HSNC UNIVERSITY, MUMBAI

Board of Studies in Faculty of Science & Technology

In the subject of Computer Science, KC College

1. **Name of Chairperson : -**
    a. **Ms. Geeta N. Brijwani,** Assistant Professor, Dept. of Comp. Sci., KC College, HSNC University, geeta.brijwani@kccollege.edu.in, 9890857969

2. **Two to five teachers each having minimum five years teaching experience amongst the full time teachers of the Departments, in the relevant subject.**
    a. **Mrs. Shalini A. Maheshgauri,** Assistant Professor, Dept. of Comp. Sci., KC College, HSNC University, shalini.maheshgauri@kccollege.edu.in, 9833179438
    b. **Mrs. Beena S. Karutharan,** Assistant Professor, Dept. of Comp. Sci., KC College, HSNC University, beena.karutharan@gmail.com, 9967014385
    c. **Mr. Naveen Pahuja,** Assistant Professor, Dept. of Comp. Sci., KC College, HSNC University, naveenpahuja94@gmail.com, 8856881398
    d. **Mr. Vipul Saluja,** Assistant Professor, Dept. of Comp. Sci., R.D. National College, Bandra(West), vipulsaluja@gmail.com, 9324088050

3. **One Professor / Associate Professor from other Universities or professor / Associate Professor from colleges managed by Parent Body; nominated by Parent Body;-**
    a. **Dr. Sushil Kulkarni,** Associate Professor, Head, Dept. of Mathematics, Jai Hind College Autonomous, Mumbai, sushiltry@gmail.com, 9967770658

4. **Four external experts from Industry / Research / eminent scholar in the field relevant to the subject nominated by the Parent Body;**
    a. **Mr. Shreekant Shiralkar,** Head - India Solution Center for SAP at Tata Consultancy, Mumbai, s_shiralkar@hotmail.com, 9819288288
    b. **Mr. Harish Chandar,** Director, India Tech International Pvt. Ltd., Mumbai, harishchandarb@gmail.com, 9821528022

c. **Dr. Subodh Deolekar,** Lead Research Engineer at REDx We School & Assistant Professor at Research and Business Analytics, Prin. L. N. Welingkar Institute of Management Development & Research, subodh3012@gmail.com, 9969958785

d. **Mr. Roy Thomas,** Head, Dept. of IT, Xavier's College – Autonomous, Mumbai, roy.thomas@xaviers.edu, 9167679668

5. **Top rankers of the Final Year Graduate and Final Year Post Graduate examination of previous year of the concerned subject as invitee members for discussions on framing or revision of syllabus of that subject or group of subjects for one year.**

a. **Mr. Maunash A. Jani**, Software Developer, Genius Lynx, Mumbai, maunash08@gmail.com, 9022155698

b. **Mr. Ajit Vishwakarma,** Corporate Master Trainer, Managing Director, Vinayavish LLP, Mumbai, ajit@vinayavish.com, 9987230297, 9969296378

Invitee BOS Members

a. **Dr. Jyotshna Dongardive,** Assistant Professor, University Department of Computer Science, Kalina, Santacruz(East), jyotss.d@gmail.com, 9819408061

b. **Mr. Rajesh Maurya,** Assistant Professor, Dept. of IT, SVKM's Usha Pravin Gandhi College, Vile Parle (West), rk.maurya@gmail.com, 9820782089

c. **Dr. Madhavi Vaidya,** Assistant Professor, Dept. of Comp. Sci., Vivekanand Education Society, Chembur, vamadhavi@gmail.com, 9869026553

d. **Dr. Girish Tere,** Assistant Professor, Dept. of Comp. Sci., Thakur College, Kandivili, girish.tere@gmail.com, 9920319945

Part –I

Outline of Choice Based Credit System as outlined by University Grants Commission:

R. ** : The Definitions Of The Key Terms Used In The Choice Based Credit System And Grading System Introduced From TheAcademicYear2020-2021AreAs Under:**

1. **Core Course:** Acourse, which should compulsorily be studied by a candidate as acorerequirement is termed as a Corecourse.

2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

   2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offerdiscipline related Elective courses of interdisciplinary nature (to be offeredby main discipline/subject of study).

   2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

   2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.
   P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Choice Base Credit System:** CBCS allows students to choose inter- disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.

4. **Honours Program:** To enhance employability and entrepreneurship abilities among the learners, through aligning Inter Disciplinary / Intra Disciplinary courses with Degree Program. Honours Program will have 40 additional credits to be undertaken by the learner across three years essentially in Inter / Intra Disciplinary course.

   A learner who joins Regular Undergraduate Program will have to opt for Honours Program in the first year of the Program. However, the credits for honours, though divided across three years can be completed within three years to become eligible for award of honours Degree.

5. **Program:** A Program is a set of courses that are linked together in an academically meaningful way and generally ends with the award of a Degree Certificate depending on the level of knowledge attained and the total duration of study, B.Sc. Programs.

6. **Course:** A 'course' is essentially a constituent of a 'program' and may be conceived of as a composite of several learning topics taken from a certain knowledge domain, at a certain level. All the learning topics included in a course must necessarily have academic coherence, i.e. there must be a common thread linking the various components of a course. A number of linked courses considered together are in practice, a 'program'.

7. **Bridge Course:** Bridge course is visualized as Pre semester preparation by the learner before commencement of regular lectures. For each semester the topics, whose knowledge is considered as essential for effective and seamless learning of topics of the Semester, will be specified. The Bridge Course can be conducted in online mode. The Online content can be created for the Bridge Course Topics.

8. **Module and Unit:** A course which is generally an independent entity having its own separate identity, is also often referred to as a 'Module' in today's parlance, especially when we refer to a 'modular curricular structure'. A module may be studied in conjunction with other learning modules or studied independently. A topic within a course is treated as a Unit. Each course should have exactly 3 Units.

9. **Self-Learning: 20% of the topics will be marked for Self-Learning.** Topics for Self-Learning are to be learned independently by the student, in a time- bound manner, using online and offline resources including online lectures, videos, library, discussion forums, fieldwork, internships etc.

   Evaluative sessions (physical/online), equivalent to the credit allocation of the Self Learning topics, shall be conducted, preferably, every week for each course. Learners are to be evaluated real time during evaluative sessions. The purpose of evaluative sessions is to assess the level of the students' learning achieved

in the topics earmarked for Self-Learning.

The teacher's role in these evaluative sessions will be that of a Moderator and Mentor, who will guide and navigate the discussions in the sessions, and offer concluding remarks, with proper reasoning on the aspects which may have been missed by the students, in the course of the Self-Learning process.

The modes to evaluate self-learning can be a combination of the various methods such as written reports, handouts with gaps and MCQs, objective tests, case studies and Peer learning. Groups can be formed to present self- learning topics to peer groups, followed by Question and Answer sessions and open discussion. The marking scheme for Self Learning will be defined under Examination and Teaching.

The topics stipulated for self-learning can be increased or reduced as per the recommendations of the Board of Studies and Academic Council from time to time. All decisions regarding evaluation need to be taken and communicated to the stakeholders preferably before the commencement of a semester. Some exceptions may be made in exigencies, like the current situation arising from the lockdown, but such ad hoc decisions are to be kept to the minimum possible.

10. **Credit Point:** Credit Point refers to the 'Workload' of a learner and is an index of the number of learning hours deemed for a certain segment of learning. These learning hours may include a variety of learning activities like reading, reflecting, discussing, attending lectures / counseling sessions, watching especially prepared videos, writing assignments, preparing for examinations, etc. Credits assigned for a single course always pay attention to how many hours it would take for a learner to complete a single course successfully. A single course should have, by and large a course may be assigned anywhere between to 8 credit points wherein 1 credit is construed as corresponding to approximately 15 learning hours.

11. **Credit Completion and Credit Accumulation:** Credit completion or Credit acquisition shall be considered to take place after the learner has successfully cleared all the evaluation criteria with respect to a single course. Thus, a learner who successfully completes a 4 CP (Credit Point) course may be considered to have collected or acquired 4 credits. Learner level of performance above the minimum prescribed level (viz. grades / marks obtained) has no bearing on the number of credits collected or acquired. A learner keeps on adding more and more credits as he completes successfully more and more courses. Thus the learner 'accumulates' course wise credits.

12. **Credit Bank:** A Credit Bank in simple terms refers to stored and dynamically updated information regarding the number of Credits obtained by any given learner along with details regarding the course/s for which Credit has been given, the course-level, nature, etc. In addition, all the information regarding the number of Credits transferred to differentprograms or creditexemptions given may also bestoredwiththeindividual's history.

13. **Credit Transfer:** (performance transfer)When a learner successfullycompletes a program, he/she is allowed to transfer his/her past performance to another academic program having some common courses and Performance transfer is saidtohave taken place.

14. **Course Exemption:** Occasionally, when two academic programs offered by a single university or by more than one university, may have some common or equivalent course-content, the learner who has already completed one of these academic programs is allowed to skip these 'equivalent' courses while registering for the newprogram. The Learner is 'exempted' from'relearning' the common or equivalent content area and from re-appearing for the concerned examinations. It is thus taken for granted that the learner has already collected in the past the creditscorrespondingto the exempted courses.

Part-II

O*** The fees for transfer of credits or performance will be based on number of credits that a learner has to complete for award of the degree.**

The Scheme of Teaching and Examination:

The performance of the learners shall be evaluated in two components: Internal Assessment with 40% marks by way of continuous evaluation and by Semester End Examination with 60% marks by conducting the theory examination.

INTERNAL ASSESSMENT:- It is defined as the assessment of the learners on the basis of continuous evaluation as envisaged in the credit based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.

A). Internal Assessment – 40% **40 marks**

Practical's (internal Components of the Practical Course

1. **For Theory Courses**

Sr. No.	Particulars	Marks
1	**ONE** class test / online examination to be conducted in the given semester	15 Marks
2	One assignment based on curriculum (to be assessed by the teacher Concerned	10 Marks
3	Self-Learning Evaluation	10 Marks
4	Active participation in routine class instructional deliveries	05 Marks

2. For Courses with Practicals

Each practical course can be conducted out of 50 marks with 20 marks for internal and 30 marks for external

Practical's (Internal component of the Practical Course)

Sr. No	Evaluation type	Marks
1	Two Best Practicals /Assignments/Presentation /Preparation of models/ Exhibits **Or** One Assignment/ project/presentation to be assessed by teacher concerned	10
2	Journal	05
3	Viva	05

The semester end examination (external component) of 60 % for each course will be as follows:

i) **Duration** – **2 Hours** ii) **Theory Question Paper**

Pattern:-

1. There shall be four questions each of 15 marks. On each unit there will be one question and the fourth one will be based on entire syllabus.
2. All questions shall be compulsory with internal choice within the questions. (Each question will be of 20 to 23 marks with options.)
3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depend on the weightage of the topic.

