Academic Programme Guide
of
Integrated Bachelor of Engineering - Master of Engineering
(Computer Science and Engineering)

Based on Choice Based Credit System (CBCS)/Elective Course System

CHITKARA UNIVERSITY

HIMACHAL PRADESH

NAAC ACCREDITED

w.e.f.
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1. General Information

Computer Science and Engineering is an evolving stream that is directly or indirectly affecting all other disciplines. Computers are becoming ubiquitous, appearing in a variety of forms in homes, industries and academia. This stream involves modelling of all other engineered, natural, and human systems.

The five-year Integrated B.E.-M.E. (CSE) Program is designed to provide conceptual knowledge of core courses in the field of Computer Science and Engineering. Various courses offered are in the areas of programming languages, database management, computational complexity theory, software engineering, algorithms, system architecture, operating system and many more. The program will emphasize on teaching fundamentals of basic courses along with the practical applications. Apart from core courses, students will be offered discipline electives and specialization elective courses in a view to provide in-depth knowledge and encourage research in integrated areas. In project courses, students are required to give practical shape to the concepts they have learned in various courses. Besides above, the students must complete one-semester training/internship in the final academic year, towards the fulfilment of degree requirements.

1.1 Programme Educational Objectives (PEO)

PEO 1. To use Computer Science and Engineering principles for solving complicated engineering problems.
PEO 2. To effectively communicate for working autonomously and productively in multi-disciplinary teams.
PEO 3. To gain extra information and abilities via continuous enlightenment.
PEO 4. To have a significant impact on finding long-term remedies for environmental and social problems.

1.2 Programme Outcomes (PO)

The department expects undergraduate students to be able to demonstrate the following outcomes. The students are expected to be able to:

PO1. Solve difficult engineering challenges by integrating your background in mathematics, physics, the basics of engineering, and your area of engineering expertise.
PO2. Recognize difficult engineering issues, create solutions, and evaluate alternatives utilizing fundamental principles in mathematics, the natural sciences, and engineering sciences.
PO3. Make sure public health and safety, as well as cultural, socioeconomic, and environmental factors are taken into account while designing solutions for complex engineering challenges and make sure system components or processes match the required demands.
PO4. Valid findings should be reached by using research-based knowledge and research procedures, such as experimental design, data analysis and interpretation, and synthesis.
PO5. Develop, evaluate, and implement novel approaches, materials, and state-of-

the-art engineering and information technology (IT) tools, including forecasting and modeling, for challenging engineering tasks while being cognizant of their constraints.

PO6. Evaluate the impact on society, health, safety, law, and culture, as well as the resulting obligations, of professional engineering practice using reasoning based on this contextual knowledge.

PO7. Demonstrate an awareness of, and commitment to, sustainable development by comprehending the repercussions of professional engineering solutions within social and environmental frameworks.

PO8. Employ moral reasoning, and pledge allegiance to the engineering profession's code of ethics, obligations, and standards.

PO9. Ability to work well both alone and as a team member or leader in interdisciplinary and culturally diverse contexts.

PO10. Comprehend and create effective reports and design documentation, give and receive clear directions, and give and receive effective presentations are all examples of how to communicate successfully on complicated engineering operations with the technical community and society at large.

PO11. Prove one well-versed in engineering and management concepts and able to use them in one's own work, as a team member or leader, in the management of projects, and in the context of interdisciplinary settings.

PO12. Understand the significance of lifelong learning in the context of rapid technological advancement, and be self-motivated to pursue it.

1.3 University Vision and Mission

Vision:

To be a globally recognized organization promoting academic excellence through interdisciplinary applied research and to expand realms of knowledge through innovation.

Mission:

M1. To carry out the academic processes in accordance with global standards through active teacher-student-industry participation.

M2. To promote research, innovation and entrepreneurship in collaboration with industry, research laboratories and academic institutions of global repute.

M3. To inculcate high moral, ethical and professional values amongst our students, faculty & staff.

M4. To contribute in building skillful society.

The Programme Educational Objectives (PEOs) of Integrated B.E.-M.E. Computer Science and Engineering programme, are well-designed on the mission of imparting the knowledge and expertise required in the field of Computer Science and Engineering and equip the students with the necessary technical and interpersonal skills for working in industries or to become an entrepreneur.

This programme prepares the students to compete in a global environment with ample opportunities available around different business domains. Every year, faculty from different reputed universities across the globe visit Chitkara University to provide

international exposure, cross-cultural competence and knowledge sharing among the students. This programme offers "Engineering Exploration" course to the students which provide an opportunity for students to be aware of the diverse technology that best meets their interest which in turn develops confidence and motivation among the students. To develop students' personality through community services, NSS activities are offered with the idea of social welfare and to provide service to the society. Variety of extra-curricular activities such as "Algorythm" have been organised every year to enrich student's interpersonal skills. Apart from these, the department in association with various technical societies like IEEE, ACM, IEI, organises industrial visits, technology-focused workshops, technical quizzes, hackathons and coding competitions for overall grooming of the students. Students also participate in sports activities which emphasize good health and their well-being. These activities have been designed taking into account various Programme Objectives like PO3, PO6, PO7, PO8, PO9 and PO10, and have been in accordance with the Programme Educational Objectives (PEO). The programme Integrated B.E.-M.E. Computer Science and Engineering is designed to build innovators, entrepreneurs, leaders, and responsible citizens with the above-mentioned skills and knowledge that will help them to achieve the UN 2030 agenda for sustainable development.

Programme Educational Objectives (PEO) and Programme Outcomes (PO) are designed and oriented to meet the mission of the university. The PEOs ensure that the graduating students are well equipped with strong technical knowledge, excellent communication skills, leadership quality, serving the community and society, helping establish a balanced social and professional environment which in turn transform the society into a knowledgeable and sustainable society.

2. Eligibility for Admission

The student seeking admission in Integrated B.E.-M.E. program should have a minimum aggregate of 60% marks or must have secured 60% in Physics, Chemistry and Mathematics in 12th grade. He / She should have appeared in JEE Mains for that admission year. The admission is based purely on merit.

3. Programme Duration

The duration of the Integrated B.E.-M.E. program is four years - divided into 10 semesters. University conducts end term examination at the end of each semester, except in the case of Co-op project at Industry or Internship at Industry, which is evaluated by a jury appointed by the University.

The maximum duration of completion of the degree is 7.5 years.

4. Pedagogical Aspects

The structural layout of the program and its courses requires that each course be divided into lecture, tutorial and practical sessions. Duration of each session as given in the column against the course in the course scheme is one hour.

Lecture Sessions: Lectures are delivered by traditional - chalkboard method, supplemented by modern Information Communication Technology (ICT) methods. The students are encouraged to ask questions and involve in a group discussion to the extent allowed by the teacher. In some courses where case study-based methodology is adopted, the lectures are supplemented by discussions on case studies.

Tutorial Sessions: The tutorial sessions are small groups of students interacting with the teacher, solving application-oriented analytical problems. The tutorial sessions are very interactive and inculcate problem-solving skills in the students.

Lab/Practical Sessions: During lab/practical sessions, the students work on a prescribed list of experiments and do what they have learnt in the lecture/tutorial sessions.

5. Programme Structure

The various courses prescribed for a Program is categorized in terms of their functional objectives as follows:

Core Courses: Core courses are the foundation courses that cater to develop the breadth of Computer Science stream and also include Humanities, Social Science, Management, Mathematics, Basic Science and Engineering Science courses. Core courses are compulsory and can be offered in any semester during the program tenure provided it meets the pre-requisite requirement. It is divided into these four categories:

a) Humanities, Social Science and Management (HSM)
b) Basic Science (BSC)
c) Engineering Science (ESC)
d) Professional Core (PC)

Elective Courses: The technical courses apart from core courses are offered as electives to the students. These are the professional courses that are offered to students to cover the depth in a specific area of computer science for their employment, research or higher education. It also includes courses from other departments and/or streams. The students may also choose a specialization track to enhance their skills in a particular area and to gain industry exposure. It includes:

a) Professional Electives (PE)
b) Open Electives (OE)

Mandatory Courses: These courses are intended for students to gain general knowledge, learn a new skill or develop personal interests. These courses may be offered in any semester of the program.

Special Courses (SC):

a) Projects and Co-op project at Industry: These are hands-on courses to apply the knowledge gained through core/elective courses. The students identify their team-mates and work on a unique project. The projects can be suggested by faculty or by students after getting due approval from faculty-in-charge. The projects are allotted to them at the start of the semester. The project statements are made in such a way that the students while working on these projects apply the concepts learned so far and the deliverables are multi-faceted.

b) Engineering Exploration Courses: Students are given a choice of technical and industry-oriented courses to get the knowledge of new technologies/skills. Students also have an option of choosing the courses from online platforms like MOOC (NPTEL/SWAYAM).

Model Programme Structure

Semester-1			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Problem Solving using Python Programming	4-0-0	4
2	Fundamentals of Web Technology	3-0-0	3
3	Object Oriented Programming Using C++	4-0-0	4
4	Calculus and Statistical Analysis	4-0-0	4
5	Introduction to Emerging Technologies	2-0-0	2
6	Fundamentals of Web Technology Lab	0-0-2	1
7	Basics of Electronics Engineering	3-0-0	3
8	Basics of Electronics Engineering Lab	0-0-2	1
		24	**22**

Semester-2			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Differential Equation and Transformations	4-1-0	5
2	Data Structures with C++	3-0-0	3
3	Advanced Web Technology	3-0-0	3
4	Operating System With Linux	3-0-0	3
5	Data Structures with C++ Lab	0-0-2	1
6	Advanced Web Technology Lab	0-0-2	1
7	Operating System With Linux Lab	0-0-2	1
8	Environmental Sciences	2-0-0	0
9	Modern and Computational Physics	3-0-0	3
10	Modern and Computational Physics Lab	0-0-2	1
		27	**21**

Semester-3			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Database Management Concepts	3-0-0	3
2	Database Management Concepts Lab	0-0-2	1
3	Principles of Computer Networks	3-0-0	3

4	Principles of Computer Networks Lab	0-0-2	1
5	Problem Solving Using C	3-0-0	3
6	Problem Solving Using C Lab	0-0-2	1
7	Linux Programming	3-0-0	3
8	Linux Programming Lab	0-0-2	1
9	Engineering Exploration	2-0-0	2
10	Discrete Structures	4-0-0	4
		26	**22**

Semester-4			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Computer System Architecture	3-0-0	3
2	Object Oriented Software Engineering	3-0-2	4
3	Soft Computing	3-1-0	4
4	Front End Engineering	3-0-2	4
5	Integrated Project-I	0-0-4	2
6	Programming Abstractions	3-0-2	4
6	English for Technical Professionals	2-0-0	2
7	Cyber Security	2-0-0	0
		30	**23**

Semester-5			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Java Programming	0-0-4	2
2	Design & Analysis of Algorithms	3-0-2	4
3	Introduction to Cloud Computing	4-0-0	4
4	Elective – I (Professional Elective – I)	**	8#
5	Elective – II (Professional Elective – II)	**	
		21#	**18#**

Semester-6			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Elective – III (Professional Elective – III)	**	8#
2	Elective – IV (Professional Elective – IV)	**	
3	Theory of Computation	3-1-0	4
5	Professional Practices	2-0-0	2
6	Integrated Project – II	0-0-4	2
7	Disaster Management	2-0-0	0
		20#	**16#**

Semester-7			
S.No	**Title of the Course**	**L-T-P**	**Credits**
1	Open Elective – I	**	9
2	Open Elective – II	**	
3	Open Elective – III	**	
4	Web Programming and Source Code Management	3-0-2	4
5	Advanced Data Structures	3-0-2	4

6	Artificial Intelligence and Expert System	4-0-0	4
7	Lab Oriented Project	0-0-6	3
		29	**24**

Semester-8			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Industry Oriented Hands-on Experience	---	12
		---	**12**

Semester-9			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Co-op project at Industry Module-I	- - -	12
		- - -	**12**

Semester-10			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Co-op project at Industry Module-II	- - -	12
2	Research Project Dissertation	- - -	
		- - -	**12**

***Students can also earn these credits by opting co-op training in seventh and eighth semesters**
#Credits can vary based on the specialization
**** L-T-P will be based on the different electives chosen by the students.**

6. Assessment and Evaluation

The evaluation will be continuous, and the weightage of various components is as given in Tables specified for each type of course. The evaluation of all courses will be detailed in the course handout document prepared by the course coordinator with the approval of Head of the Department. The document will be shared with students before the start of the session.

Evaluation for Core / Elective / Specialization Course:

Courses can be evaluated in one of these three ways depending upon the course					
Evaluation Component	Weightage (%)	Evaluation Component	Weightage (%)	Evaluation Component	Weightage (%)
Quizzes/Assignments/ Class Tests/Case Studies	10	Formative Assessments (FAs)	20	Sessional Tests (STs)	40
Sessional Tests (STs)	30	Sessional Tests (STs)	30		
End Term Examination	60	End Term Examination	50	End Term Examination	60
Total	**100**	**Total**	**100**	**Total**	**100**

Evaluation components for Theory Courses

There are three Sessional Tests (STs) for all theory papers, the average of the best two are considered. However, the course coordinator, with the approval of Head of the Department may decide the number of STs required for a specific course. The policy on the evaluation component – 'Quizzes / Tutorials / Assignments'/Formative Assessments (if applicable else weightage is merged in STs) as decided by the course coordinator and Head of the Department and is announced separately for each course.

The evaluation components for Lab Courses have weightage for regular lab performances, internal viva-voce, conducted at the end of the academic semester. The End Term Examination for lab courses includes the conduct of experiments and an oral examination (viva voce).

Lab Courses	
Evaluation Component	Weightage (%)
Lab Performances / File work	40
Internal Viva – Voce	20
End Term	40
Total	**100**

Evaluation Components for Lab Courses

Evaluation for Integrated / Lab Oriented Project Courses:

Project Courses	
Evaluation Component	Weightage (%)
Planning	10
Performance	20
Internal Viva-Voce/Presentation/ Project Report	30
End Term/ Project Display/ External viva-voce	40
Total	**100**

Evaluation Components for Project Courses

Evaluation for Co-op Projects / Industry Oriented Hands-on Experience Courses:

Industry Oriented Specific Courses	
Evaluation Component	Weightage (%)
Employer / Industry Expert Assessment	20
Synopsis	10
Mid Term Evaluation	30
Final Evaluation	40
Total	**100**

Evaluation Components for Skill Oriented Industry Specific Courses

Evaluation for Engineering Exploration Courses: There are two mid-term evaluations and one evaluation at the end of the course. The type of evaluation may vary depending on the course type on the discretion of course Expert. It is decided before the commencement of the course and provided prior information to the students.

Evaluation for MOOC Courses: There is one evaluation at the end of the course. The certificate is issued by the host institute. Upon submission of the certificate, credits will be awarded to the student.

Evaluation for Global Exposure Courses: There is only one evaluation at the end of the course. The type of evaluation may vary depending on the course type on the discretion of course Expert. It is decided before the commencement of the course and provided prior information to the students.

Evaluation for Mandatory Courses: There is only End term Examination for these courses with 100% weightage.

7. Rules for Attendance

The program being highly rigorous, all the students are expected to show utmost regularity in attendance. Even a day's absence is detrimental to a student's interest. Therefore, the University's requirements in this regard are very stringent.

The University expects its students to be regular in attending the classes. 75% attendance (of all held sessions – lectures, tutorials, project work) is compulsory in a course to be eligible to appear for End Term Examination. The students are also encouraged for participation in co-curricular activities and can do so in 25% cushion provided in the attendance requirements. 10% concession in attendance requirements is possible only in case of extreme circumstances and at the sole discretion of the Vice-Chancellor.

8. Grading System

The list of Letter Grades is given below:

% Marks Range of total	Grade	Grade Point	Qualitative Meaning
80-100	O	10	Outstanding
70-79	A+	9	Excellent
60-69	A	8	Very Good
55-59	B+	7	Good
50-54	B	6	Above Average
45-49	C	5	Average
40-44	P	4	Pass
0-39	F	0	Fail
	AB		Absent

If a student obtains grade P or above, he/she is declared pass in that course. The grade F is equivalent to failing in that course, in which case, the student has to reappear in the end

term examination of that course again, whenever its exam is conducted again with the regular examination, after payment of appropriate examination fee. The rules for grading in reappear exam will be applicable as per the examination policy of the University.

If the student is detained from appearing in the end term examination because of the shortage of attendance in the regular semester or is absent at the end term exam, his/her grade in that course is I, till he/she appears again in the end term examination and obtains a new grade.

Calculation of CGPA:

The CGPA (calculated on a 10-point scale) would be used to describe the overall performance of a student (from the semester of admission till the point of reckoning) in all courses for which LETTER GRADES will be awarded. SGPA will indicate the performance of the student for any particular semester. Formulas for calculation of SGPA and CGPA have been provided as below:

$$SGPA_i = \frac{\sum_{j=1}^{n} C_{ij}G_j}{\sum_{j=1}^{n} C_{ij}} \qquad CGPA = \frac{\sum_{i=1}^{N}\left(SGPA_i * \sum_{j=1}^{n} C_{ij}\right)}{\sum_{i=1}^{N}\left(\sum_{j=1}^{n} C_{ij}\right)}$$

Where n = number of courses in the semester; N = number of semesters; $SGPA_i$ = SGPA for the ith semester; C_{ij} = number of credits for the j^{th} course in the i^{th} semester; and G_j = Grade point corresponding to the grade obtained in the j^{th} course.

Example to Understand the Calculation of SGPA:

Suppose a student is registered in four courses 'W', 'X', 'Y' and 'Z' in a particular semester as mentioned below in the Column - I of the table given below. Column - II in the table below depicts the number of credits, which those courses carried. At the end of the semester, the student was awarded the grades as mentioned in Column – III in the table given below. Column – IV indicates the corresponding grade weight. Column – V and Column – VI indicate essentially the Credit value and Grade Points for every course completed by a student in that particular semester.

Courses in which student registered (Column – I)	**Credits (Column – II)**	**Letter Grade (Column – III)**	**Grade Value (Column – IV)**	**Credit Value (Column – V)**	**Grade Points (Column – VI)**
Course W	3	B+	7	3 x 7	21
Course X	3	A	8	3 x 8	24
Course Y	3	A+	9	3 x 9	27
Course Z	2	O	10	2 x 10	20
Total	**11**			**Total**	**92**

Thus, the total SGPA of the student would be

$$SGPA = \frac{Totalgradepts.}{Totalno.ofcredits} = \frac{92}{11} = 8.36$$

Suppose the SGPA of the student in two successive semesters is 7.0 and 8.0 with respective course credits being 12 and 11, then the CGPA would be

$$CGPA = \frac{7\times12+8\times11}{12+11} = \frac{84+88}{23} = 7.48$$

9. Promotion and Registration

Any bonafide student, who appears for the examination conducted by the University, shall be promoted to the next higher semester and shall carry forward all course(s) in which he/she is declared fail. The student shall have to pass all papers within the stipulated maximum duration as prescribed by the University to qualify for the award of the degree.

