive technical reconnaissance activities – WHOIS lookup, subdomain discovery, DNS reconnaissance, IP address tracking	
Recommended Learning Resources		
Print Resources	1. Nihad A. Hassan, Rami Hijazi, "Open Source Intelligence Methods and Tools: A Practical Guide to Online Intelligence", Apress Publisher, 2018. 2. Sudanshu Chauhan, Nutan Kumar Panda, " Hacking Web Intelligence: Open Source Intelligence, and Web Reconnaissance Concepts and Techniques", Syngress Publisher, 2015	

Year	I	Course Code: CD2VA04	Credits	2
Sem.	II	Course Title: Digital Technologies	Hours	45

Course Prerequisites, if any	-NIL-	
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs.
Course Outcomes	• Understand the importance of digital technology, digital financial tools, e-commerce. • Analyse the concepts of communication and networks. • Understand the e-governance and Digital India initiatives. • Understand the use & applications of digital technology. • Explore the applications of machine learning and big data.	

Unit No.	Course Content	Hours
	Theory Component	
Unit I	Introduction & Evolution of Digital Systems. Role & Significance of Digital Technology. Information & Communication Technology & Tools. Computer System & its working, Software and its types. Operating Systems: Types and Functions. Problem Solving: Algorithms and Flowcharts.	7
Unit II	Communication Systems: Principles, Model & Transmission Media. Computer Networks & Internet: Concepts & Applications, WWW, Web Browsers, Search Engines, Messaging, Email, Social Networking. Computer Based Information System: Significance & Types. E-commerce & Digital Marketing: Basic Concepts, Benefits & Challenges.	7
Unit III	Digital India & e-Governance: Initiatives, Infrastructure, Services and Empowerment. Digital Financial Tools: Unified Payment Interface, Aadhar Enabled Payment System, USSD, Credit / Debit Cards, e-Wallets, Internet Banking, NEFT/RTGS and IMPS, Online Bill Payments and PoS. Cyber Security: Threats, Significance, Challenges, Precautions, Safety Measures, & Tools, legal and ethical perspectives.	7
Unit IV	Emerging Technologies & their applications: Overview of Cloud Computing, Big Data, Internet of Things, Virtual Reality,	7

Unit V	Emerging Technologies & their applications: Blockchain & Cryptocurrency, Robotics, Machine Learning & Artificial Intelligence, 3-D Printing. Digital Signatures.	7
Practical Component		
Exercise	1. Operating System Installation and configuration 2. Application Software Installation and configuration 3. Hardware understanding and minor troubleshooting 4. Networking, cabling, configuration	10
Recommended Learning Resources		
Print Resources	1. Pramod Kumar, Anuradha Tomar, R. Sharmila, "Emerging Technologies in Computing - Theory, Practice, and Advances", Chapman and Hall / CRC, 1st Edition, 2021, eBook ISBN: 9781003121466. https://doi.org/10.1201/9781003121466. 2. V. Rajaraman, "Introduction to Information Technology", PHI, 3rd Edition, 2018, ISBN-10: 9387472299, ISBN-13: 978-9387472297. 3. E. Balagurusamy, "Fundamentals of Computers", Tata Mc GrawHill, 2nd Edition, 2011, ISBN: 9780071077880. 4. Behrouz A. Forouzan, "Data Communications and Networking", McGraw Hill, 4th Edition, 2007, ISBN 978-0-07-296775-3. 5. Rajkumar Buvya, James Broberg, and Andrzej Gosciniski, "Cloud Computing-Principals and Paradigms", Wiley, 2011, ISBN: 978-0-470-88799-8. 6. Stuart Russel and Peter Norvig, "Artificial Intelligence - A Modern Approach", Pearson Education, 3rd Edition, 2010, ISBN- 13: 978-0-13 -604259-4. 7. Samuel Greengard, "Internet of Things", The MIT Press, 2015, ISBN: 9780262328937, https://doi.org/10.7551/mitpress/10277.001.0001. 8. C.S.V. Murthy, "E- Commerce – Concept, Models &Strategies", Himalaya Publishing House, 2015, ISBN: 8178662760. 9. Hurwith, Nugent Halper, Kaufman, "Big Data for Dummies", Wiley & Sons, 1st Edition, 2013, ISBN-13: 978-1118504222.	