The marks will be given for all examinations and they will be converted into grade (quality) points. The semester-end, final grade sheets and transcripts will have only credits, grades, grade points, SGPA and CGPA.

3. Project and Assignment:

- Project or Assignment, which can in the following forms
  - Case Studies
  - Videos
  - Blogs
  - Research paper (Presented in Seminar/Conference)
  - Field Visit Report
  - Presentations related to the subject (Moot Court, Youth Parliament, etc.)
  - Internships (Exposition of theory into practice)
  - Open Book Test
  - Any other innovative methods adopted with the prior approval of Director Board of Examination and Evaluation.

4. Self-Learning Evaluation

14.1 20% OF THE TOPICS OF CURRICULUM ARE LEARNED BY THE STUDENT THROUGH SELF LEARNING USING ONLINE / OFFLINE ACADEMIC RESOURSE SPECIFIED IN THE CURRICULUM.

14.2 HENCE 20% OF THE LECTURES SHALL BE ALLOCATED FOR EVALUATION OF STUDENTS ON SELF LEARNING TOPICS

14.3 The identified topics in the syllabus shall be learnt independently by the students in a time bound manner preferably from online resources. Evaluative sessions shall be conducted by the teachers and will carry 10 Marks.

CLUB the self-learning topics into 3-4 GROUPS OF TOPICS ONLY FOR EVALUATION.

- **PRESCRIBE TIME DURATION (IN DAYS) FOR COMPLETION OF EACH GROUP OF TOPIC AND EARMARK SELF LEARNING EVALUATION LECTURES IN THE TIMETABLE. HENCE EACH GROUP OF TOPIC CAN BE ASSIGNED 3 REGULAR LECTURES FOR THIS EVALUATION FOR ENTIRE CLASS**

3 Sub Topics

Each evaluative session shall carry 3 Marks (3 x 3 Units = 9 Marks). Students who participate in all evaluative sessions shall be awarded 1 additional Mark.

4 Sub Topics

Each evaluative session shall carry 2.5 Marks (2.5 x 4 Units = 10 Marks)

– **EVALUATION OF SELF LEARNING TOPICS CAN COMMENCE IN REGULAR LECTURES ASSIGNED FOR SELF LEARNING EVALUATION IN THE TIMETABLE**

3. Evaluative sessions

Each evaluative session shall carry 3 Marks (3 x 3 = 9 Marks). Students who participate in all evaluative sessions shall be awarded 1 additional Mark.

4. Evaluative sessions

Each evaluative session shall carry 2.5 Marks (2.5 x 4 = 10 Marks).

Methods for Evaluation of Self-learning topics:

14.4 Seminars/presentation (PPT or poster), followed by Q&A − Objective questions /Quiz / Framing of MCQ questions.

14.5 Debates

- Group discussion
- You-Tube videos (Marks shall be based on the quality and viewership)
- Improvisation of videos
- Role Play followed by question-answers

TEACHERS CAN FRAME OTHER METHODS OF EVALUATION ALSO PROVIDED THAT THE METHOD, DULY APPROVED BY THE COLLEGE EXAMINATION COMMITTEE, IS NOTIFIED TO THE STUDENTS AT LEAST 7 DAYS BEFORE THE COMMENCEMENT OF THE EVALUATION SESSION AND IS FORWARDED FOR INFORMATION AND NECESSARY ACTION AT LEAT 3 DAYS BEFORE THE COMMENCEMENT OF THE EVALUATION SESSION

- Viva Voce
- Any other innovative method

SEMESTER END EXAMINATION: - It is defined as the examination of the learners on the basis of performance in the semester end theory / written examinations.

B. Semester End Examination- 60 % ***60 Marks***

1) Duration – These examinations shall be of 2 Hours duration.
2) Question Paper Pattern: -
   i. There shall be four questions each of 15 marks.
   ii. All questions shall be compulsory with internal choice within the questions.
   iii. Question may be sub-divided into sub-questions a, b, c, d & e only and the allocation of marks depends on the weightage of the topic.

THE MARKS OF THE INTERNAL ASSESSMENT SHOULD NOT BE DISCLOSED TO THE STUDENTS TILL THE RESULTS OF THE CORRESPONDING SEMESTER IS DECLARED.

HSNC University Mumbai

(2020-2021)

Ordinances and Regulations

With Respect to

Choice Based Credit System

(CBCS)

For the Programmes Under

The Faculty of Science and Technology

For the Course

Computer Science

Curriculum – First Year Undergraduate Programmes

Semester-I and Semester -II

2020-2021

Section D

Computer Science

Part 1- Preamble

Information and Communication Technology (ICT) has today become integral part of all industry domains as well as fields of academics and research. The industry requirements and technologies have been steadily and rapidly advancing. Organizations are increasingly opting for open source systems. The students too these days are thinking beyond career in the industry and aiming for research opportunities. B.Sc. Computer Science programme is designed to cover all aspects of computer knowledge required to prepare students for successful careers in the software industry.

1. Course Objective

i. Inculcating high knowledge levels of software development and programming languages.

ii. Provide students with the tools that will allow them to design and implement software solutions to problems.

iii. To communicate effectively with different levels of clients.

iv. To spark the ambition towards their own constant and ongoing professional development.

The programme of BSc. Computer Science will enable students to be placed in different fields such as:

- Website Development / Mobile Application Development
- Database Administration
- Automated IOT Systems
- Game designing
- Software Testing
- Artificial Intelligence
- Data Science
- Linux Server Administration

- Information Security
- Ethical hacking

2. Process adopted for curriculum designing

- The final programme was outlined after frequent discussions, meetings, brainstorming sessions and electronic interactions with academic, alumni and industry partners.

3. Salient features Syllabus made more relevant

- After discussion with stakeholders, certain changes brought about in few topics in the current subjects while a few new subjects are introduced.
- Example: New Subjects such as Web Programming I & II introduced, so as to develop interactive website, also Procedural Language extensions to SQL (PLSQL) to create programmed solutions using procedures, functions, packages and triggers for solving database problems.

4. Learning Outcomes

- Students will attain techniques, skills, and tools necessary for computing practice and development.
- Students will develop team building skills, effective communication skills and organizational abilities required to design and implement solutions to computational problems.

5. Input from stakeholders with relevant information

- Introduction of new subjects/concepts in courses to furnish students with the skills needed to contribute in an ever evolving IT field. Example: Web Technologies which is a mechanism to by which computers communicate with each other through the use of mark-up languages and multimedia packages, Digital marketing concepts which encompasses all marketing efforts that use an electronic device or the internet. Businesses leverage digital channels such as search engines, social media, email, and other websites to connect with current and prospective customers.

Part 2 - The Scheme of Teaching and Examination is as under:

Semester – I

Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	**Core Course (Computer Science)**			US-FCS-101 US-FCS-102 US-FCS-1P1 US-FCS-103 US-FCS-104 US-FCS-1P2	
2	**Elective Course**	**Discipline Specific Elective (DSE) Course**			
		2.1	**Interdisciplinary Specific Elective (IDSE) Course**		
		2.2	**Dissertation/Project**		
		2.3	**Generic Elective (GE) Course**	US-FCS-105, US-FCS-106 US-FCS-1P3	
3	**Ability Enhancement Courses (AEC)**			US-FCS-107	
4	**Skill Enhancement Courses (SEC)**				

First Year Semester I Internal and External Detailed Evaluation Scheme

Sr. No.	Subject Code	Subject Title	Periods Per Week					Credits	Internals				Total Marks
			Units	S.L.	L	T	P		SLE	CT + AT = 15 + 5	PA	SEE	
1	US-FCS-101	Computer Organization and Design	3	20% *	3	0	-	2	10	20	10	60	100
2	US-FCS-102	Programming with Python - I	3	20% *	3	0	-	2	10	20	10	60	100
3	US-FCS-103	Web Technologies - I	3	20% *	3	0	-	2	10	20	10	60	100
4	US-FCS-104	Database Systems	3	20% *	3	0	-	2	10	20	10	60	100
5	US-FCS-105	Discrete Mathematics	3	20% *	3	0	-	2	10	20	10	60	100
6	US-FCS-106	Statistics and R - I	3	20%	3	0	-	2	10	20	10	60	100
7	US-FCS-107	Soft Skills Development & Digital Marketing	3	20%	3	0	-	2	10	20	10	60	100
8	US-FCS-1P1	Practical of US-FCS-101 + US-FCS-102	-	-	-	-	6	2				100 (80+ 20)	100
9	US-FCS-1P2	Practical of US-FCS-103 + US-FCS-104	-	-	-	-	6	2				100 (80+ 20)	100
10	US-FCS-1P3	Practical of US-FCS-105 + US-FCS-106	-	-	-	-	6	2				100 (80+ 20)	100
	Total Lectures/ Credits							**20**	**Total Marks**				**1000**

***One to two lectures to be taken for CONTINUOUS self –learning Evaluation.**

First Year Semester I - Units – Topics – Teaching Hours

Sr. No.	Subject Code & Title	Subject Unit Title		Hours/ Lectures	Total No. of hours/ lectures	Credit	Total Marks
1	US-FCS-101 Computer Organization and Design	1	Computer Abstractions and Technology, Logic circuits and functions, Sequential circuits and functions	15	45L	2	100 (60+40)
		2	Instruction set architectures, Operand addressing modes, Machine language	15			
		3	Basic Processor Unit, Basic I/O, Microcontrollers	15			
2	US-FCS-102 Programming with Python - I	1	Introduction, Statements & Data Types – String, List, Tuple, Dictionaries	15	45L	2	100 (60+40)
		2	Conditional statements, Iterative statements, Modules	15			
		3	Functions, Exception handling, Python File Input-Output	15			
3	US-FCS-103 Web Technologies - I	1	Principles of Web design	15	45L	2	100 (60+40)
		2	HTML5	15			
		3	JavaScript	15			
4	US-FCS-104 Database Systems	1	Introduction to DBMS, Data models, ER model, Relational Model, ER to Table	15	45L	2	100 (60+40)
		2	Schema refinement and Normal forms, Relational Algebra, DDL & DML Statements	15			
		3	Functions, Joining Tables, Sub queries, Database Protection, Views, DCL Statements, NoSQL	15			
5	US-FCS-105 Discrete Mathematics	1	Mathematical Logic, Sets, Relations and Functions- Set theory, Relations, Functions, Recurrence Relation	15	45L	2	100 (60+40)
		2	Counting Principles, Languages and Finite State Machine, Languages, Grammars and Machines	15			
		3	Graphs and Trees	15			
6	US-FCS-106 Statistics and R - I	1	Data Presentation, Data Aggregation, Measures dispersion, An Introduction to R programming - I	15	45L	2	100 (60+40)
		2	Moments, Measures of Skewness and	15			

			Kurtosis, Correlation and Regression, Linear regression, Statistics in R				
		3	Probability, Conditional Probability, Random variables	15			
7	US-FCS-107 Soft Skills Development & Digital Marketing	1	Introduction to Soft Skills and Hard Skills	15	45L	2	100 (60+40)
		2	Professional Presentation, Job Interviews, Group Discussion, Professional Skills	15			
		3	Ethical Values, Capacity Building, Leadership and Team Building, Digital Marketing	15			
8	US-FCS-1P1	1	Practical based on US-FCS-101	3	45x2= 90 lectures per batch	2	100 (80+10+10)
		2	Practical based on US-FCS-102	3			
9	US-FCS-1P2	1	Practical based on US-FCS-103	3	45x2= 90 lectures per batch	2	100 (80+10+10)
		2	Practical based on US-FCS-104	3			
10	US-FCS-1P3	1	Practical based on US-FCS-105	3	45x2= 90 lectures per batch	2	100 (80+10+10)
		2	Practical based on US-FCS-106	3			
			TOTAL			**20**	**1000**

- **Lecture Duration – 48 Minutes**
- **One Credit =15 hours**

L: Lecture: Tutorials P: Practical Ct-Core Theory, Cp-Core Practical, SLE- Self learning evaluation CT-Commutative Test, SEE- Semester End Examination, PA-Project Assessment, AT- Attendance

Part - 3 Detailed Scheme Theory

Curriculum Topics along with Self-Learning topics to be covered, through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT.