All students are eligible to register for next semester irrespective of the number of backlogs.

A student is not permitted to register in a term if

(a) He/She has dues outstanding to the University, hostel, or any recognized authority or body of the University, or
(b) His/Her grade sheet in his/her immediately preceding term is withheld, or
(c) He/She has been specifically debarred or asked to stay away from that term

Late registration may be granted in case a student fails to register on the stipulated date. Students failing to register on the specified day of registration will be allowed to register only after permission from Head of the Departmentand after paying the stipulated late fee. Any student who has not registered will not be allowed to attend classes.

The registration of the student may be cancelled, if at the later stage, it is found that the student is not eligible for registration due to the following reasons:

(a) If the registration of a student in a course is not found to be as per the regulations, his/her registration in that course will be cancelled and the grade obtained, if any, will be rejected.
(b) The registration of a student in a course or complete set of courses in a term can be cancelled by the concerned authority when he is found guilty in case of unfair means, breach of discipline, etc. or when he/she persistently and deliberately does not pay his dues.
(c) Absence for a period of four or more weeks at a stretch during a term shall result in automatic cancellation of the registration of a student from all the courses in that term.

A student who is duly registered in a term is considered to be on the rolls of the university. After registration, if he/she withdraws from the term, or has been given prior permission to temporarily withdraw from the University for the term, or has been asked to stay away by an appropriate authority of the University will be considered to be on the rolls of the University for that term. While such a student retains the nominal advantage of being on the rolls of the University the loss of time from studies and its consequences cannot be

helped by the University.
If for any valid reason a student is unable to register in a term, he/she must seek prior permission of Head of the Departmentto drop the term. If such permission has not been requested or after a request, the permission has been denied, his/her name would be struck off the rolls of the University and he would no longer be a student of the University. His/her case will be automatically processed, and the file will be closed. However, if such a student, after his/her name has been struck off the rolls of the University, is permitted to come back, his/her case can be considered at the sole discretion of the competent authority of the University with the provision that all his/her previous records as a former student are revived under the current academic and administrative structure, regulations and schedule of fees.

10. Migration/Credit Transfer Policy

The following procedures will be followed for credit transfer for a student under migration, studied in other Universities in India and Abroad:

"The credits earned by the student from the other universities in India or abroad shall be transferred as such. The Degree shall only be awarded to the candidate subject to the condition that student earned the minimum no. of credit defined by Academic Regulation/APG of the Programme run by the Chitkara University."

In case a student undergoes international exchange programme or internship for 1 semester/ 1 year/ 2 years, then the courses, credits and grades earned by the student in abroad during that period should be reflected on the grade card issued by the Chitkara University. The courses will be marked as (*) on the grade card/transcript. The description of the (*) will be "credits and grades as adopted university/institute name . . .. during the international exchange programme.

In case of availability of seats, a student can apply for branch change. The student shall have to pass all papers of the first year and possess minimum CGPA criteria. Preference will be given to high CGPA.

11. Eligibility to Award the Degree

To be eligible for award of Integrated B.E.-ME degree in Computer Science and Engineering, a student must complete all the courses in which he/she has registered with minimum 180 credits and a minimum CGPA of 4.5.

12. Program Overview

Course type	HSM	BSC	ESC	PC	PE	OE	SC	Total
Credits	6	17	4	85	16	9	45	**182**

- In addition to these courses, a student must take three non-credit mandatory courses.

- The number of courses may vary in a semester based on the choice of electives/specialization courses.
- Student may earn credits of the seventh and eighth semester by taking co-op training.
- Student can choose additional electives instead of co-op training in the seventh semester.

List of Courses:

Course Code	Course Name	L-T-P	Credits
Humanities, Social Science and Management Courses (HSM)			**6**
CL103	English for Technical Professionals	0-0-4	2
CS254	Professional Practices	2-0-0	2
GE102	Introduction to Emerging Technologies	2-0-0	2

Basic Science Courses (BSC)			**17**
AM121	Calculus and Statistical Analysis	4-0-0	4
AM122	Differential Equations and Transformations	4-1-0	5
AM103	Discrete Structures	4-0-0	4
PH121	Modern and Computational Physics	3-0-0	3
PH111	Modern and Computational Physics Lab	0-0-2	1

Engineering Science Courses (ESC)			**4**
EC101	Basics of Electronics Engineering	3-0-0	3
EC102	Basics of Electronics Engineering Lab	0-0-2	1

Professional Core Courses (PC)			**85**
CS140	Problem Solving using Python Programming	4-0-0	4
CS124	Object Oriented Programming Using C++	4-0-0	4
CST125	Fundamentals of Web Technology	3-0-0	3
CSP125	Fundamentals of Web Technology Lab	0-0-2	1
CST106	Data Structures with C++	3-0-0	3
CST107	Advanced Web Technology	3-0-0	3
CST108	Operating System With Linux	3-0-0	3
CSP107	Advanced Web Technology Lab	0-0-2	1
CSP106	Data Structures with C++ Lab	0-0-2	1
CSP108	Operating System With Linux Lab	0-0-2	1
CST111	Linux Programming	3-0-0	3
CST102	Principles of Computer Networks	3-0-0	3
CSP102	Principles of Computer Networks Lab	0-0-2	1
CST109	Problem Solving Using C	3-0-0	3
CS122	Design & Analysis of Algorithms	3-0-2	4
CSL2202	Web Programming and Source Code Management	3-0-2	4

CST101	Database Management Concepts	3-0-0	3
CSL4305	Theory of Computation	3-1-0	4
CSL5301	Java Programming	0-0-4	2
CS2023	Advanced Data Structures	3-0-2	4
CS107	Object Oriented Software Engineering	3-0-2	4
CSP111	Linux Programming Lab	0-0-2	1
CSP109	Problem Solving Using C Lab	0-0-2	1
CSP101	Database Management Concepts Lab	0-0-2	1
CS179	Programming Abstractions	3-0-2	4
CS192	Front End Engineering	3-0-2	4
CS125	Soft Computing	3-1-0	4
CS118	Computer System Architecture	3-0-0	3
CS123	Artificial Intelligence and Expert System	4-0-0	4
CS151	Introduction to Cloud Computing	4-0-0	4

Professional Electives (PE)*			**16**
A. Specialization Tracks (Elective-I to IV)			
Full-Stack			
CS159	Back-end Development	2-0-4	4
CS126	Algorithm Design & Implementation	2-0-4	4
CS164	Advanced Front-end Development	2-0-4	4
CS167	Source Code Management	2-0-0	2
CS254H	Professional Practices - System Design	2-0-0	2

B. Departmental Electives (Elective-V & VI)			
CS174	Applications of Data Science	4-0-0	4
CS123	ArtificialIntelligenceandExpertSystem	4-0-0	4
CS124	Network Security	4-0-0	4
CS12X	Compiler Design	4-0-0	4
CS128	Enterprise Application Development	2-0-4	4
CS135	Advanced Java	2-0-4	4
CS136	Introduction to DevOps	2-0-4	4
CS139	Parallel and Distributed Computing	4-0-0	4
CS146	Web Application Development	2-0-4	4
CS160	Microprocessor and Assembly Language Programming	3-0-2	4
CS185	Technical Communication and Employability Skills	0-0-4	2
CS187	Advanced Digital Marketing	2-0-4	4
CS 190	Blockchain Technologies	2-0-4	4
CS254	Professional Practices	2-0-0	2
CS502	Department Elective - Advanced Unity Programming	0-0-8	4

Open Elective Courses (any three)		**9**

CS121	Software Quality Assurance and Testing	3-0-0	3
CS122	Business Intelligence and Data Warehousing	3-0-0	3
CS147	Android Application Development	2-0-2	3
CS148	iOS Programming	2-0-2	3
CS149	Internet of Things	2-0-2	3
CS150	Mobile Ad-hoc and Sensor Networks	3-0-0	3
CS152	Advanced Computer Architecture	3-0-0	3
CS153	Digital Image Processing	3-0-0	3
CS154	Computer Graphics	3-0-0	3
CS161	Java Programming	0-0-6	3
CS162	Full Stack Development	0-0-6	3
CS245	Big Data Analytics	3-0-0	3
ER103	Foundational Course in Entrepreneurship	3-0-0	3
CS243	Artificial Intelligence and Machine Learning	3-0-0	3
ER104	Advanced Course in Entrepreneurship	3-0-0	3
CS244	Professional Practices-Coding	3-0-0	3

Special Courses			**45**
a) Project			43
CS204	Integrated Project-I	0-0-4	2
CS205	Integrated Project – II	0-0-4	2
CS203	Lab Oriented Project	0-0-6	3
CS251	Co-op project at Industry (Module-I)	-	12
CS253	Industry Oriented Hands-on Experience	-	12
CS252	Co-op project at Industry Module II	---	12
CS248	Research Project Dissertation	---	
b) Engineering Exploration			2
c) Value Addition Courses			
	Global Engineering Week Courses	-	

Mandatory Courses			
HR101	Human Values and Professional Ethics	2-0-0	0
DM101	Disaster Management	2-0-0	0
ES101	Environmental Sciences	2-0-0	0
CS501	Cyber Security	2-0-0	0
Additional Credit Courses			
NCC01			
NSS01			

*** Students can also earn these credits by opting co-op training in seventh and eighth semesters**
 # Credits can vary according to students' choice-based credit system

List of courses offered in Engineering Exploration

Offline/E-Learning Courses	Internet of Things
	Introduction to Internet of Things
	Machine Learning
	Engineering Projects in Community Services
	Intellectual Property Rights
	Data Visualization
	Ethical Hacking
	Digital Marketing
	Publishing Research
	Entrepreneurship
	Speech Recognition
	Design Thinking
Foreign Language Certification Courses	German
	Japanese
	Spanish
	Chinese Mandarin
MOOC	The joy of Computing using Python
	Ethical Hacking
	Introduction to Internet of Things
	Programming in Java
	Artificial Intelligence Search Methods for Problem Solving
	An Introduction to programming through C++
	Software Testing
	Introduction to Machine Learning
	Blockchain Architecture Design and Use Cases
	Discrete Mathematics
	Programming in C++
	E-Commerce Technologies

Course Code	Course Name	L-T-P	Credits
CL103	English for Technical Professionals	2-0-0	2

Course Learning Outcomes:

Students will be able to:

CLO.1 To learn effective interpersonal and team communication skills that are useful for engineers in the practice of their profession.
CLO.2 To learn micro-skills of communication.
CLO.3 To discuss professional and technical written communication along with the creative aspects of writing slogans, paragraphs, dialogues and developing outlines.
CLO.4 To develop the skills of reading, note making, note taking and summarizing.

Course Outline:

Effective Communication: What do We Mean by Communication, Process of Communication, Communication Cycle, Channels and Media of Communication
Barriers to Communication, Learning Strategies for Effective Communication
Use of Technology in Developing Communication Skills, Introduction, Computer Assisted Language Learning (CALL), Self-learning Through the Use of Technology, Integrated Group Learning Using a Multimedia Language Laboratory, Effectiveness of CALL for Developing English Language Skills, Use of Internet, Word Elements
Introduction, Root,Base: The Core of a Word Affixes, Prefix: The Frontal Element, Suffix: The Tail to Modify Meaning, Vocabulary Building: Introduction
Synonyms, Antonyms, Homophones, Homonyms, Words Often Confused, One-Word Substitution, Idioms and Phrasal Verbs, Technical Terms, Professional Interaction: Introduction, Group Discussion, Job Interviews: Types of Interviews, Preparing for Interviews, Report Writing and News Reports, E-mail Writing.

Recommended Book(s):

1. Nitin, B. (2010). Communicative English for Engineers and Professionals. Pearson Education India.
2. Fast, J. (2003). English for Work: Everyday Technical English..
3. Whitcomb, C., & Whitcomb, L. E. (2012). Effective interpersonal and team communication skills for engineers. John Wiley & Sons.
4. Carmen, D. Z., & Weisman, E. M. (2007). Helping English Language Learners Succeed. Shell Education. United States of America.
5. Bhatia, V. K., & Bremner, S. (2012). English for business communication. Language teaching, 45(4), 410-445.
6. Swales, J. M., & Feak, C. B. (2004). Academic writing for graduate students: Essential tasks and skills (Vol. 1). Ann Arbor, MI: University of Michigan Press.
7. Seidl, J. (1989). English idioms exercises on idioms-A second edition of Idioms in practice. Oxford university press.
8. Ruiz-Garrido, M. F., Palmer, J. C., & Fortanet-Gómez, I. (Eds.). (2010). English for professional and academic purposes (Vol. 22). Rodopi.
9. Rajagopalan, K. (2009). Andy Kirkpatrick, World Englishes: Implications for international communication and English language teaching. Cambridge: Cambridge University Press, 2007. Pp. x, 257. Hb $39.00. Language in Society, 38(4), 537-538.

Course Code	Course Name	L-T-P	Credits
CSL254	Professional Practices	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify a new technology that will solve a problem in an organization

CLO.2 Gain skillset to examine the challenges and opportunities in designing projects that implement new and emerging technologies such as 5G technologies

CLO.3 Understand the concepts such as neurons, activation functions, and optimizers in artificial intelligence field

CLO.4 Understand, and contrast supervised and un-supervised learning algorithms.

CLO.5 Understand the context of information security with respect to social engineering and cyber security.

CLO.6 Recognize the importance of ethical practices with new technologies

CLO.7 Understand and review current literature on the selection, implementation, and evaluation of new and emerging technologies and their impacts

Course Outline:

Skillsets and traits for the future, 5G a revolution for communication services providers and consumers, social engineering in cyber security, machine learning and artificial intelligence, leading through crisis, future of technology, building scalable Android apps, impact vs actions, future trends of databases, impact of Covid – evolving skills, career and life, technical and HR skills for future readiness, demystifying AI/ML, data 4.0 journey, self-awareness for professional success, agile workforce.

Recommended Book(s):

1. Pramod Kumar, Anuradha Tomar, R. Sharmila, Emerging Technologies in Computing Theory, Practice, and Advances, Chapman and Hall/CRC
2. Kevin Kelly, The Inevitable: Understanding the 12 Technological Forces That Will Shape Our Future, Penguin; 1st edition
3. Klaus Schwab, The Fourth Industrial Revolution, Portfolio Penguin
4. Gerald C. Kane, Anh Nguyen Phillips, Jonathan R. Copulsky, Garth R.
5. Andrus, The Technology Fallacy: How People Are the Real Key to Digital Transformation (Management on the Cutting Edge), The MIT Press

Course Code	Course Name	L-T-P	Credits
GE101	Numerical Ability and Logical Reasoning	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Improve answers during the Aptitude test and develop an all-around personality with a mature outlook.

CLO.2 Enhance their logical thinking, verbal reasoning and numerical reasoning.

CLO.3 Enhance the employability skills among the students so that they will take part effectively and confidently not only in campus placements programs but also in other exams like CAT, GMAT, SSC, Bank Po, UPSC etc.

CLO.4 Enhance the problem-solvingskills, to improve the basic mathematical skills and to help students who are preparing for any type of competitive examinations.

CLO.5 Enhance the Aptitude Round Clearing ability in interview process

Course Outline:

Vedic module: Introduction with aptitude, Cube and cube root, Division, Addition and Subtraction, Algebraic formula base, Approximation, Number System, Ratio, Percentage, Simple Interest, Compound Interest, Profit and Loss, Discount, Work and Time, Permutation and Combination, Geometry, Coordinate Geometry, Reasoning, Distance and Direction, Blood Relation, Analogy and Venn diagram, Syllogism and Classification and Mathematical operation, Coding – Decoding, and Alphabet Test, Problem on Ages and dictionary, Series Cube and Dice and Missing number, Ranking, Clock, and Calendar, Inequalities and I/P and O/P, Puzzle, Sitting Arrangement, Statement –Argument, Statement- course of Action, Non-verbal.

Recommended Book(s):

1. Guha, A. (2021). Quantitative Aptitude for Competitive Examination (2nd ed). MC Graw Hill.
2. Chowdhary,S.S. (2018). Test of Reasoning & Numerical Ability. Sahitya Bhawan.
3. Quantum Cat. (2021). Quantitative Aptitude & Verbal – Nonverbal Reasoning. Arihant Publication.
4. S., E. (2021). ESE/GATE/PSUs Numerical Ability, Logical Reasoning & Analytical Ability. ACE Engineering Publications.

Course Code	Course Name	L-T-P	Credits
GE102	Introduction to Emerging Technologies	2-0-0	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify a new technology that will solve a problem in an organization

CLO.2 Skillset to examine the challenges and opportunities in designing projects that implement new andemerging technologies such as 5G technologies

CLO.3 Understand the concepts such as neurons, activation functions, and optimizers in artificial intelligence field

CLO.4 Understand and contrast supervised and un-supervised learning algorithms.

CLO.5 Understand the context of information security with respect to social engineering and cyber security.

CLO.6 Recognize the importance of ethical practices with new technologies

CLO.7 Understand and review current literature on the selection, implementation, and evaluation of new and emerging technologies and their impacts

Course Outline:

Skillsets and traits for the future, 5G a revolution for communication services providers and consumers, social engineering in cyber security, machine learning and artificial intelligence, leading through crisis, future of technology, building scalable Android apps, impact vs actions, future trends of databases, impact of Covid – evolving skills, career and life, technical and HR skills for future readiness, demystifying AI/ML, data 4.0 journey, self-awareness for professional success, agile workforce.

Recommended Book(s):

1. Kumar, P., Tomar, A. andSharmila, R. (2021). Emerging Technologies in Computing Theory, Practice, and Advances. Chapman and Hall/CRC.
2. Kelly, K. (2016) The Inevitable: Understanding the 12 Technological Forces That Will Shape Our Future, Penguin; 1st edition
3. Schwab, K. (2016). The Fourth Industrial Revolution, Portfolio Penguin
4. Kane, Gerald C., Phillips, A. N., Copulsky, J. R., Andrus, G. R., (2019). The Technology Fallacy: How People Are the Real Key to Digital Transformation (Management on the Cutting Edge), The MIT Press.

Course Code	Course Name	L-T-P	Credits
ES101	Environmental Sciences	2-0-0	0

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the concepts about natural resources, ecosystems, biodiversity, energy resources, environmental pollution and waste management which are required to understand the interrelationships of the natural world.

CLO.2 Identify and analyze environmental problems both natural (disasters such as floods and earthquakes) and man-made (industrial pollution and global warming).