Course Code: US-FCS-101 Computer Organization and Design

Unit	Content	No. of Lectures
1	**1.1 Computer Abstractions and Technology**: Basic structure and operation of a computer, functional units and their interaction. Representation of numbers and characters. **1.2 Logic circuits and functions:** Combinational circuits and functions: Basic logic gates and functions, truth tables; logic circuits and functions. Minimization with Karnaugh Maps. Synthesis of logic functions with and-or-not gates, NAND gates, NOR gates. Fan-in and fan-out requirements; Tristate buffers. Half adder, full adder, ripple carry adder, Decoders, Multiplexers. **1.3 Sequential circuits and functions:** Flip flops, Gated S-R and D latches, and Edge-triggered D latch. Shift registers and registers. State diagram and state table; finite state machines and their synthesis.	**15**
2	**2.1 Instruction set architectures:** Memory organization, addressing and operations; word size, big-endian and little- endian arrangements. Instructions, sequencing. Instruction sets for RISC and CISC (Examples Altera NIOS II and Free-scale Cold-Fire). **2.2 Operand addressing modes**; pointers; indexing for arrays. **2.3 Machine language**, assembly language, assembler directives. Function calls, processor runtime stack, stack frame. Types of machine instructions: arithmetic, logic, shifts, etc. Instruction sets, RISC and CISC examples.	**15**
3	**3.1 Basic Processor Unit:** Main components of a processor: registers and register files, ALU, control unit, instruction fetch unit, and interfaces to instruction and data memories. Data path. Instruction fetch and execute; executing arithmetic/logic, memory access and branch instructions; hardwired and micro programmed control for RISC and CISC. **3.2 Basic I/O:** Accessing I/O devices, data transfers between processor and I/O devices. Interrupts and exceptions: interrupt requests and processing. **3.3 Microcontrollers:** 8051 basics : block diagram, real world applications	**15**

Self-Learning topics (Unit wise)

Sub-Unit	Topic
1.1	**Computer Abstractions and Technology:** Basic structure and operation of a computer, functional units and their interaction. Representation of numbers and characters.
1.2	Logic circuits and functions: Combinational circuits and functions: Basic logic gates and functions, truth tables; logic circuits and functions.
3.3	**3.3** Microcontrollers: Real world applications

Online Resources

Week 1 course content from NOC: Computer Organization and Architecture A Pedagogical Aspect https://nptel.ac.in/courses/106/103/106103180/ Binary numeration system- https://www.coursera.org/lecture/digital-systems/l0-1-binary-numeration-system-n3mTp What digital systems are? https://www.coursera.org/learn/digital-systems#syllabus Logic gates- https://www.khanacademy.org/computing/ap-computer-science-principles/computers-101/logic-gates-and-circuits/a/logic-gates
Week 1 and week 6 course content from Microprocessors and Microcontrollers available on Swayam portal. Link given below. https://swayam.gov.in/nd1_noc20_ee42/preview

Reference Books: US-FCS-101 Computer Organization and Design

1.	Unit – 1	R P Jain, Modern Digital Electronics, Tata McGraw Hill Education Pvt. Ltd., 4th Edition, 2010.
2.	Unit – 2 & 3	Carl Hamacher et al., Computer Organization and Embedded Systems, 6 ed., McGraw-Hill, 2012.
3.	Unit – 1	The 8051 Microcontroller Architecture programming and applications by Kenneth J Ayala, West publishing Company, 3rd Edition, Cengage Learning, 2010.

US-FCS-102 Programming with Python - I

Unit	Content	No. of Lectures
1	**1.1 Introduction:** Introduction to the IDLE Interpreter (shell), Documentation, Expressions and its evaluation, Operators of type's int, float, boolean. Built-in function type. Operator precedence. Interactive and script modes of IDLE, running a script, restarting the shell, Writing first program – basic syntax - Input/output with print and input functions. **1.2 Statements:** Types – Simple, Compound, Expression, Assert, Assignment, import, delete (del), Augmented assignment, Dynamic binding of names to values, automatic and implicit declaration of variable names with the assignment statement; Assigning None value to a name, role of indentation for delimiting the body of a compound statement, Built-in help () function. **1.3 Data types:** Compound data types - String, tuple and list (enclosed in quotes, parentheses and brackets respectively), operations, Indexing individual elements within these types, methods and functions. Dictionaries: concept of key-value pairs, techniques to create, update and delete dictionary items, methods and functions, Type conversion functions.	**15**
2	**2.1 Conditional statements**: if, if-else, if-elif-else. **2.2 Iterative statements**: while loop, for loop, Nested compound statements. The break and continue statement, pass statement. **2.3 Modules:** Built-in modules - time, random and math module, Creating and importing own module	**15**
3	**3.1 Functions:** Definition**,** Advantages of functions, function parameters, formal parameters, actual parameters, global and local variables. The range function. Lambda functions. **3.2 Exception handling:** Definition of Exception, various keywords to handle exceptions such try, catch, except, else, finally, raise. **3.3 Python File Input-Output:** Opening and closing files, various types of file modes, reading and writing to files, manipulating directories.	**15**

Self-Learning topics (Unit wise)

Sub-Unit	Topic
1.3	**Data types:** Compound data types - String, tuple and list (enclosed in quotes, parentheses and brackets respectively), operations, Indexing individual elements within these types, methods and functions. Dictionaries: concept of key-value pairs, techniques to create, update and delete dictionary items, methods and functions, Type conversion functions.
2.1	**Conditional statements**: if, if-else, if-elif-else.
2.2	**Iterative statements**: while loop, for loop, Nested compound statements. The break and continue statement, pass statement.

Online Resources

Refer following course contents from "The Joy of Computing using Python" available on Swayam portal. Link given below.

a. Variables and Expressions : Design your own calculator
b. Loops and Conditionals : Hopscotch once again
c. Lists, Tuples and Conditionals : Lets go on a trip

Link:

a. https://swayam.gov.in/nd1_noc19_cs41/preview
b. https://docs.python.org/3/

Reference Books: US-FCS-102 Programming with Python - I

1.	Unit – 1, 2 & 3	Paul Gries, et al., Practical Programming: An Introduction to Computer Science Using Python 3, Pragmatic Bookshelf, 2/E 2014.
2.		Magnus Lie Hetland, Beginning Python: From Novice to Professional, Apress.

US-FCS-103 Web Technologies – I

Unit	Content	No. of Lectures
1	**Principles of Web design** **1.1.Web Site Design Principles –** Design for the Medium, Design for the Whole Site, Design for the User, Design for the Screen, Planning the Site – Create a Site Specification, Identify the Content Goal, Analyze your Audience, Build a Web Site Development Team, Filenames and URLs, Directory Structure, Diagram the Site **1.2 Web Page Anatomy** - Grid Theory - The Rule of Thirds, 960 Grid System, Resizing: Fixed, Fluid, or Responsive Layouts - Fixed Width, Fluid Width, An Alternative: Responsive Layouts **1.3 Planning Site Navigation** – Creating Usable Navigation, Using Text - Based Navigation, Using Graphics- Based Navigation **1.4 Web Typography –** Type Design Principles, Controlling Typography with Cascading Style Sheet, Styling with CSS, Web Fonts with @font-face - Self-hosted Web Fonts, Web Font Services - Google Fonts, Adobe Fonts **1.5 Graphics and Color –** File Format Basics, Computer Color Basic, Choosing a Graphics Tool, Using the <IMG> Element, Working with Hexadecimal Colors **1.6 Publishing and Maintaining Your Web Site –** Publishing Your Web Site, Testing Your Web Site, Refining and Updating Your Content, Attracting Notice to Your Web Site	**15**
2	**2.1 Introduction to Web Technologies**: Web Technologies, Browsers, HTML Fundamentals, HTML 4.0 elements, and Tags, Attributes, Event Handlers, Document Structure Tags, Working with Text, Formatting Tags, List Tags, links and URLs, Hyperlinks, Image & Image map, color, Table Tags, Form Tags, Frame Tags, Executable Content Tags **2.2 Introduction to HTML 5:** Difference between HTML4.0 and HTML5, Features of HTML5, New Tags in HTML5 (<section>, <article>, <main>, <nav>, <header>, <footer>, <aside>, <figure>, <figcaption>), HTML5 input types, Working with Multimedia-Use of Audio and Video Tags. **2.3 CSS**: Introduction to CSS, CSS Sectors, CSS in HTML, Inline Styles – Embedding Styles- Linking External Style Sheets, working with background, color, font and text with CSS, Display and positioning an element, Effects, Frames and controls in CSS, CSS Flexible Box Layout - two axes of flexbox, Start and end lines, The flex container, Alignment, justification and distribution of free space between items.	**15**
3	**3.1 Introduction to JavaScript**: Variables, Operators, Control Flow Statements, Dialog Boxes, **3.2 Functions –** Defining and Invoking a Function, Defining Function arguments, Defining a Return Statement, Document Object Model (DOM), Events and Event Handling, Forms and Form Elements., **3.3 JavaScript Objects** - String, RegExp, Math, Date, Browser Objects - Window, Navigator, History, Location, Document, Cookies.	**15**

Self-Learning topics (Unit wise)

Unit	Topic
2.1	**Introduction to Web Technologies**: Web Technologies, Browsers, HTML Fundamentals, HTML 4.0 elements, and Tags, Attributes, Event Handlers, Document Structure Tags, Working with Text, Formatting Tags, List Tags, links and URLs, Hyperlinks, Image & Image map, color, Table Tags, Form Tags, Frame Tags, Executable Content Tags
2.3	**CSS:** Introduction to CSS, CSS Sectors, CSS in HTML, Inline Styles – Embedding Styles- Linking External Style Sheets

Online Resources

Refer course contents from "HTML" available on Swayam portal.
Link: https://swayam.gov.in/nd2_aic20_sp11/preview

Reference Books: US-FCS-103 Web Technologies – I

1.	Unit – 1	Principles of Web Design by Joel Sklar, 6th Edition, Cengage, 2015.
2.	Unit – 1	The Principles of Beautiful Web Design, 3rd Edition, By Jason Beaird, James George (SitePoint)
3.	Unit – 2	HTML5 Black Book: Covers JAVASCRIPT, XML, XHTML, AJAX
4.	Unit – 3	JavaScript: The Definitive Guide, 6th Edition by David Flanagan
5.	Unit – 3	Eloquent JavaScript 3rd edition by Marijn Haverbeke

US-FCS-104 Database Systems

Unit	Content	No. of Lectures
1	**1.1 Introduction to DBMS:** Database, DBMS – Definition, Overview of DBMS, Advantages of DBMS, Levels of abstraction, Data independence, DBMS Architecture **1.2 Data models:** Client/Server Architecture, Object Based Logical Model, Record Based Logical Model (relational, hierarchical, network) **1.3 Entity Relationship Model:** Entities, attributes, entity sets, relations, relationship sets, Additional constraints (key constraints, participation constraints, weak entities, aggregation / generalization, Conceptual Design using ER (entities VS attributes, Entity Vs relationship, binary Vs ternary, constraints beyond ER) **1.4 Relational data model:** Domains, attributes, Tuples and Relations, Relational Model Notation, Characteristics of Relations, Relational Constraints - primary key, referential integrity, unique constraint, Null constraint, Check constraint **1.5 ER to Table**: Entity to Table, Relationship to tables with and without key constraints.	**15**
2	**2.1 Schema refinement and Normal forms:** Functional dependencies, first, second, third, and BCNF normal forms based on primary keys, lossless join decomposition. **2.2 Relational Algebra:** operations (selection, projection, set operations, union, intersection, difference, cross product, Joins –conditional, equijoin and natural joins, division) **2.3 DDL Statements**: Creating Databases, Using Databases, data types, Creating Tables (with integrity constraints – primary key, default, check, not null), Altering Tables, Renaming Tables, Dropping Tables, Truncating Tables, Backing Up and Restoring databases **2.4 DML Statements:** Viewing the structure of a table insert, update, delete, Select all columns, specific columns, unique records, conditional select, in clause, between clause, limit, aggregate functions (count, min, max, avg, sum), group by clause, having clause **2.5 Normalization Concepts:** 1NF, 2NF, 3NF, BCNF, examples.	**15**
3	**3.1 Functions:** String Functions (concat, instr, left, right, mid, length, lcase/lower, ucase/upper, replace, strcmp, trim, ltrim, rtrim), Math Functions (abs, ceil, floor, mod, pow, sqrt, round, truncate) Date Functions (adddate, datediff, day, month, year, hour, min, sec, now, reverse) **3.2 Joining Tables:** inner join, outer join (left outer, right outer, full outer) **3.3 Sub queries:** Sub queries with IN, EXISTS, sub queries restrictions, Nested sub queries, ANY/ALL clause, correlated sub queries **3.4 Database Protection:** Security Issues, Threats to Databases, Security Mechanisms, Role of DBA, Discretionary Access Control **3.5 Views:** Creating, altering dropping, renaming and manipulating views **3.6 DCL Statements:** (creating/dropping users, privileges introduction,	**15**

	granting/revoking privileges, viewing privileges) **3.7 NoSQL:** Introduction, Advantages, Disadvantages, Comparison with MySQL Types, Introduction to MongoDB, Install, Commands to handle database, Sorting.	

Self-Learning topics (Unit wise)

Sub-Unit	Topic
1.3	**Entity Relationship Model:** Entities, attributes, entity sets, relations, relationship sets, Additional constraints (key constraints, participation constraints, weak entities, aggregation / generalization, Conceptual Design using ER (entities VS attributes, Entity Vs relationship, binary Vs ternary, constraints beyond ER)
2.2	**Relational Algebra:** operations (selection, projection, set operations, union, intersection, difference, cross product, Joins –conditional, equijoin and natural joins, division)
2.3	**DDL Statements**: Creating Databases, Using Databases, data types, Creating Tables (with integrity constraints – primary key, default, check, not null), Altering Tables, Renaming Tables, Dropping Tables, Truncating Tables, Backing Up and Restoring databases

Online Resources

Refer week 3 content from "Database Management System" available on Swayam portal. Link: https://swayam.gov.in/nd1_noc19_cs46/preview
Refer week 2 and week 3 content from "Database Management System" available on Swayam portal. Link: https://swayam.gov.in/nd1_noc19_cs46/preview

Reference Books: US-FCS-104 Database Systems

1.	Unit – 1 & 2	Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, Pearson Education, Sixth Edition, 2010.
2.	Unit – 1 & 2	Ramakrishnam Gehrke, Database Management Systems, McGraw-Hill, 2007. Joel Murach, Murach's MySQL, Murach, 2012.
3.	Unit – 3	NoSQL databases, by Christof Strauch Enterprose NoSQL for Dummies, a Wiley brand, Charlie books Practical MongoDB by Shakuntala Gupta Edward Navin Sabharwal

US-FCS-105 Discrete Mathematics

Unit	Content	No. of Lectures
1	**1.1 Mathematical Logic:** Propositional Logic, Propositional Equivalences, Valid and Invalid arguments, Predicates and Quantifiers, Applications of Propositional Logic. **1.2 Sets, Relations and Functions- Set theory:** Sets, Properties of sets, Set Operations, Cardinality of sets **1.3 Relations**: Definition and examples. Properties of relations , Partial Ordering sets, Linear Ordering Hasse Daigrams , Maximum and Minimum elements, Lattices **1.4 Functions:** Definition of function. Domain, co domain and the range of a function. Direct and inverse images. Injective, surjective and bijective functions. Composite and inverse functions. **1.5 Recurrence Relations:** Definition of recurrence relations, Formulating recurrence relations, solving recurrence relations- Back tracking method, linear homogeneous recurrence relations with constant coefficients of degree two when characteristic equation has distinct roots and only one root, Particular solutions of Non-linear homogeneous recurrence relation, Solution of recurrence relation by the method of generation functions, Applications- Formulate and solve recurrence relation for Fibonacci numbers, Tower of Hanoi, Intersection of lines in a plane, Sorting Algorithms.	**15**
2	**2.1 Counting Principles, Languages and Finite State Machine:** Permutations and Combinations – Partition and Distribution of objects, Permutation with distinct and indistinct objects, Binomial numbers, Combination with identities, Pascal Identity, Vandermonde's Identity, Pascal triangle, Binomial theorem, Combination with indistinct objects. **2.2 Counting Principles:** Sum and Product Rules, Two-way counting, Tree diagram for solving counting problems, Pigeonhole Principle (without proof); Simple examples, Inclusion Exclusion Principle. (Sieve formula - without proof). **2.3 Languages, Grammars and Machines:** Languages, regular Expression and Regular languages, Finite state Automata, grammars, Finite state machines, Gödel numbers, Turing machines.	**15**
3	**2.4 Graphs and Trees:** Graphs - Definition and elementary results, Adjacency matrix, path matrix, representing relations using diagraphs, Warshall's algorithm - shortest path, Linked representation of a graph **2.5 Operations on graph with algorithms -** searching in a graph; Insertion in a graph, Deleting from a graph, Traversing a graph- Breadth-First search and Depth-First search. **2.6 Trees:** Definition and elementary results. Ordered rooted tree, Binary trees, Complete and extended binary trees, representing binary trees in memory, traversing binary trees, binary search tree, Algorithms for searching and inserting in binary search trees, Algorithms for deleting in a binary search tree	**15**

Self-Learning topics (Unit wise)

Sub-Unit	Topic
1.1	**Mathematical Logic**- Propositional Logic, Propositional Equivalences, Valid and Invalid arguments, Predicates and Quantifiers, Applications of Propositional Logic.
1.2	**Sets, Relations and Functions- Set theory-** Sets, Properties of sets, Set Operations, Cardinality of sets
2.1	**Counting Principles:** Sum and Product Rules, Two-way counting, Tree diagram for solving counting problems, Pigeonhole Principle (without proof); Simple examples, Inclusion Exclusion Principle. (Sieve formula - without proof).

Online Resources

Refer week 2, 3, 4, 5 content from "Discrete Mathematics" course available on Swayam portal. Link: https://swayam.gov.in/nd1_noc20_cs37/preview
Refer week 2, 3, 4, 5 content from "Discrete Mathematics" course available on Swayam portal. Link: https://swayam.gov.in/nd1_noc20_cs37/preview

Reference Books: US-FCS-105 Discrete Mathematics

1.	Unit – 1 & 2	Kenneth H. Rosen, Discrete Mathematics and Its Applications, Seventh Edition, McGraw Hill Education (India) Private Limited. (2011).
2.	Unit – 1 & 2	Norman L. Biggs, Discrete Mathematics, Revised Edition, Clarendon Press, Oxford 1989. Elements of Discrete Mathematics: C.L. Liu, Tata McGraw- Hill Edition.
3.	Unit – 3	Data Structures, Seymour Lipschutz, Schaum's out lines, McGraw- Hill Inc.