CLO.3 Understand and hone skills to the societal and environmental impacts of energy and examine alternative solutions for meeting the growing energy needs.

CLO.4 Apply the above knowledge, as an activity to do various Case studies, required to understand the interrelationships of the natural world and real-world issues.

CLO.5 Gain knowledge for employability in the field of environmental conservation, water sciences, waste management etc.

Course Outline:

Definition, scope, importance, need for public awareness, natural resources, renewable and non-renewable resources, water resources, ecosystems, biodiversity & its conservation, threats to biodiversity, environmental pollution, disaster management, environment protection acts, welfare program.

Recommended Book(s):

1. Bharucha, E. (2004). Textbook of Environmental Studies for Undergraduate Courses, First Edition, University Grants Commission, Universities Press (India) Private Limited.
2. Randhawa, M. (2014). The Basics of Environmental Sciences, Chitkara University publications, First edition
3. Rajagopalan, R. (2016). Environment And Ecology – A Complete Guide. Lexis Nexis, First edition.
4. Wright. Richard T. and Bourse. Dorothy F. (2016). Environmental Science: Toward A Sustainable Future, Benjamin-Cummings Pub Co, 13th edition.
5. Keen, M., Brown, Valerie A., Dyball, R. (2005). Social Learning in Environmental Management: Towards a Sustainable Future, Routledge, 1st edition.
6. Cunningham, William P. and Cunningham, Mary A. (2012). Principles of Environmental Science, McGraw-Hill Science Engineering, 7th edition.

Course Code	Course Name	L-T-P	Credits
AM121	Calculus and Statistical Analysis	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Introduce and form matrices to present mathematical solutions in a concise and informative manner. Use matrices to solve the problems of system of linear equations and solve various live problems using matrices.

CLO.2 Find local extreme values of functions of several variables, test for saddle points, examine the conditions for the existence of absolute extreme values. Solve constraint problems using Lagrange multipliers and solve related application problems.

CLO.3 Apply the principles of Integral Calculus to solve a variety of practical problems in Engineering and applied Sciences.

CLO.4 Interpret statistical inference skills with the help of probability & distributions and hypothesis testing for means, variances and proportions of large as well as small data and employ appropriate regression models in determining statistical relationships.

CLO.5 Equip with the skills to understand advanced level mathematics and its applications that would enhance analytical thinking to solve engineering problems.

Course Outline:

Differentiation, matrices, normal form, Eigen values and vectors, partial differentiation & its applications, Euler's theorem, Taylor's series expansion, Maclaurin's series, Lagrange's method of undetermined multipliers, multiple integration & its applications, change of order, change of variables, Beta and Gamma functions, introduction to scalar & vector, Green's theorem, Stokes' theorem, Gauss divergence theorem.

Recommended Book(s):

1. Erwin Kreyszig," Advanced Engineering Mathematics", Wiley India Pvt. Ltd, Second Edition
2. Srimanta Pal & Subodh C. Bhunia," Engineering Mathematics", Oxford University Press, First Edition
3. The Engineering Mathematics, Chitkara University Publication, Vol. I. Second Edition,
4. B.V. Ramana, "Higher Engineering Mathematics, Tata McGraw-Hill Education, Third Edition
5. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", Alpha Science International Ltd.
6. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications.
7. N. P. Bali and Manish Goyal,"A textbook of Engineering Mathematics", Laxmi Publications.
8. Vector Analysis with applications, by MD. Ali Ashraf, MD. Abdul Khaleq Hazra, Published by New Age International (New Delhi).
9. Calculus, by Howard Anton, Irl Bivens Stephens Davis.Advanced Engineering Mathematics, H.C. Taneja, I.K. International, Vol I.

Course Code	Course Name	L-T-P	Credits
AM122	Differential Equations and Transformations	4-1-0	5

Course Learning Outcomes:

Students will be able to:

CLO.1 Analyse and correlate many real-life problems mathematically and thus find the appropriate solutions for them using Fourier series and Transforms (Fourier and Laplace transform).

CLO.2 Using ordinary differential equations student will be able to solve various practical problems in Science and Engineering.

CLO.3 Possess an ability to recognize and find families of solutions for most real physical processes such as heat transfer, elasticity, quantum mechanics, water flow and others, which are governed by partial differential equations subject to boundary conditions.

CLO.4 Analyse functions of complex variables, techniques of complex integrals and compute integrals over complex surfaces ability to recognize and find families of solutions for most real physical processes such as heat transfer, elasticity, quantum mechanics, water flow and others, which are governed by partial differential equations subject to boundary conditions.

CLO.5 Develop skills required to find the appropriate differential equations that can be used as mathematical models.

Course Outline:

Problems related to Fourier series on arbitrary intervals, Fourier transform, differential equations of first order & first degree, complementary function, Laplace transform, formation of partial differential equations, second order linear partial differential equations, separation of variables, limits, continuity, Cauchy's theorem, Taylor's & Laurent's expansion.

Recommended Book(s):

1. The Engineering Mathematics, Chitkara University Publication, Vol. II, First Edition
2. B V Ramana, Higher Engineering Mathematics, McGraw Hill, Second Edition 2009
3. Dr. H. C. Taneja, Advanced Engineering Mathematics (Vol. I & Vol. II), I K International Publishing House Pvt. Ltd
4. RK Jain, SRK Iyengar," Advanced Engineering Mathematics ", Narosa; 1st edition
5. HK Dass," Advanced Engineering Mathematics",S Chand; Reprint Edn. 2006 edition.

Course Code	Course Name	L-T-P	Credits
AM103	Discrete Structures	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO1: To demonstrate the application of Discrete mathematical principles in investigating and solving a variety of real time problems related to Sets, Relations and Functions.

CLO2: To develop a skill to analyze and solve real time scientific problems using combinatorics.

CLO3: To analyze a given problem and to be able to apply the theory and techniques of Lattice, Logic and Boolean algebra.

CLO4: To comprehend Graph Theory and its relevance within the context of computer science and finding solutions of problems through shortest path algorithms.

CLO5: To develop skill to model and analyse computational processes using combinatorial methods, graph theory and algorithms

Course Outline:

Introducing sets, relations, functions, permutations & combinations, recurrence relation, characteristic polynomial & introduction to generating functions, logic, lattices, Boolean algebra, graph theory, multi-graph, adjacency matrix, complete bipartite graph & spanning graph, Euler's formula & its applications, trees, shortest path algorithm, Warshall's algorithm, Prim's algorithm.

Recommended Book(s):

1. C.L. Liu,"Elements of Discrete Mathematics", McGraw-Hill, ThirdEdition.
2. Babu Ram, "Discrete Mathematics", Pearson Education India, First Edition
3. Lipschutz Lipson, Schaum series, "Discrete Mathematics, TMH, Second edition,
4. Trembly Grassmann,"Logic and Discrete Mathematics ", Pearson Education, Third Edition
5. The Discrete Mathematics, Chitkara University Publication

Course Code	Course Name	L-T-P	Credits
PH121	Modern and Computational Physics	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Analyse and solve mathematical problems relating to Gradient, Divergence and Curl of scalar and vector fields and establish their relationship with propagation of Electromagnetic waves in free space using Maxwell's equation.

CLO.2 Should differentiate between different types of LASERs and optical fibres their operation, advantages, and disadvantages and solve related problems and their application in engineering domain.

CLO.3 Should differentiate between characteristics and properties of various magnetic and superconducting materials and establish their applications in engineering disciplines.

CLO.4 Should describe the dual nature of waves and particles in context of Quantum Mechanics and to apply the Schrodinger Wave Equation in solving different physical systems and processes.

CLO.5 Develop skills for critical thinking and problem solving involving the various concepts of physics.

Course Outline:

Electrodynamics,Vector and scalar fields, Gradient, divergence, curl, Gauss's theorem and Stoke's theorem, Laser, Laser characteristics such as coherence, monochromaticity, collimated and angular divergence, laser action, stimulated absorption, spontaneous emission, stimulated emission, Population inversion and pumping. Derivation of Einstein's coefficient relation, Various level lasers, two level, three level, four level, Ruby laser, Helium-Neon laser, Semiconductor laser, concepts of Holography, LASER Applications in engineering. Fiber Optics, Basic principle of optical fibre, Parameters of optical fibers, acceptance angle, acceptance cone, numerical aperture, normalized frequency, Attenuation in optical fibers, Magnetic Materials: Terminology and classification, Derivation of Magnetic moments of an atom, Ferromagnetism and related phenomena, Ferrites, The domain structure, The hysteresis loop, Types of magnetic materials, soft magnetic materials, hard magnetic materials, comparison between ferromagnetic and superparamagnetic materials, applications of magnetic materials in engineering.Superconductivity, Introduction, Meissner effect, critical field, critical current, Isotope effect , Types of superconductors: type I superconductors, type II superconductors, London equations, Penetration depth, Cooper pair and BCS theory (Qualitative only), high temperature superconductors. Applications of superconductivity e.g Lavitation Effect, SQUID,Quantum Mechanics, Introduction to Quantum Mechanics, Group velocity and phase velocity, de-Broglie waves, Uncertainty principle, Wave function and its significance, Normalised wave function, Time Independent Schrodinger wave equations, Time dependent Schrodinger wave equation.

Recommended Book(s):

1. H. K. Malik and A. K. Singh, "Engineering Physics", Mc Graw Hill Education, First Edition
2. Engineering Physics by Chitkara Publication 2nd Edition.
3. Donald A Neamen and Dhrubes Biswas, "Semiconductor Physics and devices", , Mc Graw Hill, Second Edition

Course Code	Course Name	L-T-P	Credits
PH111	Modern and Computational Physics Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Possess an ability to apply knowledge of fundamental physical concepts and appropriate mathematics involved in the course.
CLO.2 Possess an ability to analyze a physical problem and suggest the possible solution of that problem.
CLO.3 Apply fundamental principles of physics together with analytic tools to evaluate and describe physical situations appropriate to address a research problem.
CLO.4 Develop the skill to explore physical systems by setting up experiments, collecting and analyzing data, identifying sources of uncertainty, and interpreting their results in terms of the fundamental principles and concepts of physics.
CLO.5 Possess an ability to evaluate and analyze scientific measurement and error analysis.
CLO.6 Apply the fundamental concepts of physics to related engineering problems.

Course Outline:

Electrodynamics, Gauss's theorem, Stoke's theorem, equation of quantity, Green's theorem, Maxwell's equations, Laser and its types, fiber optics, optical fiber, magnetic materials, ferromagnetism and related phenomena, superconductivity, isotopes, quantum mechanics, wave function, gaming science, basic physics behind flight of drone and GPS navigation.

Recommended Book(s):

1. Engineering Physics by Chitkara Publication 2nd Edition.
2. AK Katiar, C. K Pandey, Eng. Physics Theory and Practicals, Wiley (1 January 2015)
3. Donald A Neamen and Dhrubes Biswas, "Semiconductor Physics and devices",Mc Graw Hill, Second Edition
4. Dr B Srinivasa Rao, Kesava Vamsi Krishnav, K. S Rudramba, Dr B Srinivasa Rao, Kesava Vamsi Krishnav, K.S Rudramba, Eng. PhysicsPractical, Laxmi Publications Pvt Ltd, Second edition

Course Code	Course Name	L-T-P	Credits
EC101	Basics of Electronics Engineering	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the basic concepts of semiconductor devices for use in electronic circuits.
CLO.2 Gain skills to interpret the characteristics of various types of diodes and transistors to describe the operation of related circuits for evolving engineering solutions.
CLO.3 Acquire the knowledge of digital logic gates for implementing basic digital circuits.
CLO.4 Recognize the primary functions of integrated circuits such as timer and voltage regulator.
CLO.5 Familiarize with generic IoT device and applications using case studies.

Course Outline:

Atoms & nuclei, semiconductor materials, theory of PN junction diode, V-I characteristics of a PN junction diode, Zener diode, use of diodes in rectifiers, Bipolar Junction Transistor (BJT), operation of NPN and PBP BJT, transistor amplifier, Number systems, binary arithmetic, logic gates, combinational and sequential logic, Boolean algebra, universal gates, flip-flops, integrated circuits, IC 741, Op-amps, IC 555 timer, voltage regulator IC 7805.

Recommended Book(s):

1. R. Muthusubramanian, S. Sahlivahanan," Basic Electrical and Electronics Engineering", McGraw Hill, First Edition, 2010.
2. N. N Bhargava, D. C Kulshreshtha, S. C Gupta," Basic Electronics and Linear Circuits", McGraw Hill Publications, Second Edition.
3. D. P. Kothari, I. J. Nagrath," Basic Electronics", McGraw Hill, Second Edition.
4. D. K. Bhattacharya, Rajnish Sharma, "Solid State Electronic Devices", Oxford University Press", Second Edition.
5. Albert Malvino, David J. Bates," Electronic Principles" Mcgraw Hill Education, Seventh Edition.

Course Code	Course Name	L-T-P	Credits
EC102	Basics of Electronics Engineering Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Know the basics of electronics elements, their functionality and applications.

CLO.2 Possess skills to analyze and characterize the electronic circuits and have basic understanding for their implementation.

CLO.3 Able to analyze and characterize the electronic circuits and have basic understanding for their implementation.

CLO.4 Possess an ability to perceive the concept of logic gates and integrated circuits in electronics.

CLO.5 Gain practical knowledge of primary functions of integrated circuits such as timer and voltage regulator.

Course Outline:

Familiarization with basic electronic components and measuring instruments, Plot and analyze the forward and reverse characteristics of PN junction Si / Ge diode and determine the knee voltage, Analyze Zener diode as voltage regulator and observe the output voltage with variable input voltage and fixed load resistance for zener diodes with different breakdown voltages, Study and observe the output waveform of half-wave and full wave rectifiers on CRO and calculate the average and rms values of output voltage, Analyze the NPN / PNP transistors in common emitter configuration and plot their input and output characteristics, Analyze the truth tables of various basic digital gates and implement 2-input XOR and 2-input XNOR gate using basic gates, Study the operation of astable, monostable and bistable multivibrators using IC-555 timer, Plot and analyze the V-I characteristics of light emitting diode in forward biasing, Plot and analyze the V-I characteristics of Photodiode, Analyze the varactor diode by applying reverse voltage for corresponding change in capacitance across PN junction. Plot the graph between applied reverse voltage (Vr) and capacitance (C).

Recommended Book(s):

1. R. Muthusubramanian, S. Sahlivahanan," Basic Electrical and Electronics Engineering", McGraw Hill, First Edition.
2. D. P. Kothari, I. J. Nagrath, "Basic Electronics", McGraw Hill, Second Edition.
3. B.R. Patil, "Basic Electrical and Electronics Engineering", Oxford Higher, Education Revised Second Edition.
4. T.K Nagsarkar & M.S Sukhija," Basic Electrical Engineering",Oxford, Second Edition.
5. D.C, Kulshreshtha, "Basic Electrical Engineering ", TMH, First Edition.

Course Code	Course Name	L-T-P	Credits
EC105	Digital Electronics and Logic Design	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Recognize the underlying differences between analog and digital systems, and interconversion between the two.

CLO.2 Understand and apply mathematical skills to solve digital design problems involving Boolean logic.

CLO.3 Realize the underlying differences between combinational and sequential circuits.

CLO.4 Understand and apply the design methodologies skills for implementing combinational and sequential circuits.

CLO.5 Realize the concept of memories and Programmable Logic Devices and their classification.

Course Outline:

Introduction to Digital and Analog systems, logic levels & Pulse waveform, Logic Gates, Number systems, Representation of signed numbers, Classification of binary codes, 8421 BCD code, Excess three code, Gray code, Parity and checksum, Boolean algebra and De Morgan's Theorem, Boolean Functions and their representation, canonical forms. Karnaugh map (upto 5 variable), Q-M method, Digital IC families (DTL, TTL, ECL, MOS and CMOS), Logic families, Combinational circuit, Multiplexer and Demultiplexer, Encoder and Decoder, Code Converters, Parity bit generators and checkers, Sequential circuits, Flip flops SR, JK, T, D, Race around condition and Master slave flip flops, Shift Registers, Counters, D/A and A/D converters, Semiconductor Memories, SRAM and DRAM, Programmable Logic Devices, ROM, PAL, PLA, PROM.

Recommended Book(s):

1. Anand Kumar, "Fundamentals of digital circuits", Pearson publication,Third Edition,
2. Thomas L. Floyd, 10th Edition, Digital Fundamentals, Pearson Publications, First Edition
3. M. Morris Mano, Digital Design, Prentice Hall of India Pvt. Ltd., New Delhi, Sixth impression /Pearson Education (Singapore) Pvt. Ltd., New Delhi, Fourth Edition
4. Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003, Fifth Edition

Course Code	Course Name	L-T-P	Credits
EC106	Digital Electronics and Logic Design Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the digital logic and create various systems by using these logics
CLO.2 Develop an understanding of design and simulation of digital logic circuits
CLO.3 Get a basic understanding of layout of electronic circuits
CLO.4 Practical implementation of design methodologies skills for implementing combinational and sequential circuits.
CLO.5 Implementation of the concept of memories and Programmable Logic Devices and their classification.

Course Outline:

Logic gates, design circuit using universal gates, 1-bit half-adder, 1-bit full-adder, 4-bit full-adder, comparator, convertor, combinational circuit, registers, data transfer, SISO, SIPO, PISO, PIPO, LED 7-segment, sequencer.

Recommended Book(s):

1. Lab Manual prepared by faculty of ECE.
2. Anand Kumar, “Fundamentals of digital circuits”, PHI, Third Edition,
3. Thomas L. Floyd, “Digital Fundamentals”, Pearson Publications, Tenth Edition.
4. M. Morris Mano, “Digital Design”, Prentice Hall of India Pvt. Ltd., New, Fourth Edition.
5. Donald P.Leach and Albert Paul Malvino, “Digital Principles and Applications”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003, Fifth Edition

Course Code	Course Name	L-T-P	Credits
CS140	Problem Solving using Python Programming	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Run basic python programs.
CLO.2 Use python skills in various fields of Data Science, Machine Learning and Artificial Intelligence.
CLO.3 Logic building using looping and decision statements.
CLO.4 Develop problem solving abilities using Python.
CLO.5 Learn building packages and modules for reusability.
CLO.6 Learn GUI development using Widgets in Python.