US-FCS-106 Statistics and R - I

Unit	Content	No. of Lectures
1	**1.1 Data Presentation:** Data types - attribute, variable, discrete and continuous variable, frequency distribution, histogram o give, curves, stem and leaf display **1.2 Data Aggregation:** Measures of Central tendency - Mean, Median, mode for raw data, discrete, grouped frequency distribution. **1.3 Measures dispersion:** Variance, standard deviation, coefficient of variation for raw data, discrete and grouped frequency distribution, quartiles, quartiles Real life examples **1.4 An Introduction to R programming - I:** Introduction and preliminaries, Simple manipulations; numbers and vectors, Objects, their modes and attributes, Ordered and unordered factors, Arrays and matrices, Lists and data frames, Reading data from files, Scripting with R.	**15**
2	**2.1 Moments:** Raw moments, central moments, relation between raw and central moments **2.2 Measures of Skewness and Kurtosis:** based on moments, quartiles, relation between mean, median, and mode for symmetric, asymmetric frequency curve. **2.3 Correlation and Regression:** bivariate data scatter plot, correlation, nonsense, Correlation, Karl Pearson's coefficients of correlation, independence. **2.4 Linear regression:** fitting of linear regression using least square regression, coefficient of determination, properties of regression coefficients (only statement) **2.5 Statistics in R:** mean, median, mode, Frequency Distribution in R.	**15**
3	**3.1 Probability:** Random experiment, sample space, events types and operations of events **3.2 Probability definition:** classical, axiomatic, Elementary Theorems of probability(without proof) • $0 \leq P(A) \leq 1$, • $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ • $P(A`) = 1 - P(A)$ • $P(A) \leq P(B)$ if $A \subset B$ Conditional probability, 'Bayes' theorem, independence, Examples on Probability **3.3 Random variables:** definition of random variable, discrete, continuous, expectation and variance of a random variable, pmf, pdf, cdf.	**15**

Self-Learning topics (Unit wise)

Sub-Unit	Topic
3.1	**Probability:** Random experiment, sample space, events types and operations of events **3.2 Probability definition:** classical, axiomatic, Elementary Theorems of probability(without proof) • $0 \leq P(A) \leq 1$, • $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ • $P(A`) = 1 - P(A)$ • $P(A) \leq P(B)$ if $A \subset B$

Online Resources

Refer week 3, 4 content from "Introduction to Probability and Statistics" course available on Swayam portal. Link: https://swayam.gov.in/nd1_noc20_ma22/preview

Reference Books: US-FCS-106 Statistics and R - I

1.	Unit – 1, 2 & 3	Trivedi, K.S.(2001) : Probability, Statistics, Design of Experiments and Queuing theory, with applications of Computer Science, Prentice Hall of India, New Delhi
2.		Murray R. Spiegel, Larry J. Stephens, Schaum's Outline of Theory and problems of Statistics, McGraw Hill, 4th Edition
3.		Gupta, S.C. and Kapoor, V.K. (1987): Fundamentals of Mathematical Statistics, S. Chand and Sons, New Delhi
4.		R.B. Patil, H.J. Dand and R. Bhavsar, A Practical Approach using R, SPD, 1st edition (2017).
5.	Unit 1, 2 & 3	R Documentation: https://www.r-project.org/other-docs.html
6.	Unit - 3	Ross, S.M. (2006): A First course in probability. 6th Edition, Pearson.
7.		R Tutorial with Bayesian Statistics using OpenBUGS, by Chi Yau, r-tutor.com

US-FCS-107 Soft Skills Development & Digital Marketing

Unit	Content	No. of Lectures
1	**Introduction to Soft Skills and Hard Skills** **1.1 Personality Development:** Knowing Yourself, Positive Thinking, Johari's Window, Communication Skills, Non-verbal Communication, Physical Fitness **1.2 Emotional Intelligence:** Meaning and Definition, Need for Emotional Intelligence, Intelligence Quotient versus Emotional Intelligence Quotient, Components of Emotional Intelligence, Competencies of Emotional Intelligence, Skills to Develop Emotional Intelligence **1.3 Etiquette and Mannerism:** Introduction, Professional Etiquette, Technology Etiquette **1.4 Communication Today:** Significance of Communication, GSC's 3M Model of Communication, Vitality of the Communication Process, Virtues of Listening, Fundamentals of Good Listening, Nature of Non Verbal Communication, Need for Intercultural Communication, Communicating Digital World **1.5 Academic Skills: Employment Communication-** Introduction, Resume, Curriculum Vitae, Scannable Resume, Developing an Impressive Resume, Formats of Resume, Job Application or Cover Letter	**15**
2	**2.1 Professional Presentation:** Nature of Oral Presentation, Planning a Presentation, Preparing the Presentation, Delivering the Presentation **2.2 Job Interviews:** Introduction, Importance of Resume, Definition of Interview, Background Information, Types of Interviews, Preparatory Steps for Job Interviews, Interview Skill Tips, Changes in the Interview Process, FAQ During Interviews **2.3 Group Discussion:** Introduction, Ambience/Seating Arrangement for Group Discussion, Importance of Group Discussions, Difference between Group Discussion, Panel Discussion and Debate, Traits, Types of Group Discussions, topic based and Case based Group Discussion, Individual Traits **2.4 Professional Skills:** Creativity at Workplace - Introduction, Current Workplaces, Creativity, Motivation, Nurturing Hobbies at Work, The Six Thinking Hat Method	**15**
3	**3.1 Ethical Values:** Ethics and Society, Theories of Ethics, Correlation between Values and Behavior, Nurturing Ethics, Importance of Work Ethics, Problems in the Absence of Work Ethics **3.2 Capacity Building: Learn, Unlearn and Relearn:** Capacity Building, Elements of Capacity Building, Zones of Learning, Ideas for Learning, Strategies for Capacity Building **3.3 Leadership and Team Building:** Leader and Leadership, Leadership Traits, Culture and Leadership, Leadership Styles and Trends, Team Building,	**15**

	Types of Teams. **3.4 Digital Marketing :** Introduction, Market research, marketing plan, Search Engines, SEO, Search Engine Marketing, Content & Email marketing, Social Media Marketing - YouTube/Facebook/Twitter marketing	

Self-Learning topics (Unit wise)

Sub-Unit	Topic
2.1	**Professional Presentation:** Nature of Oral Presentation, planning a Presentation, Preparing the Presentation, Delivering the Presentation
2.2	**Group Discussion:** Introduction, Ambience/Seating Arrangement for Group Discussion, Importance of Group Discussions, Difference between Group Discussion, Panel Discussion and Debate, Traits, Types of Group Discussions, topic based and Case based Group Discussion, Individual Traits
2.3	**Professional Skills**: Creativity at Workplace - Introduction, Current Workplaces, Creativity, Motivation, Nurturing Hobbies at Work, The Six Thinking Hat Method

Online Resources

Refer week 9 and week 10 course contents from "Soft Skills" course available on Swayam portal. Link: https://swayam.gov.in/nd1_noc19_hs33/preview
Refer week 1, week 2, week 3 course contents from "Basics of Digital Marketing" course available on Swayam portal. Link: https://swayam.gov.in/nd2_cec19_mg23/preview

Reference Books: US-FCS-107 Soft Skills Development & Digital Marketing

1.	Unit – 1, 2 & 3	Gajendra S. Chauhan, Sangeeta Sharma, Soft Skills: an Integrated Approach to Maximise Personality, Wiley India
2.		Big Book of Digital Marketing - https://digitalfireflymarketing.com/wp-content/uploads/2017/02/Big-Book-of-Digital-Marketing.pdf

Part - 4 Detailed Scheme Practical

Course Code: US-FCS-1P1

Practical I	**Computer Organization and Design** & **Programming with Python - I**	**Total Credits: 2**
Unit	**Content**	**No. of Lectures**
1, 2, 3	**1)** Study and verify the truth table of various logic gates (NOT, AND, OR, NAND, NOR, EX-OR, and EX-NOR). **2)** Simplify given Boolean expression and realize it. **3)** Design and verify a half/full adder, Design and verify half/full subtractor **4)** Design a 4-bit magnitude comparator using combinational circuits. **5)** Design and verify the operation of flip-flops using logic gates. **6)** Verify the operation of a counter. **7)** Verify the operation of a 4-bit shift register. **8)** Using SPIM, write and test an adding machine program that repeatedly reads in integers and adds them into a running sum. The program should stop when it gets an input that is 0, printing out the sum at that point. **9)** Using SPIM, write and test a program that reads in a positive integer using the SPIM system calls. If the integer is not positive, the program should terminate with the message "Invalid Entry"; otherwise the program should print out the names of the digits of the integers, delimited by exactly one space. For example, if the user entered "528," the output would be "Five Two Eight." **10)** Basic Microcontroller programs #Practical No. 1 to 8 can be performed using any open source simulator (like Logisim) (Download it from https://sourceforge.net/projects/circuit/) # Practical No. 9 and 10 are required to be done using SPIM. SPIM is a self-contained simulator that will run MIPS R2000/R3000 assembly language programs. # Latest version is available at https://sourceforge.net/projects/spimsimulator/	**(90)**
1, 2, 3	**1)** Installing and setting up the Python IDLE interpreter. Executing simple statements like expression statement (numeric and Boolean types), assert, assignment, delete statements; the print function for output, Script and interactive modes; defining a function in the two modes; executing a script; interactively executing a statement list (semicolon-separated sequence of simple statements); the input function. **2)** Programs based on conditional constructs, loops, the range function, built-in functions len, sum, max, min, break and continue statement **3)** Programs based on strings and their methods **4)** Programs based on lists and their methods **5)** Programs based on tuples and their methods	

	6) Programs based on dictionaries and their methods **7)** Programs based on functions and anonymous functions, **8)** Programs based on time, math and random modules, creating your own modules **9)** Programs based on File Handling **10)** Programs based on Exception handling	

Course Code: US-FCS-1P2

Practical II	**Web Technologies – I & Database Systems**	**Total Credits: 2**
Unit	**Content**	**No. of Lectures**
1, 2, 3	**1)** Image Mapping **2)** List tags **3)** Table tags **4)** Form Tags **5)** HTML5 Tags - Audio Tags and Video Tags **6)** To apply CSS (Internal and External style) to a Web Page **7)** Execute different Control structures **8)** client-side scripts using JavaScript **9)** JavaScript Form Validations **10)** Write JavaScript code for: Demonstrating different JavaScript Objects such as String, RegExp, Math, Date, demonstrating different JavaScript Objects such as Window, Navigator, History, Location, Document, Storing and Retrieving Cookies	**(90)**
1, 2, 3	**1)** For given scenario, Draw E-R diagram and convert entities and relationships to table. **2)** Write relational algebra queries on the tables created in Practical-1. **3)** Perform queries for: Viewing all databases, creating a Database, viewing all Tables in a Database, Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback) **4)** Perform queries for: Altering a Table, Dropping / Truncating / Renaming Tables, backing up / Restoring a Database **5)** Perform queries for: Simple Queries, Simple Queries with Aggregate functions, Queries with Aggregate functions (group by and having clause) **6)** Queries involving: Date Functions, String Functions, Math Functions **7)** Join Queries and Sub queries: Inner Join, Outer Join, With IN clause, With EXISTS clause **8)** Views: Creating Views (with and without check option), Dropping views, Selecting from a view **9)** DCL statements: Granting and revoking permissions **10)** MongoDB: Queries to handle database, Sorting	

Course Code: US-FCS-1P3

Practical III	Discrete Mathematics & Statistics and R - I	Total Credits: 2
Unit	**Content**	**No. of Lectures**
1, 2, 3	**1)** Sets, Relations and Functions **2)** Recurrence relations and recursion **3)** Counting principles **4)** Permutations and Combinations **5)** Finite state Automata and Finite state machines **6)** Graph data structure & its operations **7)** Warshall's Algorithm **8)** Shortest Path algorithms **9)** Breadth and Depth First search algorithms **10)** Concept of searching, inserting and deleting from binary search trees	**(90)**
1, 2, 3	**1)** Execute the fundamental R commands, working with vector, list and data frames in R. **2)** Measures of central tendency using R. **3)** Perform data visualization using R. **4)** Perform data visualization by using ggplot2 library in R. **5)** Data entry using, functions, c (), scan (), Creating vectors, Mathematical Operations: ** +/-/*/ / ^, exp, log, log10, etc, creating vector of text type, useful functions: data, frame, matrix operations, seq (), split () etc. **6)** Frequency distribution using cut () and table () in R. **7)** Study correlation between two variables using suitable R function(s). **8)** Perform linear regression in R. **9)** Measures of skewness and kurtosis. **10)** Demonstrate the following concepts of probability theory by using suitable R functions: a. Sample spaces and events b. Equally likely model c. Counting methods d. Conditional probability e. Independent events	

Part - 5 The Scheme of Teaching and Examination is as under:
First Year Semester – II
Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	**Core Course (Computer Science)**			US-FCS-201 US-FCS-202 US-FCS-2P1 US-FCS-203 US-FCS-204 US-FCS-2P2	
2	**Elective Course**	**Discipline Specific Elective (DSE) Course**			
		2.1	**Interdisciplinary Specific Elective (IDSE) Course**		
		2.2	**Dissertation/Project**		
		2.3	**Generic Elective (GE) Course**	US-FCS-205, US-FCS-206 US-FCS-2P3	
3	**Ability Enhancement Courses (AEC)**			US-FCS-207	
4	**Skill Enhancement Courses (SEC)**				

First Year Semester -II Internal and External Detailed Evaluation Scheme

Sr. No.	Subject Code	Subject Title	Periods Per Week					Credits	Internals				Total Marks
			Units	S.L.	L	T	P		SLE	CT + AT = 15 + 5	PA	SEE	
1	US-FCS-201	Data Structures using C	3	20% *	3	0	-	2	10	20	10	60	100
2	US-FCS-202	Programming with Python - II	3	20% *	3	0	-	2	10	20	10	60	100
3	US-FCS-203	Web Technologies - II	3	20% *	3	0	-	2	10	20	10	60	100
4	US-FCS-204	Database Management using PLSQL	3	20% *	3	0	-	2	10	20	10	60	100
5	US-FCS-205	Calculus	3	20% *	3	0	-	2	10	20	10	60	100
6	US-FCS-206	Statistics and R - II	3	20% *	3	0	-	2	10	20	10	60	100
7	US-FCS-207	Green and Open Source Technologies	3	20% *	3	0	-	2	10	20	10	60	100
8	US-FCS-2P1	Practical of US-FCS-201 + US-FCS-202	-	-	-	-	6	2				100 (80+ 20)	100
9	US-FCS-2P2	Practical of US-FCS-203 + US-FCS-204	-	-	-	-	6	2				100 (80+ 20)	100
10	US-FCS-2P3	Practical of US-FCS-205 + US-FCS-206	-	-	-	-	6	2				100 (80+ 20)	100
	Total Lectures/ Credits							**20**	**Total Marks**				**1000**

****One to two lectures to be taken for CONTINUOUS self –learning Evaluation.**

First Year Semester – II Units – Topics – Teaching Hours

Sr. No.	Subject Code & Title	Subject Unit Title		Hours/ Lectures	Total No. of hours/ lectures	Credit	Total Marks
1	US-FCS-201 Data Structures using C	1	Structure of C program, Data, Iterations, Looping, Arrays	15	45L	2	100 (60+40)
		2	Functions, Structures and Unions, Pointer, Introduction to Data Structures - Stack and Queues	15			
		3	Linked List, Trees, Graphs, Sorting and Searching	15			
2	US-FCS-202 Programming with Python - II	1	Object-oriented programming concepts, Regular Expressions, GUI Programming in Python	15	45L	2	100 (60+40)
		2	Database connectivity in Python, Network connectivity, Python CSV	15			
		3	Python comprehension, Threads, CGI programming and XML processing	15			
3	US-FCS-203 Web Technologies - II	1	XML, JSON, Introduction to AJAX	15	45L	2	100 (60+40)
		2	jQuery, HTML Graphics: HTML Canvas, HTML SVG	15			
		3	HTML5 APIs	15			
4	US-FCS-204 Database Management using PLSQL	1	Fundamentals of PL/SQL, Overview of PL/SQL Control Structures	15	45L	2	100 (60+40)
		2	Stored Procedures, Stored Procedures, Sequences, Packages, Exception Handling	15			
		3	Transaction Management, TCL Statements, Crash Recovery	15			
5	US-FCS-205 Calculus	1	Derivatives and its applications	15	45L	2	100 (60+40)
		2	Integration and its applications	15			
		3	Partial derivatives and its applications	15			
6	US-FCS-206 Statistics and R - II	1	Revisiting Elementary Probability Theory and Random Variables, Standard distributions, An Introduction to R programming - II	15	45L	2	100 (60+40)
		2	Elementary Sampling Theory, Hypothesis testing, Analysis of variance	15			
		3	Non-parametric tests, Statistical Modeling and its Applications in Machine Learning	15			
7	US-FCS-207	1	Green IT Overview, Green Devices	15	45L	2	100

	Green and Open Source Technologies		and Hardware, Green Software, Sustainable Software Development				(60+40)
		2	Green Data Centers, Green Data Storage, Green Networks and Communications, Enterprise Green IT Strategy	15			
		3	Introduction to FOSS, Methodologies, Philosophy, Contributing to Open Source Projects	15			
8	US-FCS-2P1	1	Practical based on US-FCS-201	3	45x2= 90 lectures per batch	2	100 (80+10+10)
		2	Practical based on US-FCS-202	3			
9	US-FCS-2P2	1	Practical based on US-FCS-203	3	45x2= 90 lectures per batch	2	100 (80+10+10)
		2	Practical based on US-FCS-204	3			
10	US-FCS-2P3	1	Practical based on US-FCS-205	3	45x2= 90 lectures per batch	2	100 (80+10+10)
		2	Practical based on US-FCS-206	3			
			TOTAL			**20**	**1000**

- **Lecture Duration – 48 Minutes**
- **One Credit =15 hours**

L: Lecture: Tutorials P: Practical Ct-Core Theory, Cp-Core Practical, SLE- Self learning evaluation CT-Commutative Test, SEE- Semester End Examination, PA- Project Assessment, AT- Attendance

Part - 6 Detailed Scheme Theory

Curriculum Topics along with Self-Learning topics - to be covered, through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT

Course code: US-FCS-201 Data Structures using C

Unit	Content	No. of Lectures
1	**1.1 Structure of C program**: Header and body, Use of comments, Interpreters v/s compilers, Compilation of a program. Formatted I/O: printf (), scanf(). **1.2 Data**: Variables, Constants, data types like: int, float, char, string, double and void, short and long size qualifiers, signed and unsigned qualifiers. String handling functions. Operators and its types, Precedence and order of evaluation, statements and Expressions. Automatic and explicit type conversion. **1.3 Iterations**: Control statements for decision making: (i) Branching: if statement, else... if statement, if…else or nested ifs, switch statement. (ii) **1.4 Looping:** while loop, do... while, for loop. (iii) Jump statements: break, continue and goto. **1.5 Arrays:** (One and two dimensional), declaring array variables, initialization of arrays, accessing array elements.	**15**
2	**2.1 Functions**: Function declaration, function definition, Global and local variables, return statement, calling a function by passing values. Recursion: Definition, Recursive functions. **2.2 Structures and Unions**: Declaration of structure and union, creating and accessing structure and union variables, Array of structures, structures within structures, Comparison of structures and union. **2.3 Pointer:** Fundamentals, Pointer variables, Referencing and de-referencing, Using Pointers with Arrays and strings, Array of Pointers, Pointers as function arguments. **2.4 Introduction to Data Structures:** Introduction, Types of Data Structures – Linear and Nonlinear, Operations on Data Structures, Concept of ADT, Arrays. **2.5 Stack and Queues:** Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack – Well form-ness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation, Recursion. ADT of Queue, Operations on Queue, Array Implementation of Queue, Circular Queue, Priority Queue, Double Ended Queue, Applications of Queue.	**15**
3	**3.1 Linked List:** Introduction, Representation of Linked List, Linked List v/s Array, Implementation of Linked List, Linked Implementation of Stack and Queue, Circular Linked List, Doubly Linked List, Application – Polynomial Representation and Addition. **3.2 Sorting and Searching:** Introduction, Bubble Sort, Insertion Sort, Merge Sort, Quick Sort, Linear Search, Binary Search, Hashing – Concept, Hash Functions, Collision Handling Techniques.	**15**

Self-Learning topics (Unit wise)

Sub-Unit	Topic
1.2	**Operators and its types,** Precedence and order of evaluation, statements and Expressions. Automatic and explicit type conversion.
1.3	**Iterations**: Control statements for decision making: (i) Branching: if statement, else... if statement, if…else or nested ifs, switch statement. (ii)
1.4	**Looping:** while loop, do... while, for loop. (iii) Jump statements: break, continue and goto.

Online Resources

Refer week 3 and week 4 course contents from "Art of C Programming" course available on Swayam portal. Link: https://swayam.gov.in/nd2_cec20_cs02/preview

Reference Books: US-FCS-201 Data Structures using C

1.	Unit – 1	E Balagurusamy, Programming in ANSI C, 3rd Edition, TMH
2.	Unit – 1	Yashavant P. Kanetkar. " Let Us C", BPB Publications
3.	Unit – 2	Data Structures using C, Reema Thareja, Oxford
4.	Unit - 3	Introduction to Data Structure and Its Applications, JeanPaul Tremblay, P. G. Sorenson.
5.	Unit - 3	Data Structure Using C, Balagurusamy.

US-FCS-202 Programming with Python - II

Unit	Content	No. of Lectures
1	**1.1 Object-oriented programming concepts:** Object, Class, Constructors, Methods, Inheritance, Overloading methods. Iterables, iterators and their problem solving applications. **1.2 Regular Expressions:** Concept of regular expression, various types of regular expressions, using match function. **1.3 GUI Programming in Python (using Tkinter/ wxPython/ Qt):** GUI, Advantages of GUI, and Introduction to GUI library, Layout management, events and bindings, fonts, colors', draw on canvas (line, oval, rectangle, etc.) Widgets such as: frame, label, button, check button, entry, list box, message, radio button, text, spin box etc.	**15**
2	**2.1 Database connectivity in Python:** Installing MYSQL connector, accessing connector module, using connect, cursor, execute & close functions, reading single & multiple results of query execution, executing different types of statements, executing transactions, understanding exceptions in database connectivity. **2.2 Network connectivity**: Socket module, creating server-client programs, sending email, reading from URL. **2.3 Python CSV –** Spreadsheets writing, reading using CSV module	**15**
3	**3.1 Python comprehension** – List and Dictionary using map, filter & reduce functions. **3.2 Threads –** Process v/s Thread, Thread module, Creating a thread or multiple threads, Producer-consumer problem Synchronizing threads with lock, semaphores **3.3 CGI programming** **3.4 XML processing**	**15**

Self-Learning topics (Unit wise)

Sub-Unit	Topic
1.2	**Regular Expressions:** Concept of regular expression, various types of regular expressions, using match function.
2.3	**Python CSV –** Spreadsheets writing, reading using CSV module
3.1	**Python comprehension –** List and Dictionary using map, filter & reduce functions.