Course Outline:

Introduction to python programming, Applications in All Engineering Domains, Origin and intentions, Differences to other programming languages, Introduction to logic building and flowcharts. Anaconda Installation, Running Python Programs, Writing Python Scripts with Jupyter Notebook. Logic building, Algorithm and Flowchart.Fundamentals: Data Types, Variables and literals, Blocks and Syntax Rules, Operators and Expressions, Assignment Statements, Expression Statements, Multiway Branching. Looping, Decisions, Control Flow- Conditionals and loops, pattern designing. Defining Functions, Scope Rules, Global Statements, Closures, Argument Matching, Passing Arguments, Recursive Functions, Lambda Expressions. Lists, Indexing and Slicing, References and Copies, List Comprehension, map, filter & reduce functions. Searching & Sorting: Imports and Attributes, Creating Modules, Searching & Sorting, Namespaces, Reloading, Generating Random values. Two Dimensional Lists, Strings and its relative methods and properties, Tuples, Set and Dictionaries- introduction, methods and its relative properties. Files and Directories, File I/O, File positioning, File operators. Introducing Widgets, Adding and Working with Widget, Displaying Text and Images with Label Widgets, Getting User Input with Entry Widgets, Displaying Clickable Buttons With Button Widgets, Controlling Layout With Geometry Managers, Using Events and Event Handlers.

Recommended Book(s):

1. Lutz, Mark," Learning python: Powerful object-oriented programming ", O'Reilly Media, Inc., Fifth edition
2. Shaw, Zed A, "Learn Python the hard way: A very simple introduction to the terrifyingly beautiful world of computers and code", Addison-Wesley, Third edition 2013.
3. Dierbach, Charles, "Introduction to computer science using python: A computational problem-solving focus", Wiley Publishing, First edition
4. Luty, Mark, "Programming python", Shroff Publication,Fifth edition

Course Code	Course Name	L-T-P	Credits
CS124	Object Oriented Programming Using C++	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the difference between the top-down and bottom-up approach
CLO.2 Describe the object-oriented programming approach in connection with C++
CLO.3 Apply the concepts of object-oriented programming
CLO.4 Illustrate the process of data file manipulations using C++
CLO.5 Apply virtual and pure virtual function & complex programming situations

Course Outline:

Introduction to Object Oriented Programming: Structure of C++ program, Keywords, Basic Data Types, Derived Data Types, Declaration of Variables, Operators in C++, Scope Resolution Operator, Control Structure, Actual & Formal arguments, Default Arguments, Storage Class Specifiers, Functions, Arrays Declaration, Initialization, Processing Arrays, Arrays and Functions, Character Array, Pointer's declaration, Pointer Arithmetic, Pointers and Function, Pointers, and Arrays.
Classes: Class Declaration, Member functions, Inline Function, Arrays within class, Static data, Static member functions, Friend Functions, Friend class, Constructors, Parameterized constructor, Multiple Constructor, Copy Constructor, Destructor, Dynamic memory Allocation.
Overloading: Operator Overloading, Overloading assignment operator, overloading arithmetic operator, Overloading comparison operator, Function Overloading.
Inheritance: Hierarchical, Hybrid, Single Inheritance, Multilevel Inheritance, Multiple Inheritance, Advantages & Disadvantages of Inheritance, Virtual Functions, Pure Virtual Functions, Virtual Base class, Abstract Class Templates, Function Template, Class Template.
Files: File Stream, Opening and Closing Files, File modes, Sequential Input output, Random Access Files, Updating Files, Exception Handling, Graphic Functions in C++.

Recommended Book(s):

1. Herbert Schildt, The Complete Reference C++, Fourth Edition, TMH Publications.
2. Deitel&Deitel, C++ How to Program, Pearson Education, 3rd Edition.

Course Code	Course Name	L-T-P	Credits
CST125	Fundamentals of Web Technology	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the semantic web vision and technologies.
CLO.2 Apply the multimedia content, client-side programming and transformation of web content.
CLO.3 Employ modern tools and technologies for the development of web pages.
CLO.4 Experiment the web programming concepts to modify the design and layouts of web pages.
CLO.5 Examine the adaptability of scripting languages in web development.
CLO.6 Demonstrate and develop web-portals independently or in teams.

Course Outline:

Web programming and HTML5, document tags, HTML5 formatting, lists, introduction to link, images, tables, HTML frames, form, DHTML & CSS, CSS properties, introduction to JavaScript, working with data, functions & objects, event handling, regular expressions, JavaScript & DOM, events, form validation.

Recommended Book(s):

1. Ivan Bayross," Web Enabled Commercial Application Development using HTML, JavaScript, DHTML and PHP", BPB Publications, Fourth Edition
2. Thomas Powell," The Complete Reference HTML & XHTML", Tata McGraw-Hill Company Limited, Fifth Edition,
3. E. Stephen Mack, Janan Platt," HTML 4.0", Multimedia publication., Fourth Edition
4. Laura Lemay, Rafe Coburn, Jennifer Kyrnin," Mastering HTML, CSS & JAVAScript", SAMS publication, Seventh edition,
5. Niederst Robbins," Learning web designing: a beginner's guide to HTML, CSS, JavaScript, and web graphics", Oreilly Publication, Fourth Edition

Course Code	Course Name	L-T-P	Credits
CSP125	Fundamentals of Web Technology Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Applying the semantic web vision and technologies.
CLO.2 Implementation of client-side programming and transformation of web content.
CLO.3 Experimentation on modern tools and technologies for the development of web pages.
CLO.4 Experiment the web programming concepts to modify the design and layouts of web pages.
CLO.5 Apply the adaptability of scripting languages in web development.
CLO.6 Develop web-portals independently or in teams.

Course Outline:

This course is designed to equip students with practical skills and an understanding of the underlying advanced principles of programming the World Wide Web. Major topics include advanced concepts of Internet and Web server, advanced implementations of Client-side programming using HTML5, Cascading Style Sheets, and JavaScript Server-side programming using PHP and setting up a business website

Recommended Book(s):

1. Ivan Bayross," Web Enabled Commercial Application Development using HTML, JavaScript, DHTML and PHP", BPB Publications, Fourth Edition
2. Thomas Powell," The Complete Reference HTML & XHTML", Tata McGraw-Hill Company Limited, Fifth Edition,
3. E. Stephen Mack, Janan Platt," HTML 4.0", Multimedia publication., Fourth Edition
4. Laura Lemay, Rafe Coburn, Jennifer Kyrnin," Mastering HTML, CSS & JAVA Script", SAMS publication, Seventh edition,
5. Niederst Robbins," Learning web designing: a beginner's guide to HTML, CSS, JavaScript, and web graphics", Oreilly Publication, Fourth Edition

Course Code	Course Name	L-T-P	Credits
CST106	Data Structures With C++	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Summarize different categories of Data Structures
CLO.2 Identify different parameters to analyze the performance of an algorithm.
CLO.3 Explain the significance of dynamic memory management Techniques
CLO.4 Design algorithms to perform operations with Linear and Nonlinear data structures
CLO.5 Illustrate various technique to for searching, Sorting and hashing
CLO.6 Choose appropriate data structures to solve real world problems efficiently.

Course Outline:

Introduction, elementary data organization, asymptotic notations for complexity, array, linked list, stacks & queues, implementation of recursive and non-recursive procedures, trees, binary trees, balanced binary tree, AVL tree, heap tree, graphs, directed and undirected graphs, graph traversals (DFS and BFS), searching & sorting, hashing.

Recommended Book(s):

1. Seymour Lipschutz," Data Structures", Published By Tata McGraw-Hill, Second Edition.
2. Hubbard, Anita Huray, "Data Structures with Java, R", Prentice Hall of India, Second Edition,
3. Richard Gilberg, Behrouz Forouzan," Data Structures", McGraw-Hill, Second edition
4. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles", Pearson publication, Third Edition.

Course Code	Course Name	L-T-P	Credits
CST107	Advanced Web Technology	3-0-0	3

CourseLearningOutcomes:

Students will be able to:

CLO.1 Manipulateelementsonawebpageandrespondingtouserinteractions

CLO.2 Developweb,desktop,andmobileapplications skills

CLO.3 Use Angular JS to develop cross-platform applications

CLO.4 Explore core jQuery features which would help in designing GUI.

CLO.5 Use Angular JS to develop cross-platform applications

CourseOutlines:

jQuery, jQuery effects, jQuery callback, jQuery chaining, jQuery HTML, jQuery AJAX,bootstrap, BS tables, images, jumbotron, glyphicons, BS forms, BS media objects, BScarousel, bootstrap grids, angular js, databinding, controllers, scopes, filters, forms &validations,filestructures.

Recommended Book(s):

1. Robbins, Niederst (2012). Learning web designing: a beginner's guide to HTML, CSS, JavaScript, and web graphics (4th ed). Oreilly Publication.
2. Bayross, Ivan (2016). Web Enabled Commercial Application Development using HTML, JavaScript, DHTML and PHP (4th ed)., BPB Publications.
3. Thomas Powell (2016). The Complete Reference HTML & XHTML. (5th ed). Tata McGraw-Hill.
4. Laura, Janan Lemay & Rafe, Coburn (2017). Mastering HTML, CSS & JAVAScript. (7th ed) SAMS publication.

Course Code	Course Name	L-T-P	Credits
CST108	Operating System With Linux	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Gain extensive knowledge on principles, types and advance concepts of operating systems.
CLO.2 Recognize key mechanisms in design of operating systems modules.
CLO.3 Compare performance of processor scheduling algorithms.
CLO.4 Practice with operating system concepts such as process management, concurrent processes and threads, memory management, virtual memory concepts, deadlocks.
CLO.5 To identify various system security and protection issues.
CLO.6 To learn the latest trends in building mobile OS.

Course Outline:

Introduction to Operating systems, OS structure, OS operations, ComponentsTypes of OS: Batch OS, Time-sharing OS, Multi-user OS, Real Time OS, Distributed OSOperating System Services, User and OS interface, System Calls/API, Types of System Call, System Program. Process Concept: Process Scheduling, Operations on Processes, Inter-process Communication. Threads: Overview of Threads, Multicore Programming, Multithreading Models, Threading issues, Linux Threads. CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms- First In first Out Scheduling Algorithms (FIFO), Shortest Job First Scheduling Algorithms (SJF), Priority scheduling Algorithms, Round-Robin scheduling Algorithms. Process Synchronization: Background, The Critical-Section Problem, two process solution, Multiple Process solution, Synchronization Hardware, Semaphores, Classic problems of Synchronization, Critical regions, Monitors. Deadlock: System Model, Deadlock Characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlocks. Memory Management: Basics, Swapping, Contiguous memory allocation, Segmentation, Paging, Segmentation with paging. Introduction to Virtual Memory, Demand Paging, Page Replacement Algorithms, Allocation of frames, Thrashing. File System: File Concept, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection. Implementing File System: File System Structure, File System Implementation, Directory implementation, Allocation Methods, Free-space Management. Mass Storage structure: Overview, Disk Structure, Disk attachment, Disk Scheduling algorithms. Protection: Domain of Protection, Access Control list, Cryptography, Authentication. Security: Security Problem, Standard Security Attacks, Inside and Outside System Attacks, Malware, Defense.

Recommended Book(s):

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, John Wiley & Sons (ASIA) Pvt. Ltd, Ninth Edition,
2. D.M. Dhamdhere, “System Programming & Operating Systems”, Tata McGraw Hill Second Edition
3. Andrew S. Tanenbaum, “Modern Operating System”, Prentice-Hall, Second Edition
4. Andrew S. Tanenbaum,” Operating Systems: Design and Implementation”, Prentice-Hall, Third Edition

Course Code	Course Name	L-T-P	Credits
CSP107	Advanced Web Technology Lab	0-0-2	1

CourseLearningOutcomes:

Students will be able to:

CLO.1 Develop webpageswhich can respondtouserinteractions

CLO.2 Implement web,desktop,andmobileapplications skills

CLO.3 Apply Angular JS to develop cross-platform applications

CLO.4 Apply and experiment on core jQuery features which would help in designing GUI.

CLO.5 Apply Angular JS to develop cross-platform applications

CourseOutlines:

jQuery, jQuery effects, jQuery callback, jQuery chaining, jQuery HTML, jQuery AJAX,bootstrap, BS tables, images, jumbotron, glyphicons, BS forms, BS media objects, BScarousel, bootstrap grids, angular js, databinding, controllers, scopes, filters, forms &validations,filestructures.

Recommended Book(s):

1. Robbins, Niederst (2012). Learning web designing: a beginner's guide to HTML, CSS, JavaScript, and web graphics (4th ed). Oreilly Publication.
2. Bayross, Ivan (2016). Web Enabled Commercial Application Development using HTML, JavaScript, DHTML and PHP (4th ed)., BPB Publications.
3. Thomas Powell (2016). The Complete Reference HTML & XHTML. (5th ed). Tata McGraw-Hill.
4. Laura, Janan Lemay & Rafe, Coburn (2017). Mastering HTML, CSS & JAVAScript. (7th ed) SAMS publication.

Course Code	Course Name	L-T-P	Credits
CSP106	Data Structures With C++ Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Ability to implement linear and non-linear data structure operations.
CLO.2 Identify appropriate data structure operations for solving a given problem.
CLO.3 Apply appropriate use of linear / non-linear data structure operations for a given problem.
CLO.4 Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval
CLO.5 Apply the searching and sorting algorithms for problem solving.

Course Outline:

Introduction, elementary data organization, asymptotic notations for complexity, array, linked list, stacks & queues, implementation of recursive and non-recursive procedures, trees, binary trees, balanced binary tree, AVL tree, heap tree, graphs, directed and undirected graphs, graph traversals (DFS and BFS), searching & sorting, hashing.

Recommended Book(s):

1. Seymour Lipschutz," Data Structures", Published By Tata McGraw-Hill, Second Edition.
2. Hubbard, Anita Huray, "Data Structures with Java, R", Prentice Hall of India, Second Edition,
3. Richard Gilberg, Behrouz Forouzan," Data Structures", McGraw-Hill, Second edition
4. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles", Pearson publication, Third Edition.

Course Code	Course Name	L-T-P	Credits
CSP108	Operating System With Linux Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Students will learn the installation and basic handling of Linux System.
CLO.2 Understanding the basic set of commands and utilities in Linux/UNIX systems.
CLO.3 Ability to change/write specifications, scripts, and programs.
CLO.4 Students can create new users accounts in Linux operating system using different commands.
CLO.5 Manage the resources and security of a computer running Linux at a basic level.
CLO.6 Make effective use of Linux utilities, and scripting languages.

Course Outline:

Introduction: Linux Foundation, Linux Requirements, Linux Philosophy and Components, Linux History, Linux Community, Linux Terminology, Linux Distributions. Installation: Configuration & Customizations of Unix/Linux, Linux Structure and Installation. Linux file-system basics, The boot process, Linux Distributions Installation. Introduction to GCC compiler: Compilation of program, Execution of program. Study basic & User status Unix/Linux Commands: Purpose commands: man, help, history, who, whoami, id, uname, tty, usermod. System Configuration from the Graphical Interface: System, Display, Time and Date Settings, Network Manager, Installing and Updating Software. Command-line Operations: Command Line Mode Options, Basic Operations, Installing Software, terminals, types of terminals, switching between terminals. Working with Files: cat, cp, mv, rm. File system: Introduction to File system, File system Architecture, Comparing Files and File Types. Text Editors: vi and emacs. Local Security Principles: Understanding Linux Security, Understand the Uses of root, Using the sudo Command, Working with Passwords, permissions modification using chmod. Chown, chgrp. Process oriented commands: ps, pstree, kill, killall (with all their options), at, cron. Regular expressions, redirections & Filters in Linux. Bash Shell Scripting.

Recommended Book(s):

1. John Purcell," Linux the Complete Reference", Seventh Edition
2. Richard Blum," Linux Command Line and Shell Scripting Bible", Third Edition
3. Sumitabha Das," Your Unix - The Ultimate Guide", Tata McGraw-Hill, Fourth Edition.

Course Code	Course Name	L-T-P	Credits
CST111	Linux Programming	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify and use UNIX/Linux utilities to create and manage simple file processing operations, organize directory structures with appropriate security, and develop shell scripts to perform more complex tasks.
CLO.2 Effectively use the UNIX/Linux system to accomplish typical personal, office, technical, and software development tasks.
CLO.3 Monitor system performance and network activities.
CLO.4 Effectively use software development tools including libraries, preprocessors, compilers, linkers, and make files.
CLO.5 Comprehend technical skills to prepare simple readable user documentation and adhere to style guidelines.

Course Outline:

Introduction, history of Linux, installation, mounting, introduction to GCC compiler, Linux commands, system configuration from the graphical interface, command-line operations, working with files, directory-oriented commands, searching, GCC, file system, communication-oriented commands, managing users, local security principles, network operations, regular expressions, redirections & filters in Linux, advanced Bash shell scripting, process scheduling, process priority, bash shell scripting.

Recommended Book(s):

1. John Purcell," Linux the Complete Reference", Seventh Edition
2. Richard Blum," Linux Command Line and Shell Scripting Bible", Third Edition
3. Sumitabha Das," Your Unix - The Ultimate Guide", Tata McGraw-Hill,Fourth Edition
4. John Goerzen," Linux Programming Bible", IDG Books, New Delhi, Eight Edition
5. Mark G. Sobell," A Practical Guide to Linux", Pearson Education, Second Edition
6. Yashwant kanetkar, "Unix Shell programming ", BPB Publications, First Edition

Course Code	Course Name	L-T-P	Credits
CSP111	Linux Programming Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Understanding the basic set of commands and utilities in Linux/UNIX systems.
CLO.2 To learn to develop software for Linux/UNIX systems.
CLO.3 To learn the C language and get experience programming in C.
CLO.4 To learn the important Linux/UNIX library functions and system calls.
CLO.5 To understand the inner workings of UNIX-like operating systems.
CLO.6 To obtain a foundation for an advanced course in operating systems

Course Outline:

Session	Experiment
1	Installation of Red Hat Linux using VMWARE.
2	Demonstrate general purpose commands in Linux- cal, who, date, echo, bc, tty.
3	Demonstrate Directory and File Management in Linux- mkdir, rmdir, cd, pwd, ls, cat, rm, mv, cp.
4	Demonstrate to handle File and Directory permissions through: ls –l,ls –ld, chmod.
5	Show use of vi-editor and its various options.
6	Implement User Management in LINUX- useradd, userdel, groupadd, groupdel, passwd.
7	Demonstrate working of Shell's Wild cards, Escaping and Quoting.
8	Implement Redirection with proper examples
9	Implement Pipes and Command substitution in LINUX
10	Demonstrate the working of all process handling commands (ps and its various options)
11	WAP that accepts user name and reports if user is logged in
12	WAP which displays the following menu and executes the option selected by user

13	WAP to print 10 9 8 7 6 5 4 3 2 1
14	WAP that takes a filename as input and checks if it is executable, if not make it executable
15	WAP to take string as command line argument and reverse it
16	Create a data file called employee in the given format
17	Create a Menu driven shell script which manages users and display following menu
	• create a new user • set passwords for new user or update passwords for existing users • Lock the user password • locate the home directory for the user and create its backup file with timestamp • View all the authentic users and their id
18	Install and configure SSH server on Linux System and access it from remote location

Course Code	Course Name	L-T-P	Credits
CST102	Principles of Computer Networks	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Describe and analyze the hardware, software, components of a network and the interrelations.
CLO.2 Explain networking protocols and their hierarchical relationship hardware and software.
CLO.3 Compare protocol models and select appropriate protocols for a particular design.
CLO.4 Manage multiple operating systems, systems software, network services and security.
CLO.5 Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing performance and implementing new technologies.
CLO.6 Imparting skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure

Course Outline:

Uses of computer networks, network hardware, network software, ISO-OSI architecture, TCP/IP reference model, physical layer, data link layer, network layer, transport layer, application layer, wireless WAN, routing protocols, network security.

Recommended Book(s):

1. Forouzan,"Data Communications and Networking", McGraw-Hill, 5TH edition
2. Andrew S,"Computer Networks by Andrew", Pearson Education, Fourth Edition
3. William Stallings,"Data and computer Communications", Pearson, Eighth Edition
4. Todd Lammle," CCNA Cisco Certified Network Associate Study Guide", Wiley, Second Edition

Course Code	Course Name	L-T-P	Credits
CSP102	Principles of Computer Networking Lab	0-0-2	1

Course Learning Outcomes (CLO):

Students will be able to:

CLO.1 Understand the practical approach to network communication protocols.
CLO.2 Understand network layers, structure/format and role of each network layer.
CLO.3 Able to design and implement various network application such as data transmission between client and server, file transfer, real-time multimedia transmission.
CLO.4 Understand the various Routing Protocols/Algorithms and Internetworking.
CLO.5 Imparting skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure

Session	Experiment
1	a) How to find IP address of your computer.
	b) Sharing a file or folder over LAN.
2	a) Understanding the ping command.
	b) Understanding the netstat command.
	c) Understanding the tracert command.
3	a) Printer sharing over the LAN.
	b) Understanding the network topologies.
4.	Wifi Access and configuration of access point.
5	a) Crimping and Punching.
	b) To make cables: Cables: Straight Through, Crossover and Rollover.
6	a) PC to PC connectivity.
	b) Connectivity through switch.
7	Remote Access.
8.	Configuring email clients.
9.	Introduction of Network devices: Hub, Switches, Router etc.
10	Introduction of Mac Address, IP addresses, Subnet Mask, Network Classes: A, B, C, D, E.
11	Introduction to Packet Tracer.
12	Simulation of Network Devices (HUB, Switches, Router) and connect more than two computers using Switch –Star Topology.
13	Subnetting of Class A, B and C using FLSM.
14	Subnetting of Class A, B and C using VLSM.
15	Basic commands of Routers: hostname, password, Show Run, Show IP int brief, Assigning IP addresses to interfaces.
16.	To Perform Static Routing.
17.	To Perform Dynamic Routing using RIP (RIP-V1 and RIP-V2)
18.	To Perform Dynamic Routing using EIGRP
19.	To Perform Dynamic Routing using OSPF with Single area concept
20.	To Perform Dynamic Routing using OSPF with Multiple area concept

Course Outline:

Introduction to computer network devices, Cabling and Connecting Computers through Cross cables, Introduction to Wire-shark, How to capture packets in Wire-shark, Subnetting –Class C, B and A, VLSM, Connecting Computers through Switches

Recommended Book(s):

1. Forouzan (2014). Data Communications and Networking. (3rd ed). McGraw-Hill.
2. Andrew, S. (2012). Computer Networks by Andren. (2nd ed), Pearson Education.
3. Stallings, William (2011) . Data and computer Communications. (6th ed). Pearson.
4. Lammle, Todd. (2012). CCNA Cisco Certified Network Associate Study Guide. (2nded). Wiley.

Course Code	Course Name	L-T-P	Credits
CST109	Problem Solving Using C	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Describe the basics of digital computer and programming languages.
CLO.2 Demonstrate problem solving techniques using flowchart, algorithm/pseudo code to solve the given problem.
CLO.3 Design and Implement C program using Control Statements and Functions.
CLO.4 Design and Implement C program using Pointers and File operations.
CLO.5 Identify the need for embedded C in real-time applications.
CLO.6 Students will be able to develop solutions through independent and innovative learning.

Course Outline:

This course is aimed at enabling the students to formulate simple algorithms for arithmetic and logical problems, Translate the algorithms to programs (in C language), Test and execute the programs and correct syntax and logical errors, Implement conditional branching, iteration and recursion, Decompose a problem into functions and synthesize a complete program using divide and conquer approach, Use arrays, pointers and structures to formulate algorithms and programs, Apply programming to solve matrix addition and multiplication problems and searching and sorting problems, Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration

Recommended Book(s):

1. Jeyapoovan T, “Fundamentals of Computing and Programming in C”, Vikas Publishing house, 2015.
2. 2. Mark Siegesmund, "Embedded C Programming", first edition, Elsevier publications, 2014

Course Code	Course Name	L-T-P	Credits
CSP109	Problem Solving Using C Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

CLO.1 Write efficient algorithms to solve various problems
CLO.2 Understand and use various constructs of the programming language such as conditionals, iteration, and recursion
CLO.3 Implement your algorithms to build programs in the C programming language
CLO.4 Use data structures like arrays, linked lists, and stacks to solve various problems
CLO.5 Understand and use file handling in the C programming language
Course Outline:

Session	Experiment
1	Write a program to swap the value of two variables without using a third variable.
2	Write a program to find the prime factors of a number.
3	Write a method **threeConsecutive(int a,int b,int c)** that accepts three integers as parameters and returns 1 if they are three consecutive numbers (i.e if the numbers can be arranged into an order such that their values differ by exactly 1) otherwise return 0.
4	Write a recursive function **factorial** that accepts an integer *n* as a parameter and returns the factorial of *n*, or *n!*.
5	Write a recursive function **power** that accepts two integers representing a *base* and an *exponent*, and returns the base raised to that exponent. For example, the call to power(3, 4) should return 3^4 i.e. 81. If the exponent passed is negative, then return -1.
6	Write a recursive function **gcd** that accepts two positive non-zero integer parameters *i* and *j* and returns the greatest common divisor of these numbers.
7	Write a program to find second maximum in an array.
8	Write a program to find maximum frequency in a sequence.
9	Write a program to search sorted element in a rotated sorted array
10	Write a program to find two strange elements
11	Write a program to find the number of shifts in insertion sort.
12	Write a program to sort the strings lexicographically
13	Write a program to implement stack using array.
14	Reverse a String Using Stack
15	Write a Program to implement Queue using array

Course Code	Course Name	L-T-P	Credits
CS118	Computer System Architecture	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Understanding of the basic components of a computer system.
CLO.2 Analyze the working of computer organization and control unit.
CLO.3 Design a CPU in terms of its organization and program Control.
CLO.4 Understand the concept of pipeline and Input Output Organization for consistent execution of instructions & Data Transfer.
CLO.5 Understand the working of Memory organization.

Course Outline:

Introduction to Computer Organization and Evolution of Computers from 1st Generation to Present generation, Introduction to digital computers, Introduction to number system,Octal and Hexadecimal Numbers, Decimal Representation, Logic gates (AND, OR, NOT, NAND, NOR, EX-OR and Ex-NOR) Introduction to combinational and sequential circuits, Flip Flops (SR, D), Flip Flops (T, JK)
Registers (SISO, PISO, SIPO, PIPO), Basic Computer Organization: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory Reference Instructions, Input-Output and Interrupt, Complete Computer Description, Microprogrammed Control: Control Memory, Address Sequencing, Micro program Example, Design of Control unit,Central Processing Unit Introduction, General Register Organization, Stack Organization, Instruction Format (Three address, Two Address, one address, zero address), Addressing Modes, Data Transfer and Manipulation, Program Control: Status bits, Conditional Branch Instructions, Program Interrupts & Types, RISC/CISC Characteristics, Pipeline Processing, Parallel processing-Flynn's Classification Pipelining General considerations, Arithmetic Pipeline: Floating point addition and subtraction, Input-Output Organization: Peripheral Devices, I/O Interface, Asynchronous Data Transfer, Modes of Transfer, Direct Memory Access (DMA), DMA Transfer, DMA Controller Input-Output Processor (IOP), Virtual Memory, Page replacement

Recommended Book(s):

1. Mano, M. M. (2007). Computer System Architecture, 3e.
2. Patterson, D. A., & Hennessy, J. L. (2016). Computer organization and design ARM edition: the hardware software interface. Morgan kaufmann.
3. Tanenbaum, A. S. (2016). Structured computer organization. Pearson Education India..
4. Balch, M. (2003). Complete digital design: a comprehensive guide to digital electronics and computer system architecture. McGraw-Hill Education

Course Code	Course Name	L-T-P	Credits
CS122	Design & Analysis of Algorithm	3-0-2	4

Course Learning Outcomes:

Students will be able to:

CLO.6 Analyze algorithms and algorithm correctness.
CLO.7 Analyze time complexities of algorithms using asymptotic analysis.
CLO.8 Summarize searching and sorting techniques.
CLO.9 Describe stack, queue and linked list operation. Compare different data structures and pick an appropriate data structure for a design situation.
CLO.10 Explain the major graph and tree algorithms and their analysis skills. Employ graphs to model engineering problems.

Course Outline:

Introduction, divide & conquer, greedy method, Knapsack problem, dynamic programming, backtracking, branch &bound, B-trees, NP hard & NP complete problems, polynomial time approximation.

Recommended Book(s):

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Galgotia Publications, Second Edition,
2. Thomas Cormen, Charles Leiserson, Ronald Rivest, Clifford Stein, "Introduction to Algorithms", Prentice-Hall India, Third edition
3. Seymour Lipschutz, "Data Structures"' Outline Indian Adapted Edition, 2006 Tata McGraw-Hill Edition
4. 'Computer algorithms' by Horowitz, Ellis, 2008, University Press.
5. Baase, sara," Computer algorithms: Introduction to Design and Analysis', Pearson Education, Third Education

Course Code	Course Name	L-T-P	Credits
CSL2202	Web Programming and Source Code Management	3-0-2	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Develop a dynamic webpage by the use of java script and DHTML.
CLO.2 Write a well-formed / valid XML document.
CLO.3 Connect a java program to a DBMS and perform insert, update and delete operations on DBMS table.
CLO.4 Write a server-side java application called Servlet to catch form data sent from client, process it and store it on database.
CLO.5 Write a server-side java application called JSP to catch form data sent from client and store it on database

Course Outline:

This course is aimed at enabling the students to the concepts of web programming. This course is designed to start you on a path toward future studies in web development and design, no matter how little experience or technical knowledge you currently have. Source code management is the add up learning module of this course where students will be exploring GitHub for source code management.

Recommended Book(s):

1. Jon Duckett "Beginning Web Programming" WROX.
2. Marty Hall and Larry Brown "Core Servlets and Java Server pages Vol. 1: Core Technologies", Pearson.

Course Code	Course Name	L-T-P	Credits
CST101	Database Management Concepts	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Design and implement database system by implementing SQL commands for RDBMS and analyze database requirements to determine the entities involved in the system and their relationship to one another.
CLO.2 Describe relational algebra expression and tuple relation expression from queries.
CLO.3 Implement the concept of normalization and functional dependency while designing the databases.
CLO.4 Apply the concept of transaction, concurrency control, security and recovery in database.
CLO.5 Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills.
CLO.6 Explain and evaluate the fundamental theories and requirements that influence the design of distributed database systems.

Course Outline:

Introduction to database and Characteristics of Data Base approach. Advantages and Disadvantages of DBMS approach. Introduction to Data Models: Hierarchical Model, Network Model, ER Model, Relational Model. Schemas, Instances, Schema architecture and Data Independence, three tier Architecture for DBMS, ER Model: Data base design process, Entity Types, Entity sets, Attributes, keys and their types, Weak entity types, ER diagrams, naming convention and design issues. Relational Algebra: Unary operation Relation, Relational Algebra Operations from Set Theory. Introduction to Normalization, their practical uses. Functional Dependencies (Full, Partial, Transitive, Multi-valued & Join Dependencies), SQL queries programming: The Forms of a Basic SQL Query, Null Values, Introduction to Concurrency Control Techniques. Two Phase Locking Techniques for Concurrency Control. Dealing with Deadlocks, Introduction to Database Recovery Techniques, Distributed Databases: Introduction to distributed databases, Advantages and Functions of distributed databases.

Recommended Book(s):

1. Abraham Silberscatz, Henry F.Korth, Sudharsan," Database System Concepts", McGraw-Hill, Fifth Edition
2. C.J.Date, "An Introduction to Database Systems", O'Reilly Media, Eighth Edition
3. Bipin.C.Desai," An Introduction to Database Systems", West Group Division, Eleventh Edition
4. Ramez Z. Elmasri, Shamkant B. Navathe, "Database Systems", Pearson Education, Seventh Edition
5. Ramez Elmasri, Shamkant B. Navathe," Fundamentals of Database Design", Wesley Publications, Seventh Edition
6. Ivan Bayross," Introduction to PL/SQL", BPB Publications, Fourth Edition

Course Code	Course Name	L-T-P	Credits
CSP101	Database Management Concepts Lab	0-0-2	1

Course Learning Outcomes:

Students will be able to:

- CLO.1 Ability to design and implement a database schema for given problem.
- CLO.2 Apply the normalization techniques for development of application software to realistic problems.
- CLO.3 Ability to formulate queries using SQL DML/DDL/DCL commands

Course Outline:

Session	Experiment
1	Introduction to Oracle, SQL Statements, Introduction (DDL, DML, DQL, TCL, DCL), Data types,
2	Create, Insert, Delete, Drop, Truncate, Update, Alter, Rename, Describe, Distinct, Arithmetic Expressions
3	Alias, Comparison Condition, NULL Values (Between….AND, NOT Between, IN, NOT IN, IS NULL, IS Not NULL), Implementing Integrity constraints
4	Like, Logical Conditions, Order by Clause, Group by and Having Clause
5	SQL Functions (Aggregate Functions, Numeric Functions, String Functions, Date Function,
6	Subqueries, Nested Subqueries
7	Join (Cartesian Product, Equi Join, Non-Equi Join, Natural Join, Self-Join, Outer Join, Cross Join
8	View, Index, Rollback , TCL Commands, DCL Commands
9	Introduction to PL/SQL, PL/SQL Environment,
10	Block Types, Fundamentals (Character Set, Delimiters, Identifiers, etc.), PL/SQL Expression, Displaying User Message
11	PL/SQL Control Structure, %ROWTYPE and %TYPE, Cursors in PL/SQL
12	Cursors with Parameters, Handling Exceptions
13	Procedures and Functions
14	Triggers and DDL Statements

Course Code	Course Name	L-T-P	Credits
CSL4305	Theory of Computation	3-1-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Familiar with skills of basic automata theory of computer system.

CLO.2 Understand the working and data flow in computer components.

CLO.3 Understand the challenges for Theoretical Computer Science and its contribution to other sciences such as biology, economics, physics, and many other fields.

CLO.4 Deal with the problems efficiently on a model of computation using an algorithm.

CLO.5 Describe unrecognizable languages and undecidable problems.

Course Outline:

Mathematical notations and techniques, mathematical foundation of theory of computation basic mathematical objects – sets, logic, functions, relations, languages, non-determinism and Kleene's theorem, regular and nonregular languages, context free languages and pushdown automata, non-context-free languages, introduction to Turing machines, unsolvable problems, restricted Turing machines, programming techniques for Turing machines, undecidability, problems about Turing machines, intractable problems, NP complete problems, complements of languages in NP.

Recommended Book(s):

1. KLP Mishra, "Theory of Computer Science", PHI, Third Edition,
2. Hopcroft & Ullman, Addison, "Introduction to Automata Theory, Languages and Computation", Wesley'2007, Second edition.
3. James Martin, "Introduction to Languages and the Theory of Computation", Tata McGraw Hill, India, Second edition.
4. Mahesh, Kavi, "Theory Of computation: problem-solving approach", Wiley, Second edition.
5. Shukla, Rajesh, "Theory of Computation", Cengage Learning, First edition.

Course Code	Course Name	L-T-P	Credits
CSL5301	Java Programming	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Implement the concept of object-oriented techniques and methodologies using Java.
CLO.2 Use Exception Handling skill for a Robust Application in Java.
CLO.3 Demonstrate an understanding of Java Input/Output and Multithreading.
CLO.4 Use and Implement several Data structures using Collection Framework.
CLO.5 Use database connectivity for a complete Java application.
CLO.6 Use Html, JavaScript, CSS, Servlets, JSP and XML to develop web-based applications.

Course Outline:

Java introduction, history, overview of JDK, JVM, garbage collection, benefits and applications of OOP, basic concepts and characteristics of OOP, abstract methods and classes, packages and interfaces, exception handling, wrapper classes, Junit, stream classes, object serialization, collection interface, generic classes, Java threads, multithreading, thread controlling, RDBMS, Oracle 11g, DML, DDL, JDBC, HTML, CSS, servlets, JSP, XML, DTD, AJAX.

Recommended Book(s):

1. Schildt, Herbert, and Danny Coward, “Java: the complete reference. New York: McGraw-Hill Education", Ninth Edition
2. Sierra, Kathy, and Bert Bates,” Headfirst java”, " O'Reilly Media, Inc.", Third Edition
3. Herbert Schildt, “Java:The Complete Reference”, Seventh Edition
4. Edward G. Finegan, OCA Java SE8 Programmer I Study Guide, Oracle Press

Course Code	Course Name	L-T-P	Credits
CS2023	Advanced Data Structures	3-0-2	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Design and analyze programming problem statements.
CLO.2 choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.
CLO.3 understand the necessary mathematical abstraction to solve problems.
CLO.4 come up with analysis of efficiency and proofs of correctness
CLO.5 comprehend and select algorithm design approaches in a problem specific manner.

Course Outline:

Review of Basic Concepts, Asymptotic Analysis of Recurrences. Randomized Algorithms. Randomized Quicksort, Analysis of Hashing algorithms. Algorithm Analysis Techniques - Amortized Analysis. Application to Splay Trees. External Memory ADT - B-Trees. Priority Queues and Their Extensions: Binomial heaps, Fibonacci heaps, applications to Shortest Path Algorithms. Partition ADT: Weighted union, path compression, Applications to MST. Algorithm Analysis and Design Techniques. Dynamic Programming-Bellman-Ford, Greedy Algorithms. Network Flows-Max flow, min-cut theorem, Ford-Fulkerson, Edmonds-Karp algorithm, Bipartite Matching. NP-Completeness and Reductions.

Recommended Book(s):

1. Introduction to Algorithms, by T. H. Cormen, C. E. Lieserson, R. L. Rivest, and C. Stein, Third Edition, MIT Press.
2. Algorithms, by S. Dasgupta, C. Papadimitrou, U Vazirani, Mc Graw Hill.
3. Algorithm Design, by J. Klienberg and E. Tardos, Pearson Education Limited.