Online Resources

a. https://docs.python.org/3/library/re.html#
b. https://github.com/python/cpython/blob/3.8/Lib/re.py
c. https://docs.python.org/3/
d. https://github.com/python/cpython/blob/3.8/Lib/csv.py
e. https://www.w3schools.com/python/
f. https://docs.python.org/3/tutorial/datastructures.html

Reference Books: US-FCS-202 Programming with Python - II

1.	Unit – 1, 2 & 3	Paul Gries, et al., Practical Programming: An Introduction to Computer Science Using Python 3, Pragmatic Bookshelf, 2/E 2014
2.		Magnus Lie Hetland, Beginning Python: From Novice to Professional, Apress
3.		A. Lukaszewski, MySQL for Python: Database Access Made Easy, Pact Publisher, 2010

US-FCS-203 Web Technologies – II

Unit	Content	No. of Lectures
1	**1.1 XML-** Introduction to XML, Comparing XML with HTML, Advantages and Disadvantages of XML, Describing the Structure of XML - Declaration, Elements, Attributes, Comments, CDATA, XML Entity References, Parsers, Document Type Definitions (DTD). **1.2 JSON** – What is JSON, JSON vs. XML, JSON data type – String, Number, Boolean, Null, Object, Array. **1.3 Introduction to AJAX** – AJAX Web Application Model, Working of AJAX Asynchronous Data Transfer with XMLHttpRequest-Creating the XMLHttpRequest Object, XMLHttpRequest Properties, XMLHttpRequest Methods, Using the XMLHttpRequest Object in Different Browsers, Reading a File Synchronously, Reading a File Asynchronously, Performing Tasks Using the XMLHttpRequest Object, Accessing XML and JSON data using AJAX.	**15**
2	**2.1 jQuery -** JavaScript DOM objects their methods and properties-Window, History, Location Document, Form etc. Fundamentals of jQuery, Loading and using jQuery, using jQuery Library files, Callback functions, jQuery Selectors, jQuery Methods to Access HTML Attributes, jQuery Methods of traversing, jQuery Manipulators, jQuery Events, jQuery Effects, jQuery with AJAX **2.2 HTML Graphics: HTML Canvas** – Introduction to Canvas, Canvas - Drawing, Coordinates, Text, Images. **2.3 HTML SVG** – Introduction to SVG, Differences and comparison between Canvas and SVG, SVG shapes – Rectangle, Circle, Line, Text.	**15**
3	**3.1 HTML5 APIs** GeoLocation API - Geolocation interface, The getCurrentPosition() method and its data return properties. HTML Drag and Drop API - DragEvent interface, Event Handlers - draggable, ondragstart, ondragover, ondrop and methods - setData(), getData(). HTML Web Storage - localStorage and sessionStorage objects. Fetch API - fetch() method Fullscreen API - Document.exitFullscreen() and Element.requestFullscreen() URL API - URL constructor, properties - hash, host, hostsname, href, port, protocol Vibration API - Navigator.vibrate() method	**15**

Self-Learning topics (Unit wise)

Sub-Unit	Topic
2.1	**jQuery -** JavaScript DOM objects their methods and properties-Window, History, Location Document, Form etc.
2.2	**HTML Graphics: HTML Canvas** – Introduction to Canvas, Canvas - Drawing, Coordinates, Text, Images.
2.3	**HTML SVG** – Introduction to SVG, Differences and comparison between Canvas and SVG, SVG shapes – Rectangle, Circle, Line, Text.

Online Resources

https://www.w3schools.com/graphics/svg_text.asp https://www.w3schools.com/graphics/canvas_intro.asp https://www.w3schools.com/js/js_jquery_dom.asp

Reference Books: US-FCS-203 Web Technologies – II

1.	Unit – 1	HTML5 Black Book: Covers JAVASCRIPT, XML, XHTML, AJAX
2.	Unit – 2 & 3	JavaScript: The Definitive Guide, 6th Edition by David Flanagan

US-FCS-204 Database Management using PLSQL

Unit	Content	No. of Lectures
1	**1.1 Fundamentals of PL/SQL:** Introduction, Features, Advantages, PLSQL Engine, PLSQL basic syntax, Data types: Number Types, Character Types, String Types, Boolean Type, Date time and Interval Types, Defining variables and constants, default values to variables, PL/SQL expressions and comparisons: Logical Operators, Boolean Expressions, CASE Expressions Handling, Null Values in Comparisons and Conditional Statements, Arrays, Use variables to store data, The %TYPE & %ROWTYPE Attribute **1.2 Overview of PL/SQL Control Structures:** Conditional Control: IF and CASE Statements, IF-THEN Statement, IF-THEN-ELSE Statement, IFTHEN-ELSIF Statement, CASE Statement, Iterative Control: LOOP and EXIT Statements, WHILE-LOOP, FOR-LOOP, Sequential Control: GOTO and NULL Statements	**15**
2	**2.1 Stored Procedures:** Types and benefits of stored procedures, creating stored procedures, executing stored procedures, altering stored procedures, viewing stored procedures. **2.2 Triggers:** Concept of triggers, Implementing triggers – creating triggers, Insert, delete, and update triggers, nested triggers, viewing, deleting and modifying triggers, and enforcing data integrity through triggers. **2.3 Sequences**: creating sequences, referencing, altering and dropping a sequence. **2.4 Packages:** Advantages of Packages, Components of a Package, Develop a Package, Visibility of a Package's components, Package Specification and Body, Package Constructs, Package Information **2.5 Exception Handling:** Understand Exceptions, Raising Exceptions, Trap Predefined exceptions, Creating and handling user defined exceptions	**15**
3	**3.1 Transaction Management:** ACID Properties, Serializability, Two-phase Commit Protocol, Concurrency Control, Lock Management, Lost Update Problem, Inconsistent Read Problem , Read-Write Locks, Deadlocks Handling, Two Phase Locking protocol. **3.2 TCL Statements:** Defining a transaction, Making Changes Permanent with COMMIT, Undoing Changes with ROLLBACK, Undoing Partial Changes with SAVEPOINT and ROLLBACK **3.3 Crash Recovery:** ARIES algorithm. The log based recovery, recovery related structures like transaction and dirty page table, Write-ahead log protocol, check points, recovery from a system crash, Redo and Undo phases.	**15**

Self-Learning topics (Unit wise)

Sub-Unit	Topic
1.1	**Introduction to PLSQL**, Features, Advantages, PLSQL Engine, PLSQL basic syntax, Data types: Number Types, Character Types, String Types, Boolean Type, Date time and Interval Types, Defining variables and constants, default values to variables
1.2	**Overview of PL/SQL Control Structures:** Conditional Control: IF and CASE Statements, IF-THEN Statement, IF-THEN-ELSE Statement, IFTHEN-ELSIF Statement, CASE Statement, Iterative Control: LOOP and EXIT Statements, WHILE-LOOP, FOR-LOOP, Sequential Control: GOTO and NULL Statements

Online Resources

https://www.oracletutorial.com/plsql-tutorial/ https://docs.oracle.com/

Reference Books: US-FCS-204 Database Management using PLSQL

1.	Unit – 1 & 2	Ivan Bayross, "SQL, PL/SQL -The Programming language of Oracle", B.P.B. Publications
2.		ORACLE "The Complete Reference", Tata McGraw Hill, New Delhi
3.		SQL and PL/SQL for Oracle 11g Black Book by P.S. Deshpande
4.	Unit – 3	Abraham Silberschatz, Henry F. Korth,S. Sudarshan , Database System Concepts, 6th Edition
5.	Unit – 3	Ramakrishnan, Raghu and Gehrke, Johannes - Database Management Systems, 3rd Edition

US-FCS-205 Calculus

Unit	Content	No. of Lectures
1	**1.1 Derivatives and its applications:** Review of Functions, limit of a function, continuity of a function, derivative function. Derivative In Graphing And Applications: Analysis of Functions: Increase, Decrease, Concavity, Relative Extreme; Graphing Polynomials, Rational Functions, Cusps and Vertical Tangents. Absolute Maxima and Minima, Applied Maximum and Minimum Problems, Newton's Method.	**15**
2	**2.1 Integration and its applications:** An Overview of the Area Problem, Indefinite Integral, Definition of Area as a Limit; Sigma Notation, Definite Integral, Evaluating Definite Integrals by Substitution, Area Between Two Curves, Length of a Plane Curve. Numerical Integration: Simpson's Rule. Modeling with Differential Equations, Separation of Variables, Slope Fields, Euler's Method, First- Order Differential Equations and Applications.	**15**
3	**3.1 Partial derivatives and its applications:** Functions of Two or More Variables Limits and Continuity Partial Derivatives, Differentiability, Differentials, and Local Linearity, Chain Rule, Directional Derivatives and Gradients, Tangent Planes and Normal, Vectors, Maxima and Minima of Functions of Two Variables.	**15**

Self-Learning topics (Unit wise)

Unit	Topic
1.1	Review of Functions, limit of a function, continuity of a function, derivative function
2.1	Modeling with Differential Equations, Separation of Variables, Slope Fields, Euler's Method, First- Order Differential Equations and Applications.
3.1	Functions of Two or More Variables Limits and Continuity Partial Derivatives

Online Resources

Refer week 1, 2 and 3 course contents from "Differential Calculus" course available on Swayam portal. Link: https://swayam.gov.in/nd2_cec19_ma02/preview
Refer week 2 and week 3 course contents from "Mathematical Methods and its Applications" course available on Swayam portal. Link: https://swayam.gov.in/nd1_noc20_ma14/preview
Refer week 11course contents from "Differential Calculus" course available on Swayam portal. Link: https://swayam.gov.in/nd2_cec19_ma02/preview

Reference Books: US-FCS-205 Calculus

1.	Unit – 1, 2 & 3	Calculus: Early transcendental (10th Edition): Howard Anton, Irl Bivens, and Stephen Davis, John Wiley & sons, 2012.