Course Code	Course Name	L-T-P	Credits
CS107	Object Oriented Software Engineering	3-0-2	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Acquire strong fundamental knowledge in science, mathematics, fundamentals of computer science, software engineering and multidisciplinary engineering to begin in practice as a software engineer.

CLO.2 Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.

CLO.3 Deliver quality software products by possessing the leadership skills as an individual or contributing to the team development and demonstrating effective and modern working strategies by applying both communication and negotiation management skill.

CLO.4 Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.

CLO.5 Learn and understand various object-oriented concepts along with their applicability contexts

Course Outline:

Software engineering concepts, software development life cycle, software process models, modeling with UML, projectorganization& communication, requirements elicitation, analysis & system design, object design & code, mapping models to code, testing, project management strategies, project estimation, project scheduling, risk management, quality management.

Recommended Book(s):

1. Roger S. Pressman," Software Engineering, A practitioner's Approach", McGraw-Hill International Edition,Sixth Edition
2. Ian Sommerville," Software Engineering", Adison- Wesley Pub. Co, Sixth Edition
3. Pankaj Jalota," An Integrated Approach to Software Engineering", Narosa Publishing, Third Edition
4. Bernd Bruegge and Allen H. Dutoit," Object-Oriented Software Engineering", Pearson, Third Edition

Course Code	Course Name	L-T-P	Credits
CS179	Programming Abstractions	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Explain the basic concepts of object-oriented programming language and their representation.
CLO.2 Illustrate dynamic memory allocation functions, access specifiers and the friend functions.
CLO.3 Demonstrate the use of constructors, destructors and also the behaviour of inheritance and its implementation.
CLO.4 Implement polymorphism and overloading of operators.
CLO.5 Apply the I/O operations to handle backup system using files and to develop general purpose templates.
CLO.6 Handle raised exception while implementing various object-oriented concepts.

Course Outline:

C++ Fundamentals, arrays, pointers, strings, dynamic memory management, recursion, classes and objects, constructors and destructors, operator overloading, inheritance, virtual base class, overriding, virtual functions, polymorphism, exception handling, templates and generic programming, containers, iterators, vectors, lists, maps, project.

Recommended Book(s):

1. The C++ Programming Language (4th Edition) By Bjarne Stroustrup.
2. Data Structures by Schaums Outlines Indian Adapted Edition by Seymour Lipschutz, TMH
3. The C++ Standard Library by Nicolai M. Josuttis.

Course Code	Course Name	L-T-P	Credits
CS192	Front End Engineering	3-0-2	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Develop a deep understanding of HTML, CSS, and JavaScript, and be able to apply this knowledge to create responsive and accessible web pages.

CLO.2 Learn how to use front-end frameworks, API's and Async programming to build front end applications.

CLO.3 Understand the basics of responsive design, and be able to create websites that work well on a variety of devices and screen sizes.

CLO.4 Develop strong problem-solving skills, and be able to break down complex problems into smaller, more manageable parts.

CLO.5 Learn how to collaborate effectively with other developers, designers, and stakeholders on web development projects.

CLO.6 Project development and GIT hub.

Course Outline:

Introduction to Web, Static and dynamic Pages, Introduction and fast revision to html tags and their usages, HTML Tags and assignments, Java script Introduction and its advantages and disadvantages

Writing first java script program and and intro to difference development tools, Introduction to Variables and basics programming concepts in java script, Scope of variables, conditional statements

Loops, Arrays accessing array elements using different methods, Functions, Type of function and their scope anonymous functions and arrow functions, Array Iterators, for each, filter, map ad creating custom iterators, Introduction to Object, managing objects, What is JSON and how local storage is managed in java script, Nested JSON and Different JSON methods, Data transfer, exchange methods using JSON, Advantages and drawbacks of using local storage and other possible ways, Assignment Pomodoro Clock based on the async, Async and await, Promises and handling promises, Callback and exceptions, GIT Version Control System (Installation, Life Cycle, Clone GIT log, diff, commit, push, pull, Branches, and contributions, ES6, Introduction to Es6, Advantages and disadvantages, List and keys, NPM and router.

Recommended Book(s):

1. H. B. Covers CSS3. Javascript, XML, XHTML, Ajax, PHP and Jquery..
2. Duckett, B. J. (2008). Beginning Web Programming with HTML. XHTML, and CSS, 2nd Edition, Wrox.
3. Meloni, J. C., & Kyrnin, J. (2018). HTML, CSS, and JavaScript All in One, Sams Teach Yourself. Sams Publishing.
4. Humphrey, B. (2016). Get Coding! Learn HTML, CSS & JavaScript & Build a Website, App & Game. The School Librarian, 64(3), 189

Course Code	Course Name	L-T-P	Credits
CS126	Algorithm Design & Implementation	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Well versed with Object Oriented Concepts and Java skills.
CLO.2 Implement graph traversal algorithms and hashing techniques.
CLO.3 Write program in Java to solve graph-based problems.
CLO.4 Apply graph searching algorithms to real life problems.
CLO.5 Simulate real world problems to Java based software solutions.

Course Outline:

Java basics, classes & objects, data types & operators, methods & classes, introduction for generation of random numbers, inheritance, packages & interfaces, using I/O, generics, autoboxing, static import & annotations, graph primitives, DFS, BFS, connected components, directed and undirected graphs, balanced search trees and its applications, hash tables.

Recommended Book(s):

1. HerbertSchildt, “The Complete Reference Java”, McGraw Hill Education India, Fifth Edition
2. Data Structures by Schaum’s Outline Seymour Lipschutz,” Tata McGraw-Hill, Second Edition.
3. Kathy Sierra,” Head First Java”,Pearson, Second Edition.
4. Edward G. Finegan,” OCA Java SE8 Programmer I Study Guide”, Oracle Press, Third Edition
5. Norton, Ivor,"Beginning Java 2" Dreamtech Publication, Fifth Edition.

Course Code	Course Name	L-T-P	Credits
CS145	Front-end Development	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify the basis of designing a website, create webpages, links, images, tables and page layouts in HTML.
CLO.2 Describe and identify the use of Javascript and successfully place it into webpages and also recognize the uses of Javascript.
CLO.3 Use Javascript to manipulate elements in the DOM to change appearance and visibility.
CLO.4 Describe how intended website design features will specifically benefit a target user group content strategy.
CLO.5 Understanding the role and functions of Web servers and server frameworks.

Course Outline:

History of Web, client-server architecture, front-end and back-end, introduction to HTML, forms, introduction to CSS, styling with CSS, resume project, flex, responsive design, animations and 3D space, bootstrap, starting with Javascript, Javascript functions and arrays, object and timing events, understanding DOM, calculator project, constructors and prototypes, JQuery.

Recommended Book(s):

1. Alex Banks and Eve Porcello, Learning React: Functional Web Development with React and Redux, O′Reilly, 1st edition
2. Francesco Strazzullo, Frameworkless Front-End Development: Do You Control Your Dependencies or Are They Controlling You? Apress, 1st ed. Edition
3. Jon Duckett, Front-End Back-End Development with HTML, CSS, JavaScript, jQuery, PHP, and MySQL Paperback, Wiley, 1st edition
4. https://www.w3schools.com/react/
5. https://www.codecademy.com/learn/react-101
6. https://www.codecademy.com/learn/react-101

Course Code	Course Name	L-T-P	Credits
CS159	Back-end Development	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Gain skills to build full stack end applications using Javascript, Nodejs, Expressjs and MongoDB.
CLO.2 Understand the concept of full stack development and APIs.
CLO.3 Learn debugging issues and end-to-end testing.
CLO.4 Deliver features in an agile development environment.
CLO.5 Architect solutions to programming problems by combining visual components and classes and develop a fully functioning website and deploy on a web server.

Course Outline:

Introduction and setup of NodeJS, ExpressJS and middlewares, session handling, templating using EJS, SQL and No SQL databases, introduction to AWS and IAM, AWS-EC2, RDS, Route 53, AWS S3, docker, elastic bean talk.

Recommended Book(s) and References:

1. Ethan Brown,Web Development with Node and Express: Leveraging the JavaScript Stack, O'Reilly Media, 2nd edition
2. Jon Duckett, Front-End Back-End Development with HTML, CSS, JavaScript, jQuery, PHP, and MySQL Paperback, Wiley, 1st edition
3. DT Editorial Services, HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, AJAX, PHP and jQuery, Dreamtech Press: 2nd edition
4. https://expressjs.com/
5. https://www.w3schools.com/react/

Course Code	Course Name	L-T-P	Credits
CS254H	Professional Practices-System Design	2-0-0	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Distinguish concepts related to processes, threads, process scheduling, race conditions and critical sections.
CLO.2 Examine and categorize various memory management techniques like caching, paging, segmentation, virtual memory, and thrashing.
CLO.3 Design and implement file management system.
CLO.4 Construct the SQL queries for given specifications.
CLO.5 Explain the functions of the different layer of the OSI Protocol.

Course Outline:

Process Management, Process Control Blocks, Process States. Process Control Block (PCB), Process Scheduling Queues. Schedulers, Threading, Memory management (types, fragmentation, paging, segmentation). Scheduling Algorithms pre-emptive and non-pre-emptive. Virtual memory, Demand Paging, page replacement algorithms. Swapping, Thrashing. File System (Types of file system, File system structure). Allocation methods, directory implementation file system vs DBMS. HLD (Decision Tables, Decision Trees, Flow Diagrams, Flow Charts, Data Dictionary), LLD. Case Studies, Scaling (Vertical and Horizontal Scaling) OSI Layers (physical layer). Data link layer, network layer. Transport layer, session layer, presentation layer, application layer. IP addressing. Types of IP address, Classes. SQL Commands, NoSQL (graph, Document, Column family) Practice Queries. Normalization, Indexing Tabular vs Columnar Data.

Recommended Book(s) and References:

1. System Analysis and Design, 7th edition, Julie E Kendall and Kenneth E Kendal, 2009.
2. Systems Analysis and Design, 9th edition, Gary Shelly, Harry J. Rosenblatt, 2011.
3. System Analysis and Design, 5th edition, Wixom & Roth, 2012.
4. Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill, 2010.
5. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill, 2007.
6. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition, 2013.

Course Code	Course Name	L-T-P	Credits
CS108	Python Basics	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Designing real life scenario problems, identifying and analysing solutions for it.
CLO.2 Accurately and efficiently designing the solutions in python.
CLO.3 Use python skills in various fields of Data Science, Machine Learning and Artificial Intelligence.
CLO.4 Use indexing and slicing to access data in Python programs.
CLO.5 Design loops and decision statements in Python.

Course Outline:

Introduction to objects & Python's math library, strings, lists, dictionary, understanding dictionary specific methods, keys, values, items, copy, update, pop, using * & ** during calling time & receiving time, modules, using Python GUI.

Recommended Book(s):

1. Lutz, Mark, "Learning python", O'Reilly Media, Inc.", Fifth Edition.
2. Zed A.Shaw, Learn python the hard way, Pearson publications, Third Edition
3. Dierbach, Charles, "Python, A Computational Problem-Solving Focus", Wiley, ThirdEdition
4. Ljubomir," Introduction to programming using python: An application development focus. Percovic", Wiley, Third Edition

Course Code	Course Name	L-T-P	Credits
CS133	Data Visualization and Query Language	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Infer skills for various performance measures and benchmarking progress towards business goals.
CLO.2 Aanalyze automated dashboard project to determine the entities involved in the system and their relationship to one another.
CLO.3 Create database and work on complex queries.
CLO.4 Differentiate various mapping tools.
CLO.5 Learn web mapping services requirements.

Course Outline:

Introduction to Excel, data preparation, pivots, Vlookup, Hlookup, bar charts, pie charts, dynamic data filters, dynamic data validation, Tableau 10.0, creating a dashboard layout, introduction to maps, custom geocoding, web mapping services, case studies, SQL.

Recommended Book(s):

1. Microsoft Business Intelligence Tools for Excel Analysts (WILEY)
2. Tableau Your Data! Fast and Easy Visual Analysis with Tableau Software.
3. Ivan Bayross," Introduction to PL/SQL", BPB Publication, Third Edition.
4. Dr. Anil Maheshwari, Data Analytics - Made Accessible, 2021 Edition

Course Code	Course Name	L-T-P	Credits
CS134	Business Analytics	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand and critically apply the concepts and methods of business analytics
CLO.2 To use basic functions and packages in Python.
CLO.3 To understand statistical concepts, skills and different hypothesis tests.
CLO.4 To learn how to prepare data using Python.
CLO.5 To learn how to prepare data using Python.

Course Outline:

About data, probability theory, inferential statistics, metrics & charts, hypothesis testing, Python, data preparation using Python, working with relational database in Python, data ingestion & inspection, concatenating data, merging data.

Recommended Book(s):

1. Magnus Vilhelm Persson, Luiz Felipe Martins," Mastering Python Data Analysis", PACKT Publications, Second Edition
2. Richard L. Halterman," Learning to program with python", Pearson publication, Second Edition
3. Andriy Burkov," The Hundred-Page Machine Learning", Pearson publication, First Edition
4. Wayne L. Winston," Microsoft Excel Data Analysis and Business Modeling", Microsoft Press,U.S,Second Edition

Course Code	Course Name	L-T-P	Credits
CS254J	Professional Practices-Dashboard Designing	2-0-0	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Learn Design thinking
CLO.2 Convert information into actionable outcomes.
CLO.3 Prototyping data models.
CLO.4 Create dashboards using PowerBI
CLO.5 Learn basic and advanced fundamentals of Excel

Course Outline:

Introduction What is design thinking? How (Design thinking process), Empathize, Define, Ideate, Prototype, Test, Implement Why is it important? The history of Design thinking the phase of design thinking Clustering ideas and reveal insights: Affinity diagrams. Creating your POV (Point of view) of the problem statement Importance of questioning. Mapping stakeholders in the project. Deciding and presenting most important information needed. Consolidation and Arrangement on a single screen. Definition and importance of Ideation. Discussing around brainstorming techniques, SCAMPER method etc. Selecting the best idea at the end of the session. Definition of prototyping Benefits of prototyping. Test: Evaluate the prototype by asking real users to use it. Implement: Put the vision into effect and ensure that it meets to original objectives. Understand your end goal. Know your purpose and audience Leverage the most-viewed spot. Optimal size of the display / Dashboard / Report Adding interactivity to encourage exploration. Advanced data cleaning and processing REPT, SUBSTITUTE, REPLACE, TEXTJOIN, CONCAT, TEXT, TRIM, CLEAN. Advanced Find and Replace Sorting | Filtering. Sorting data, Advance Sorting Hide/ Unhide data. Filter / Advance Filter Data Validation Sorting | Filtering. Sorting data, Advance Sorting Hide/ Unhide data. Filter / Advance Filter Data Validation. Handling dates Fixing incorrect dates DATE, DAY, MONTH, YEAR LOOKUPs. Understand how to use Vlookup, Hlookup, Index, Match, and Offset functions Understand how to use the SUMIFS function. Designing Interactive Dashboards with MS-Excel Visualization Concepts Tables. Basic Charts (Including custom formatting) Pivot table Pivot Chart Slicer, Timeline Conditional Formatting. Interactive Control Concepts Scrollbar Radio button Checkbox Dropdown list. How to create Form Controls. Create dynamic Interactive Charts in Excel with Form Controls Learn Excel techniques by creating dashboards Creating your own Dashboard – HandsOn Case Studies and HnadsOn Practice Aligning with Design principles. Applying right statistics angle Applying AI insights Comparing content types. Applying styles and layouts: content sizing and layout Web URL Add Logo
AI based intelligent Summary Mobile layout Dashboard and BI Apps. Incorporating Design concepts Dashboard Considerations Choosing right chart type Choosing relevant control Optimal chart Formats Data Modelling Choosing the relevant data for the analysis Type conversions Choosing the right types of relationship between data Schedule Refresh of Data (pro version)

Recommended Book(s):

1. The Big book of Dashboards, Steve Wexler, Wiley, 2017.
2. Story telling with data, Cole Knaflic, Wiley, 2015.
3. Microsoft Excel 2019: Data Analysis & Business Model, PHI Learning Pvt. Ltd, 2019.

Course Code	Course Name	L-T-P	Credits
CS138	Machine Learning	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand and implement classical models and algorithms in machine learning as well as python programming concepts.
CLO.2 Analyze the data, identify the problems.
CLO.3 Learn the skills to analyze relevant models and algorithms to turn available data into valuable and useful Information.
CLO.4 Understand the comparative study of the related approaches.
CLO.5 Explore new techniques and ideas that can be used to improve the effectiveness of current AI tools.

Course Outline:

Python & flow control, data structures & functions in Python, AI-ML, expert systems, unsupervised & supervised learning, linear algebra, fundamentals & types of metrices, statistics, NumPy, probability, Bayes theorem, random variables, Gaussian distribution, Pandas, exploratory data analysis (EDA), feature engineering, linear & logical regression, performance measurement of models, support vector machines, principal component analysis (PCA), introduction to deep learning.

Recommended Book(s):

1. Tom M Mitchell,"Machine Learning" Tata MacGraw Hills, Second Edition
2. Garrett Grolemund and Hadley Wickham, "R for Data Science", Shroff/O'Reilly; First Edition
3. Oliver Theobald," Machine Learning for Absolute Beginners: A Plain English Introduction", Pearson publication, Second Edition.
4. Jiawei Han and Micheline Kamber, T," Data Mining: Concepts and Techniques"', Morgan Kaufman Publishers. Third Edition

Course Code	Course Name	L-T-P	Credits
CS129	Introduction to Cyber Security	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Review and practice computer and network etiquette and ethics found in working environments
CLO.2 Perform risk assessment
CLO.3 Install, configure, use and manage anti malware software on a working network
CLO.4 Evaluate best practices in security concepts and skills to maintain confidentiality, integrity and availability of computer systems
CLO.5 Articulate informed opinion about issues related to cyber security

Course Outline:

Information security, basic networking & TCP/IP, introduction of malwares, attacks and offensive security, virtualization, Debian hands-on, Wireshark, Internet Information Service (IIS), TCP headers, IP tables, SNORT, SDLC, security tools and sites, fingerprinting, cryptography, system vulnerability test, Metasploit, HTTP basics, CTF challenges.

Recommended Book(s):

1. Chwan-Hwa Wu and J David Irwin, "Introduction to Computer Networks and Cybersecurity", CRC Press, Second Edition
2. J Brooks," Cybersecurity Essentials", Wiley, Second Edition
3. Hacking: A Beginners' Guide to Computer Hacking, Basic Security, And Penetration Testing, John Slavio
4. Mitnick, "The Art of Invisibility: The World's Most Famous Hacker Teaches You How to Be Safe in the Age of Big Brother and Big Data", Back Bay Books; Second edition

Course Code	Course Name	L-T-P	Credits
CS130	Cyber Security for Forensics & Investigation	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the importance of a systematic procedure for investigation of data found on digital storage media that might provide evidence of wrongdoing.