US-FCS-206 Statistics and R - II

Unit	Content	No. of Lectures
1	**1.1 Revisiting Elementary Probability Theory and Random Variables:** Sample Space and Events, Probability Definition, Dependent & Independent events, Mutually Exclusive events, Discrete and Continuous Random variables, Probability mass function, Probability density function, Cumulative Distribution Function, Expected value and Variance. **1.2 Standard distributions:** Introduction and properties without proof for following distributions; binomial, poisson, normal, chi-square, t, F. Examples **1.3 An Introduction to R programming - II:** Probability distributions, Grouping, loops and conditional execution, Writing your own functions, Statistical models in R, Packages.	**15**
2	**2.1 Elementary Sampling Theory:** Sampling Theory, Random Samples and Random Numbers, Sampling With and Without Replacement, Sampling Distributions, Sampling Distribution of Means. **2.2 Hypothesis testing:** one sided, two sided hypothesis, critical region, p-value, tests based on t, Normal and F, confidence intervals. **2.3 Analysis of variance :** one-way, two-way analysis of variance	**15**
3	**3.1 Non-parametric tests:** need of non-parametric tests, sign test, Wilicoxon's signed rank test, run test, Kruskal-Walis tests. Post-hoc analysis of one-way analysis of variance : Duncan's test Chi-square test of association **3.2 Statistical Modeling and its Applications in Machine Learning:** Exploratory Data Analysis, Data summarization, Data visualization, Correlation & Regression, Linear regression model, Time series analysis, Forecasting.	**15**

Self-Learning topics (Unit wise)

Sub-Unit	Topic
1.1	**Revisiting Elementary Probability Theory and Random Variables:** Sample Space and Events, Probability Definition, Dependent & Independent events, Mutually Exclusive events, Discrete and Continuous Random variables, Probability mass function, Probability density function, Cumulative Distribution Function, Expected value and Variance.

Online Resources

Refer week 3, 4 content from "Introduction to Probability and Statistics" course available on Swayam portal. Link: https://swayam.gov.in/nd1_noc20_ma22/preview
http://r-statistics.co/Time-Series-Analysis-With-R.html https://blogs.oracle.com/datascience/introduction-to-forecasting-with-arima-in-r https://datascienceplus.com/time-series-analysis-using-arima-model-in-r/

Reference Books: US-FCS-206 Statistics and R - II

1.	Unit – 1, 2 & 3	Trivedi, K.S. (2009): Probability, Statistics, Design of Experiments and Queuing theory, with applications of Computer Science, Prentice Hall of India, New Delhi.
2.		Murray R. Spiegel, Larry J. Stephens, Schaum's Outline of Theory and problems of Statistics, McGraw Hill, 4th Edition
3.		Sinan Ozdemir, Principles of Data Science, Packt, 2016.
4.		R.B. Patil, H.J. Dand and R. Bhavsar, A Practical Approach using R, SPD, 1st edition (2017).

US-FCS-207 Green and Open Source Technologies

Unit	Content	No. of Lectures
1	**1.1 Green IT Overview:** Introduction, Environmental Concerns and Sustainable Development, Environmental Impacts of IT, Green I, Holistic Approach to Greening IT, Greening IT, Applying IT for Enhancing Environmental Sustainability, Green IT Standards and Eco-Labelling of IT, Enterprise Green IT Strategy, Green Washing, Green IT: Burden or Opportunity? **1.2 Green Devices and Hardware:** Introduction, Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose **1.3 Green Software:** Introduction, Processor Power States, Energy-Saving Software Techniques, Evaluating and Measuring Software Impact to Platform Power **1.4 Sustainable Software Development:** Introduction, Current Practices, Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics, Sustainable Software Methodology, Defining Actions	**15**
2	**2.1 Green Data Centers:** Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure, Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics **2.2 Green Data Storage:** Introduction, Storage Media Power Characteristics, Energy Management Techniques for Hard Disks, System-Level Energy Management **2.3 Green Networks and Communications:** Introduction, Objectives of Green Network Protocols, Green Network Protocols and Standards **2.4 Enterprise Green IT Strategy:** Introduction, Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation, Organizational Considerations in a Green IT Strategy, Steps in Developing a Green IT Strategy, Metrics and Measurements in Green Strategies.	**15**
3	**3.1 Introduction to open source:** open Source, Free Software, Free Software vs. Open Source software, Public Domain Software, FOSS does not mean any cost. History: BSD, The Free Software Foundation and the GNU Project. **3.2 Methodologies:** Open Source History, Initiatives, Open source vs. closed source, Shared software, Shared source **3.3 Philosophy:** Software Freedom, What Is A License, Important FOSS Licenses (Apache, BSD, GPL, LGPL), copyrights and copy lefts, Zero Marginal Cost, Open Source Hardware, Open Source Design, Open source Teaching. Open source media. **3.4 Contributing to Open Source Projects:** Introduction to Github, interacting with the community on Github, Introduction to Wikipedia, contributing to Wikipedia, Case studies: GNU/Linux, Android, Mozilla (Firefox), Wikipedia, WordPress, Github, Open Office, Python, MySQL	**15**

Self-Learning topics (Unit wise)

Unit	Topic
3.1	**Introduction to open source** open Source, Free Software, Free Software vs. Open Source software, Public Domain Software, FOSS does not mean any cost. History: BSD, The Free Software Foundation and the GNU Project.
3.4	**Contributing to Open Source Projects:** Introduction to Github, interacting with the community on Github, Introduction to Wikipedia, contributing to Wikipedia, Case studies: GNU/Linux, Android, Mozilla (Firefox), Wikipedia, WordPress, Github, Open Office, Python, MySQL

Online Resources

Refer week 1 and week 2 contents from "Open Source Software Development Methods" course available on coursera. Link: https://www.coursera.org/learn/open-source-software-development-methods#syllabus

Reference Books: US-FCS-207 Green and Open Source Technologies

1.	Unit – 1 & 2	Harnessing Green IT: Principles and Practices, San Murugesan, G. R. Ganadharan, Wiley & IEEE.
2.		Green Communications: Principles, Concepts and Practice- Samdanis et al, J. Wiley
3.	Unit - 3	Kailash Vadera, Bhavyesh Gandhi, Open Source Technology Wikipedia: https://en.wikipedia.org/ https://en.wikipedia.org/wiki/Wikipedia:Contributing_to_Wikipedia Github: https://help.github.com/ Open Source Initiative: https://opensource.org/ The Linux Documentation Project: http://www.tldp.org/ https://www.openoffice.org/

Part – 7 Detailed Scheme Practical

Course Code: US-FCS-2P1

Practical I	**Data Structures using C & Programming with Python - II**	**Total Credits: 2**
Unit	**Content**	**No. of Lectures**
1, 2, 3	**1)** Basic data types and I/O **2)** Operators and Expressions **3)** Decision statements & Looping **4)** Arrays & Strings **5)** Functions, Structures and Unions **6)** Pointers **7)** Data structures – Stack & queues **8)** Linked List **9)** Graph & trees **10)** Searching & sorting	**(90)**
1, 2, 3	**1)** Programs based on Class, Object, Method, Inheritance, Overloading **2)** Programs based on regular expressions **3)** Programs based on GUI Programming **4)** Programs based on Database connectivity **5)** Programs based on Network connectivity **6)** Programs based on Python CSV **7)** Programs based on Python comprehension **8)** Programs based on Threads **9)** Programs based on CGI programming **10)** Programs based on XML processing	

Course Code: US-FCS-2P2

Practical II	**Web Programming – II & Database Management Systems using PLSQL**	**Total Credits: 2**
Unit	**Content**	**No. of Lectures**
1, 2, 3	**1)** Create an XML file with Internal / External DTD **2)** Create a JSON data file of given schema. **3)** Retrieving data from server & Sending data to server using AJAX using XML and JSON. **4)** Design a webpage to handle asynchronous requests using AJAX on: a. Mouseover b. Button Click **5)** Representing Data Using jQuery Selectors / jQuery Methods to Access HTML Attributes **6)** Representing Data using jQuery Manipulators, jQuery Events, jQuery Effects **7)** Draw and Display the following shapes with the help of HTML Canvas on a web page – Circle, Line, Text, and Image. **8)** Create the following shapes as SVG: Rectangle, Circle, Line, Text. **9)** Demonstrate the use of HTML5 Storage APIs. **10)** Demonstrate the use of the following HTML5 APIs: a. GeoLocation API b. Fetch API c. Fullscreen API d. HTML Drag and Drop API e. URL API	**(90)**
1, 2, 3	**1)** Writing PL/SQL Blocks with basic programming constructs by including following: a. Sequential Statements b. Unconstrained loop c. %TYPE & %ROWTYPE d. Arrays **2)** Writing PL/SQL Blocks with basic programming constructs by including If...then...Else, IF...ELSIF...ELSE... END IF, Case statement, GOTO & NULL stamen in IF **3)** Writing PL/SQL Blocks with basic programming constructs for Iterative Structure: while-loop Statements, for -loop Statements. **4)** Writing Procedures in PL/SQL Block a. Create an empty procedure, replace a procedure and call procedure b. Create a stored procedure and call it c. Define procedure to insert data	

	d. A forward declaration of procedure **5)** Writing PLSQL blocks for triggers **6)** Writing Functions in PL/SQL Block. a. Define and call a function b. Define and use function in select clause, c. Call function in dbms_output.put_line d. Count Employee from a function and return value back e. Call function and store the return value to a variable **7)** Sequences: a. Creating simple Sequences with clauses like START WITH, INCREMENT BY, MAXVALUE, MINVALUE, CYCLE | NOCYCLE, CACHE | NOCACHE, ORDER | NOORECER. b. Creating and using Sequences for tables. **8)** Writing PLSQL blocks for packages **9)** Writing PLSQL blocks for handling exceptions: Built-in & User-defined **10)** Writing PLSQL blocks of transactions and locks	

Course Code: US-FCS-2P3

Practical III	**Calculus** & **Statistical and R- II**	**Total Credits: 2**
Unit	**Content**	**No. of Lectures**
1, 2, 3	**1)** Continuity of functions; Derivative of functions **2)** Increasing, decreasing, concave up and concave down functions **3)** Relative maxima, relative minima, absolute maxima, absolute minima **4)** Newton's method to find approximate solution of an equation **5)** Area as a limit and length of a plane curve **6)** Numerical integration using Simpson's rule **7)** Solution of a first order first degree differential equation, Euler's method **8)** Calculation of Partial derivatives of functions **9)** Local linear approximation and directional derivatives **10)** Maxima and minima of functions of two variables	**(90)**
1, 2, 3	**1)** Problems solving on random variables, expected value and variance. **2)** Random variables using R. **3)** Problem solving on binomial distribution. **4)** Binomial distribution using R. **5)** Problems solving on normal distribution **6)** Normal distribution using R. **7)** Perform hypothesis testing using suitable R functions: t test, normal test, F test **8)** Perform chi-square test using R. **9)** Analysis of Variance & Non parametric tests **10)** Perform time series analysis in R	