CLO.2 Understand the file system storage mechanisms of two common desktop operating systems (i.e., versions of Microsoft Windows and LINUX).

CLO.3 Use tools for faithful preservation of data on disks for analysis.

CLO.4 Find data that are hidden on a computer disk.

CLO.5 Learn the skills to use of computer forensics tools used in data analysis, such as searching, absolute disk sector viewing and editing, recovery of files, password cracking, etc.

Course Outline:

Introduction, CIA tried with case study, introduction to digital forensics, hard disk structure, booting sequence, cyber laws & case studies, file system overview, FAT and NTFS, data wiping, forensic image, digital investigation process, zip and Windows password cracking and bypass, analyzing server logs, steganography & tools.

Recommended Book(s):

1. Dejey Murugan, “Cyber Forensics”, Oxford Press, First Edition
2. Cyber Forensics in India: A Legal Perspective by Nishesh Sharma, Universal Law Publishing, First Edition
3. Marjie T Britz, “Cyber Forensics and Cyber Crime an Introduction”Pearson, Second Edition
4. Cengage, “Hands on Ethical Hacking and Network Defense”, Pearson, Second Edition

Course Code	Course Name	L-T-P	Credits
CS131	Malware and Reverse Engineering – I	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Apply malware analysis methodology and technology
CLO.2 Apply static malware analysisskills.
CLO.3 Identify basic and some malware functionality
CLO.4 Identify known anti-reverse engineering techniques
CLO.5 Conduct an analysis without revealing that the investigation is taking place and/or revealing their identity.

Course Outline:

Introduction to malwares, RE & malware analysis lab setup guide, introduction to Windows internal, Windows PE file format, assembly programming, reverse engineering basics, case study – Root kit, detection and removal of malwares, anti-reverse engineering techniques, decrypting communications of a RAT.

Recommended Book(s):

1. Eldad Eilam, “Reversing: Secrets of Reverse Engineering”, Wiley, 1st Edition
2. Michael Sikorski, Andrew Honig, “Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software” 1st Edition
3. Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition
4. Practical Reverse Engineering by Bruce Dang, Wiley

Course Code	Course Name	L-T-P	Credits
CS132	Malware and Reverse Engineering – II	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Apply advanced malware analysis methodology and technologyskills.
CLO.2 Apply advanced static malware analysis.
CLO.3 Identify basic and some advanced malware functionality
CLO.4 Identify known anti-reverse engineering techniques
CLO.5 Conduct an analysis without revealing that the investigation is taking place and/or revealing their identity.

Course Outline:

Introduction to malware analysis & reverse engineering, types of analysis, dynamic analysis, programming in Linux, basics of assembly language programming, loop program, hands-on.

Recommended Book(s):

1. Eldad Eilam, “Reversing: Secrets of Reverse Engineering”, Wiley, 1st Edition
2. Michael Sikorski, Andrew Honig, “Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software” 1st Edition
3. Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition
4.Bruce Dang, “Practical Reverse Engineering”, John Wiley & Sons Inc, First edition

Course Code	Course Name	L-T-P	Credits
GPP101	Fundamentals of Game Programming	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Develop the skill to be able to program for a game.
CLO.2 Develop their own games.
CLO.3 Perform their games on multiple platforms.
CLO.4 Skill development by apply mathematical and game programming knowledge and skills to solve development tasks.
CLO.5 Seek new knowledge of games development through self-directed study.

Course Outline:

Introduction with SFML, sprites, textures, shapes draw, font, audio, sprite animation, scrolling BG, key inputs, mouse inputs, mobile technologies, animation for Android & iOS, Cocos2DX, collider, HUD, gameplay, runner game.

Recommended Book(s):

1. Michael Dawson," Beginning C++ Through Game Programming", Course Technology PTR,Third Edition
2. Fletcher Dunn, "3D Math Primer for Graphics and Game Development", CRC Press, 2nd Edition
3. Robert Nystrom, "Game Programming Patterns Paperback", Lightning Source Inc,First edition.
4. Jason Gregory, "Game Engine Architecture", CRC Press, 2nd Edition

Course Code	Course Name	L-T-P	Credits
GPP103	Graphics Programming	1-0-2	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Program computer graphics renderers.
CLO.2 Learn the skills to develop OpenGL applications.
CLO.3 Perform transformations on objects in graphics application.
CLO.4 Analyze, synthesize, and utilize design processes and strategy from concept to delivery to creatively solve communication problems.
CLO.5 Create and develop skill in communication solutions that address audiences and contexts, by recognizing the human factors that determine design decisions.

Course Outline:

Game engine architecture, advanced C++, modern OpenGL, lighting, model loading, advanced OpenGL, advanced lighting, PBR, 2D game.

Recommended Book(s):

1. David Wolff, OpenGL 4 Shading Language Cookbook: Build high-quality, real-time 3D graphics with OpenGL 4.6, GLSL 4.6 and C++17, 3rd Edition, Paperback
2. Eric Lengyel, Foundations of Game Engine Development, Volume 1: Mathematics
3. John Kessenich, Graham Sellers, Dave Shreiner, OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.5 with SPIR-V (9th Edition) 9th Edition, Paperback.
4. Alan Thorn, John P.Doran, Alan Zucconi, Jorge Palacios. Complete Unity 2018 Game Development: Explore techniques to build 2D/3D application using real-world examples, Packt.

Course Code	Course Name	L-T-P	Credits
GPL104	Game Design – BG	1-0-2	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Generate the skill of innovative ideas and go beyond the obvious and predefined.
CLO.2 Listen to, evaluate, and respond critically to the ideas of others.
CLO.3 Identify steps, develop, and manage a successful professional workflow.
CLO.4 Synthesize trends, theories, and movements in the development of new ideas
CLO.5 Identify and apply foundational theories and approaches that inform contemporary for skill development and creative work

Course Outline:

Game design, iteration & rapid prototyping, role of game designer, how the system works, three stages of documentation, game flow summary, game progression, screen flow, control system, opponent and enemy AI, support AI, game art.

Recommended Book(s):

1. Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann Publishers Inc, First Edition
2. Eric Lengyel,"Foundations of Game Engine Development, Volume 1: Mathematics", Papeback,CRC Press, First edition.
3. Jesse Schell," The Art of Game Design: A Book of Lenses", A K Peters/CRC Press,Third Edition
4. Scott Rogers, "Level Up! The Guide to Great Video Game Design", Wiley, 2nd Edition
5. Steve Swink," Game Feel: A Game Designer's Guide to Virtual Sensation",CRC Press,First edition.

Course Code	Course Name	L-T-P	Credits
GPL102	Game Design – 2D & 3D	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Generate the skill of innovative ideas and go beyond the obvious and predefined.
CLO.2 Listen to, evaluate, and respond critically to the ideas of others.
CLO.3 Identify steps, develop, and manage a successful professional workflow.
CLO.4 Generate innovative ideas and go beyond the obvious and predefined.
CLO.5 Synthesize trends, theories, and movements in the development of new ideas.

Course Outline:

Level constraints, bubble diagram, rough maps, path finding for 2D platforms, modeling social problems as a game, mathematical theory of human behavior, mixed strategy equilibrium, generating ideas for games, mechanics, dynamics, rules and discovery, explaining & imagination, the friend and the enemy.

Recommended Book(s):

1. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann,First Edition
2. Ernest Adams and Joris Dormans," Game Mechanics: Advanced Game Design", New Riders, New Riders, First Edition
3. Raph Koster," A Theory of Fun for Game Design", O'Reilly, First Edition
4. Eric Lengyel,"Foundations of Game Engine Development, Volume 1: Mathematics", PaperbackCRC Press, First edition.

Course Code	Course Name	L-T-P	Credits
GPP107	Unity Game Development	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Development of 2D & 3D games using the learned skills.
CLO.2 Development of Special effects and Multiplayer games
CLO.3 Apply mathematical and game programming knowledge and skills to solve development tasks.
CLO.4 Build familiarity and appreciation of the programmatic components of an industry standard game development engine.
CLO.5 Seek new knowledge and skill development of games development through self-directed study.

Course Outline:

UI, unity programming, 2D games, raycast, line renderer, Mario type games, 3D games, rigidbody3D, RPG type games, postproduction, lighting, materials, camera, walkthrough, particles, occlusion, culling, memory management, networking (Photon & UNET), creating server, join room.

Recommended Book(s):

1. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, First Edition
2. Ernest Adams and Joris Dormans," Game Mechanics: Advanced Game Design", New Riders, New Riders, First Edition
3. Raph Koster," A Theory of Fun for Game Design", O'Reilly, First Edition
4. Eric Lengyel,"Foundations of Game Engine Development, Volume 1: Mathematics", Papeback,CRC Press, First edition.

Course Code	Course Name	L-T-P	Credits
CS254I	Professional Practices-Unreal Basis	2-0-0	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Demonstration of asymptotic notations of games.
CLO.2 Compare and contrast the operation and complexity of various level design and game play.
CLO.3 Analyze the fundamental concepts of complexity of level design and game play.
CLO.4 Create suitable solutions to solve complex game level puzzles.
CLO.5 Create Solutions for problems related to real world gaming.

Course Outline:

Getting Started in Unreal Engine, A Tour of the new Unreal Engine Learning Portal, Introduction about Unreal editor, Comprehending Projects and File Structure, Unreal Editor Fundamentals - Editor Introduction, Animation Kickstart, Materials Kickstar, Blueprint Kickstart, Lighting Essential Concepts and Effects, Introducing Global Illumination, Rendering Kickstart, Introducing the Principles of Real-time, An In-Depth look at Real-Time Rendering, Real-Time Rendering Fundamentals, VFX and Particle Systems with Unreal Engine, Sequencer, Unreal motion graphics, Real-Time Compositing Basics, Post Processing Essentials.

Recommended Book(s):

1. Game development and simulation with unreal technology by Tavakkoli, Alireza
2. Learning Unreal Engine game development: a step-by-step guide that paves the way for developing fantastic games with Unreal Engine 4 by Lee, Joanna
3. Unreal Engine 4 Game Development Essentials by Satheesh.

Course Code	Course Name	L-T-P	Credits
CS141	Digital & Social Media Marketing Building Blocks and Content Development & Marketing	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understanding of the key concepts,and trends associated with Digital Marketing & Internet Technologies.
CLO.2 Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.
CLO.3 Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing & Internet Technologies.
CLO.4 Explain emerging trends in digital marketing and critically assess the use of digital marketing tools by applying relevant marketing theories and frameworks.
CLO.5 Interpret for entrepreneur development the traditional marketing mix within the context of a changing and extended range of digital strategies and tactics.

Course Outline:

Introduction to digital marketing, types of digital marketing, domain selection & registration, web space, park a domain, WP installation and dashboard, use of visual composer & its elements, WooCommerce pages and settings, tools of trade and social book marketing, B2B directories and forum postings, various online tools for content marketing, Google AdSense.

Recommended Book(s):

1. Brad Williams and David Damstra," Professional WordPress: Design and Development", Wrox, Third Edition
2. Venakataramana Rolla, "Digital Marketing Practice Guide for SMBs: SEO, SEM and SMM Practice Guide", Wiley, SecondEdition
3. Damian Ryan," Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation", Kogan page, Fourth Edition
4. Shivani Karwal, "Digital Marketing Handbook: A Guide to Search Engine Optimization, Pay Per Click Marketing, Email Marketing, Social Media Marketing and Content Marketing", Reilly, First Edition.

Course Code	Course Name	L-T-P	Credits
CS142	Search Engine Marketing (SEO & PPC), Web Analysis and Email Marketing & Management	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.
CLO.2 Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.
CLO.3 Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing skills, entrepreneurship & Internet Technologies.
CLO.4 Analyze the confluence of marketing, operations, and human resources in real-time delivery.
CLO.5 Demonstrate cognitive knowledge of the skills required in conducting online research and research on online markets, as well as in identifying, assessing and selecting digital market opportunities.

Course Outline:

What is search engine optimization, how to make search engine friendly page, what are off-page factors, search engine marketing (SEM), pay per click advertising (PPC), web analytics, Google analytics, email marketing, MailChimp, Interspire, autoresponder.

Recommended Book(s):

1. Jennifer Grappone and Gradiva Couzin, “Search Engine Optimization (SEO): An Hour a Day”,Wiley, Second Edition.
2. Adam Clarke, “Search engine optimization 2016: Learn SEO with smart internet marketing strategies”, Pearson, Second Edition
3. Jason McDonald,SEO Fitness Workbook, 2016 Edition: The Seven Steps to Search Engine Optimization Success on Google by Search Engine Marketing, Inc.: Driving”, Wiley, First Edition
4. Mike Moran and Bill Hunt, “Search Traffic to Your Company's Website”, (IBM Press), Third Edition

Course Code	Course Name	L-T-P	Credits
CS143	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.
CLO.2 Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.
CLO.3 Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing skills & Internet Technologies.
CLO.4 Find out the significance of Search Engine Marketing and Social Media Optimization
CLO.5 Analyze various ranking factors of online applications with Search Engine Optimization Techniques for entrepreneurs.

Course Outline:

Social media marketing, Facebook marketing, invite potential followers, group monetization, Facebook ads and promotions, LinkedIn marketing, Twitter marketing, Instagram marketing, Pinterest marketing, introduction to affiliate marketing, mobile marketing, online reputation management.

Recommended Book(s):

1. Michael Richards, "Social Media: Dominating Strategies for Social Media Marketing with Twitter, Facebook, Youtube, LinkedIn, and Instagram", Paperback, First edition.
2. Andrew Macarthy, "500 Social Media Marketing Tips: Essential Advice, Hints and Strategy for Business: Facebook, Twitter, Pinterest, Google+, YouTube, Instagram, LinkedIn, and More", Wiley, First Edition
3. J. Wolf, "Social Media: Master, Manipulate, And Dominate Social Media Marketing Facebook, Twitter, YouTube, Instagram and LinkedIn",Paperback, Second edition.
4. Daniel Rowles, "Mobile Marketing: How Mobile Technology is Revolutionizing Marketing, Communications and Advertising, Kogan Page, First Edition.
5. Rachel Pasqua, Mobile Marketing: An Hour a Day by Rachel Pasqua and Noah Elkin, Sybex, First Edition

Course Code	Course Name	L-T-P	Credits
CS144	Affiliate Marketing and Online Reputation Management (ORM)	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.
CLO.2 Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.
CLO.3 Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing skills & Internet Technologies.
CLO.4 Find out the significance of Search Engine Marketing and Social Media Optimization.
CLO.5 Analyze various ranking factors of online applications with Search Engine Optimization Techniques useful for entrepreneurs.

Course Outline:

Introduction to affiliate marketing, adding paid sponsoring placement, getting the most from what you are delivering, forums, websites, conference, message boards, generating revenue through a membership site or list building, search engine techniques, online reputation management, tools for monitoring online reputation.

Recommended Book(s):

1. Rachael Aprill Phillips, “Affiliate Marketing for Women”, Lulu.com, Second edition.
2. New Thrive Learning Institute, Affiliate Marketing - the Complete Affiliate Marketing Handbook, Lulu.com, First edition.
3. A Anderson,”Affiliate Marketing: How to Make Money and Create an Income”, Createspace Independent Publishing Platform,First edition
4. Lori Randall Stradtman, “Online Reputation Management for Dummies”, John Wiley & Sons, Third edition.
5. Keith Fugate, “Affiliate Marketing”, Paperback, First edition.

Course Code	Course Name	L-T-P	Credits
EP101	Entrepreneurship and Opportunity	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Sell themselves and their ideas and become entrepreneurs.
CLO.2 Master oral and visual presentation skills and establish a foundation of confidence in the skills necessary to cause others to act.
CLO.3 Find problems worth solving.
CLO.4 Advance their entrepreneurship skills in customer development, customer validation, competitive analysis, and iteration while utilizing design thinking and process tools to evaluate in real-world problems and projects.
CLO.5 Increase their awareness and deliberately practice the entrepreneurship skills and disciplines necessary to increase confidence and agency; foster self-efficacy and self-advocacy; improve communication and problem-solving skills, manage strong impulses and feelings; and identify personal purpose.

Course Outline:

What is entrepreneurship, key aspects, entrepreneurship fundamentals, self-discovery, effectuation, case study, team formation, identify problems worth solving, design thinking, look for solutions, customers and markets, identify your costumer segment and niche, craft your value proposition, present your value proposition, basics of business model and lean approach, sketch the lean canvas, risks and assumptions, gap analysis, common observation methods.

Recommended Book(s):

1. Bart Clarysse and Sabrina Kiefer, “The Smart Entrepreneur: How to Build for A Successful Business”, Elliott &Thompson Publications, First edition.
2. Eric Ryes, “The Lean Startup: How Constant Innovation Creates Radically Successful Businesses, Penguin UK, Second edition.
3. Katy Milkman, “How to Change: The Science of Getting from Where You Are to Where You Want to Be”, Thompson Publications, First edition,
4. Peter G. Peterson, “The Education of an American Dreamer”, Twelve, First edition.

Course Code	Course Name	L-T-P	Credits
EP102	Consumer &Market Research for Entrepreneurs	2-0-4	4

Course Learning Outcomes:

Students willbeable to:

CLO.1 Identify and evaluate entrepreneurial opportunities, manage risks and learn from the results.

CLO.2 Understand the process that enables entrepreneurs with limited resources.

CLO.3 Understand and apply fundamental aspects as a means of personal empowerment.

CLO.4 Help a company or business development, through proper planning, organization, and both human and material resources control, and thus satisfy all specific needs within the market, at the right time.

CLO.5 Satisfy customer's specific needs through a required product or service.

Course Outline:

Blue Ocean Strategy to refine your value proposition, Applying the Four Actions Framework, Build Solution Demo, Problem-Solution Fit, Identify Your MVP and Build It, Conduct MVP Interviews, Prototyping and MVP, present your MVP, Money, Team, Marketing & Sales, Support, Pitch your idea

Recommended Book(s):

1. Kevin D Johnson, The Entrepreneur Mind, Jaico Publishing House, 1st Edition
2. Pankaj Goyal, Before You Start Up: How to Prepare to Make Your Startup Dream a Reality, Fingerprint! Publishing
3. Peter F Drucker, The Entrepreneurial Innovator; Harper Business, Reprint Edition
4. Arvind Kumar Bhatt, INNOVATION AND ENTREPRENEURSHIP, Laxmi Publications Pvt. Ltd., First Edition

Course Code	Course Name	L-T-P	Credits
CS168	UX Design and Digitalization	1-0-2	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand what interaction design is, the importance of user-centred design and methods of user information gathering.

CLO.2 Understand how the sensory, cognitive and physical capabilities of users inform the design of interactive products.

CLO.3 Understand the process of interaction design, including requirements elicitation, prototyping, evaluation and the need for iteration.

CLO.4 Analyse and critique the design of interactive products.

CLO.5 Learn skills to select, adapt and apply suitable interaction design approaches and techniques towards the design of an interactive product.

Course Outline:

Understand the evolution of UX design, learning about UX industry experts, UX design process and methodologies, user centered design, 5S model, job roles and responsibilities in the UX industry, UX industry trends, deep-dive in UX methodologies, case studies in UX design, heuristic evaluation, understanding product UX lifecycle, BFSI, manufacturing, retail, automotive, media, FMCG, logistics, oil & gas, understand industry specific problems, digitalization for the bottom of the pyramid, localization of experience, project.

Recommended Book(s):

1. Dave and Tom Kelly Tom Kelley, David Kelley, Creative Confidence: Unleashing the Creative Potential Within Us, Currency, Illustrated Edition
2. Don Norman, The Design of Everyday Things, Basic Books, 2nd Edition
3. Nir Eyal, hooked: How to Build Habit-Forming Products, Portfolio Penguin; Latest Edition
4. Kim Goodwin, designing for the Digital Age: How to Create Human-Centered Products and Services, Wiley, 1st Edition

Course Code	Course Name	L-T-P	Credits
CS169	User Interface Design	1-0-2	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Construct navigation that enables users to easily accomplish tasks.
CLO.2 Determine which data to display in order to meet user needs.
CLO.3 Enable users make social connections through their mobile devices.
CLO.4 Focus on patterns that bring clarity.
CLO.5 Learn the skills of design strategy development that provides solutions to meet business and user goals.

Course Outline:

Elements of design, principles of design, tools of visual design, introduction to the operating systems and digital devices, visual design principles, contrast ratio, colour psychology, laws in UI design, consistency and legibility, creating digital guidelines considering factors of UX color, typography, iconography, grid, document and portfolio guidelines.

Recommended Book(s):

1. Everett N McKay, UI is Communication: How to Design Intuitive, User Centered Interfaces by Focusing on Effective Communication, Morgan Kaufmann, Illustrated edition
2. Jeff Johnson, designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines, Morgan Kaufmann, 2nd edition
3. Chris Nodder, Evil by Design: Interaction Design to Lead Us into Temptation, Wiley, 1st Edition
4. Golden Krishna, The Best Interface Is No Interface: The simple path to brilliant technology, New Riders

Course Code	Course Name	L-T-P	Credits
CS170	Empathy & its Tools	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Use empathy to change behavior and build better relationshipskills.

CLO.2 Develop empathy through role-play activities.

CLO.3 Explain what it means to have different perspectives.

CLO.4 Empathy prepares students to be leaders in their community.

CLO.5 Understand the key difference(s) between empathy and sympathy.

Course Outline:

Learn how to understand user, techniques to empathize with users, identify key user problems, learn how to gain insights from empathy, empathy tools, emotional mapping, emotional observation, understand the user's interaction with the environment, understand the people and culture, understand the UX and societies, user scenarios, understanding research problems, perform field study to understand people design, project.

Recommended Book(s):

1. Daniel J Siegel, Mindsight: Transform your Brain with the new Science of Empathy, Pan Macmillan India
2. Frans De Waal, The Age of Empathy: Nature's Lessons for a Kinder Society, Broadway Books, Illustrated edition
3. Jon Kolko, Well-Designed: How to use Empathy to Create Products People Love, Harvard Business
4. Dev Patnaik, Wired to Care: How Companies Prosper when They Create Widespread Empathy, FT Press; 1st edition

Course Code	Course Name	L-T-P	Credits
CS173	Visual Design and Photoshop Basics	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand the basic principles of graphic design using Photoshop including typography, compositing, color, and composition

CLO.2 Design better pages and documents using design-thinking principles

CLO.3 Create learning materials including infographics and visual content to fortify learning objectives

CLO.4 Understand how to create better layouts using grids and guides using Photoshop

CLO.5 Understand how to use layers, effects, gradients, scaling, cloning, levels, and layer masks in Photoshop

CLO.6 Apply selections and alpha channels to isolate and extract parts of an image using Photoshop

Course Outline:

Advanced Graphics: Students learn to create dynamic Photoshop art. They learn the elements of the workspace, how to work with layers, make selections, incorporate color techniques, and adjust colors. Students also learn to use paint tools, place type in an image, to liquefy an image, and create Photoshop images for web pages.

Recommended Book(s):

1. Lauer, D. A., & Pentak, S. (2011). Design basics. Cengage Learning.
2. Pentak, S., Roth, R., & Lauer, D. A. (2012). Design Basics: 2D and 3D. Cengage Learning.

Course Code	Course Name	L-T-P	Credits
CS189	Visual Design Advanced	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Learn how to create simple digital paintings including some brushes that let you create the look of an oil painting from a photo

CLO.2 Discover how to edit your own photographs to get rid of dust and scratches, fix the color, and correct image exposure

CLO.3 Master techniques for switching the backgrounds on images and removing wrinkles and blemishes from photos, as they do in magazines

CLO.4 Learn about the content-aware Move tools that let you move something on an image and intelligently replace the "hole" left behind at the same time

CLO.5 Design layouts for web pages, paper adverts, brochures, CD covers, package designing event and exhibition stall designs, pop ups, touch ups, color corrections paintings, drawings, converting B/W photo to color

Course Outline:

Advanced Graphics: Students learn to create dynamic Photoshop art. They learn the elements of the workspace, how to work with layers, make selections, incorporate color techniques, and adjust colors. Students also learn to use paint tools, place type in an image, to liquefy an image, and create Photoshop images for web pages.

Recommended Book(s):

1. Lauer, D. A., & Pentak, S. (2011). Design basics. Cengage Learning.
2. Pentak, S., Roth, R., & Lauer, D. A. (2012). Design Basics: 2D and 3D. Cengage Learning

Course Code	Course Name	L-T-P	Credits
CS174	Applications of Data Science	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Apply quantitative modeling and data analysis techniques to the solution of real-world business problems, communicate findings, and effectively present results using data visualization techniques.

CLO.2 Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy.

CLO.3 Apply ethical practices in everyday business activities and make well-reasoned ethical business and data management decisions.

CLO.4 Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.

CLO.5 Apply principles of Data Science to the analysis of business problems.

Course Outline:

Introduction: What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication - Current landscape of perspectives - Skill sets needed. Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model - Intro to Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA - The Data Science Process - Case Study: RealDirect (online real estate firm)
Three Basic Machine Learning Algorithms - Linear Regression - k-Nearest Neighbors (k-NN) - k-means One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam - Data Wrangling: APIs and other tools for scrapping the Web. Feature Generation and Feature Selection (Extracting Meaning from Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests. Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighborhood properties in graphs. Data Visualization - Basic principles, ideas and tools for data visualization 3 - Examples of inspiring (industry) projects - Exercise: create your own visualization of a complex dataset

Recommended Book(s):

1. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly, 2nd Edition,2018.
2. Jake Vander Plas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’Reilly, 2017.
3. Roger D. Peng,” R Programming for Data Science” Lean Publishing, 2016.

Course Code	Course Name	L-T-P	Credits
CS123	ArtificialIntelligenceandExpertSystem	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Learning the basic concepts and skills of Artificial Intelligence.
CLO.2 Represent Knowledge using propositional calculus and predicate calculus.
CLO.3 Use inference rules to produce predicate calculus expression.
CLO.4 Demonstrate awareness of informed search and uninformed search techniques.
CLO.5 Explain about AI techniques for planning, knowledge representation and management.
CLO.6 Outline the process involved in Expert systems and in building such systems.

Course Outline:

Overview of artificial intelligence, knowledge, general concepts, knowledge manipulation, first order logic, knowledge engineering in first order logic, inference, forward chaining, backward chaining, propositional logic, predicate logic, conceptual dependencies, scripts, expert systems, neural networks, fuzzy expert system, TIERES, MYCIN, Genetic Algorithms.

Recommended Book(s):

1. Dan W. Patterson, 'Introduction to Artificial Intelligence & Expert Systems', Englewood Cliffs, NJ, 1990 (Prentice Hall International)
2. Elaine Rich, Kevin Knight, Shivashankar B Nair, 'Artificial Intelligence', (McGraw-Hill)
3. Giarratano & Riley, 'Expert Systems Principles and Programming', Course Technology; 4th edition
4. N.P. Padhy, Soft Computing techniques, Oxford University Press, UK ed. edition

Course Code	Course Name	L-T-P	Credits
CS124	Network Security	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify common network security vulnerabilities/attacks
CLO.2 Explain the foundations of Cryptography and network security
CLO.3 Gain skills to critically evaluate the risks and threats to networked computers.
CLO.4 Demonstrate detailed knowledge of the role of encryption to protect data.
CLO.5 Analyze security issues arising from the use of certain types of technologies.
CLO.6 Identify the appropriate procedures required to secure networks.

Course Outline:

Introduction to network security, security attacks, authentication and authorization, overview of computer networking, basics of cryptography, symmetric and asymmetric cryptography, public key crypto system, hash function, MAC, SHA, HMAC, MD5, digital signatures, web security, secure socket layer, firewalls.

Recommended Book(s):

1. William Stallings, 'Cryptography and Network Security- Principles and Practices', 8th Edition,
2. William Stallings, 'Computer Security- Principles and Practice', Ist Edition, Pearson Education
3. William Stallings, 'Network Security Essentials', 4th Edition, Pearson Publication
4. Bruce Schneier,'Applied Cryptography', Edition 2001, Wiley & Sons Inc
5. Bernard Menezes, 'Network security and Cryptography', Ist Edition, Cengage Learning Publication, Prentice Hall Publication

Course Code	Course Name	L-T-P	Credits
CS12X	Compiler Design	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 To understand the context and use of a compiler.
CLO.2 Skill to implement lexical analysis, parsing of the code and semantic analysis of the source code.
CLO.3 Skill to implement back end, include intermediate code generation, run time environment, code generation and register allocation.
CLO.4 To understand the special aspects of compilers and runtime such as code optimization, garbage collection etc.
CLO.5 Knowledge and ability to devise, select, and use modern techniques and tools needed to design and implement compilers.

Course Outline:

Introduction to compiler, compiler structure, lexical analyzer, top-down parsing, bottom-up parsing, parser generator, YACC, intermediate code generation, Boolean expression, procedure calls, code optimization.

Recommended Book(s):

1. Compilers: Principles, Techniques and Tools by Alfred V. Aho, Ravi Sethi, and Jeffrey D. Ullman, Low Price Edition, Pearson Education.
2. Compilers: Principles and Practice by Parag H.Dave and Himanshu B.date, First edition, Pearson Education.
3. Compiler Design by Dr. O.G. Kakde, fourth edition, Laxmi Publications.
4. Compiler Construction principles and Practice by Kenneth C. Louden, India Edition, Cengage Learning
5. Compiler Design by K. Muneeswaran, Oxford Higher Education by Oxford University Press.

Course Code	Course Name	L-T-P	Credits
CS128	Enterprise Application Development	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Integrate knowledge from different business functions to create a business plan
CLO.2 Understand the process for developing large scale enterprise applications
CLO.3 Develop multi-tier architecture
CLO.4 Enhance their critical thinking and presentation skills by developing the business plan and presenting their work to a professional audience
CLO.5 Develop strong skills to cater Enterprise Application Development needs and challenges.

Course Outline:

Entrepreneurship, Generation/Evaluation of Business Ideas, Group Formation, Feasibility & Financial Analysis, Human Resources & Marketing, Implementation & Technology, Business Plan Presentation and Review, Enterprise Architecture Design & Review of Database Design, SQL & Java Database Connectivity, Introduction to Servlets / User Interface Design, Advanced Servlet Design & Developing Use Cases, Connecting the 3-Tiers, Deploying the Server Application, Debugging Application Components.

Recommended Book(s):

1. Beginning J2EE 1.4: From Novice to Professional (Apress Beginner Series)
2. Covello & Hazelgren, The Complete Book of Business Plans
3. Ira Pohl & Charlie McDowell, Java by Dissection, The essentials of Java Programming, Updated Edition.
4. Kroenke, David M. (2005). Database Concepts, 2nd Edition. Prentice Hall.

Course Code	Course Name	L-T-P	Credits
CS135	Advanced Java	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Design the website
CLO.2 Develop project using Spring framework skills
CLO.3 Maintain and enhance existing web platform
CLO.4 Use and Implement several Data structures using Collection Framework.
CLO.5 Use database connectivity for a complete Java application.

Course Outline:

Object oriented concepts, exception handling, version control, build tools, introduction to JSON and XML, DBMS and MySql, database connectivity, servlets, n-tier architecture, MVC and spring, ORM and hibernate.

Recommended Book(s):

1. Headfirst Java, O'Reilly Publication
2. OCA Java SE 8 Programmer I Study Guide (Exam 1Z0-808) (Oracle Press) by Edward G. Finegan, Robert Liguori.
3. OCA/OCP Java SE 7 Programmer I & II Study Guide (Exams 1Z0-803 & 1Z0-804) byKathy Sierra
4. Pro Spring 5, An In-Depth Guide to the Spring Framework and Its Tools, 5th Edition

Course Code	Course Name	L-T-P	Credits
CS136	Introduction to DevOps	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Explain the need to do DevOps.
CLO.2 Understand the DevOps foundations, principles, and practices.
CLO.3 Understand, analyze, and map value streams.
CLO.4 Explain and implement the deployment pipeline skills.
CLO.5 Illustrate the concept of Continuous Delivery.
CLO.6 Create a problem-solving culture.

Course Outline:

Amazon Elastic Block Storage – EBS, creating EBS partition, Amazon S3 simple storage services, Amazon S3 storage classes, Amazon EC2 and its pricing, launch EC2 instance, auto-scaling and benefits, IAM, identity & access management, virtual private cloud, VPC-subnet, Internet gateways, elastic IP addresses (EIPs), docker, introduction to container, docker architecture, install docker & its various commands.

Recommended Book(s):

1. Len Bass, Ingo Weber, Liming Zhu, DevOps: A Software Architect's Perspective, O'Reilly, Second edition.
2. Jennifer Davis, Ryn Daniels, "Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale", O'Reilly", Third edition.
3. Stephen Fleming, "Blockchain Technology & Microservices Architecture A Non-Programmer's Handbook, Createspace Independent Publishing Platform, Stephen Fleming,Second edition
4. Ingo M. Weber, Len Bass, and Liming Zhu, "DevOps: A Software Architect's Perspective", Addison-Wesley Professional,First edition.

Course Code	Course Name	L-T-P	Credits
CS139	Parallel and Distributed Computing	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Develop and apply knowledge of parallel and distributed computing skills and methodologies.
CLO.2 Apply design, development, and performance analysis of parallel and distributed applications.
CLO.3 Use the application of fundamental Computer Science methods and algorithms in the development of parallel applications.
CLO.4 Explain the design, testing, and performance analysis of a software system, and to be able to communicate that design to others.
CLO.5 Develop and apply knowledge of parallel and distributed computing techniques and methodologies.

Course Outline:

Motivating parallelism, scope of parallel computing. Flynn's classification, pronciples of parallel algorithm design, parallel programming models, effect of granularity, scalability of parallel systems, distributed computing, message passing and RPC, Java RMI, distributed shared memory, distributed databases, distributed operating systems.

Recommended Book(s):

1. Zbigniew J Czech, "Introduction to Parallel Computing", Cambridge University Press, First edition.
2. Carlos Varela, "Programming Distributed Computing Systems", MIT Press, First edition.
3. BASU, S. K., "Parallel and Distributed Computing: Architectures and Algorithms", PHI Learning Private Limited, First edition.
4. Albert Zomaya, "Parallel & distributed computing handbook", McGraw-Hill Education, First edition.

Course Code	Course Name	L-T-P	Credits
CS146	Web Application Development	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Apply the web application development skills to design the responsive website
CLO.2 Develop multi/ single page interactive website
CLO.3 Maintain and enhance existing web application
CLO.4 Experiment the web programming concepts to modify the design and layouts of web pages.
CLO.5 Examine the adaptability of scripting languages in web development.

Course Outline:

Fundamental of modern web application design, web application frameworks, Ruby on Rails, managing data, middleware, user interface.

Recommended Book(s):

1. Learning Web Design: a beginner's guide to HTML, CSS, Javascript, and Web Graphics, Fifth Edition, O'Reilly Media, 2018
2. Don't make me think, revisited: a commonsense approach to web usability, 3rd edition, New Riders, 2014
3. Jennifer Kyrnin, Laura Lemay, Rafe Coburn, Mastering HTML, CSS & JAVAScript Web Publishing, 7th edition, SAMS publication.
4. Niederst Robbins, Learning web designing: a beginner's guide to HTML, CSS, JavaScript, and web graphics, 4th Edition, Oreilly Publication

Course Code	Course Name	L-T-P	Credits
CS151	Introduction to Cloud Computing	4-0-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
CLO.2 Explain the core issues of cloud computing such as security, privacy, and interoperability.
CLO.3 Identify problems, and explain, analyze, and evaluate various cloud computing solutions.
CLO.4 Provide the appropriate cloud computing solutions and recommendations according to the applications used.
CLO.5 Build skills to generate new ideas and innovations in cloud computing.

Course Outline:

Introduction to cloud computing, cloud computing platforms, parallel programming in the cloud, distributed storage systems, virtualization, cloud security, multicore operating system.

Recommended Book(s):

1. Daniel Kirsch and Judith Hurwitz, "Cloud Computing for Dummies, Wiley, Second edition,
2. Rajkumar Buyya, James Broberg and Andrzej Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, First edition.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud", O'Reilly Media, First edition
4. Rajkumar Buyya, Cloud Computing Principles and Paradigms, Wiley, 1st edition

CourseCode	CourseName	L-T-P	Credits
CS160	Microprocessor and Assembly LanguageProgramming	3-0-2	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Provides with in-depth knowledge of basic components of microprocessor-based systems
CLO.2 Implement microprocessor-based systems using 8085
CLO.3 Gain skills to write programs using assembly language of 8085 microprocessor
CLO.4 Identify and apply flag registers data to utilize the arithmetic and logic instructions
CLO.5 Analyze programming problems and apply assembly instructions to solve the problems using logic, shift and rotate instructions

Course Outline:

Microprocessor overview and structure, organization of a microprocessor-based system, 8085 instruction set, 8085 pin diagram, instruction word and data formats, assembly language programming, data transfer instructions, arithmetic and logic instructions, addressing modes, functional blocks, bus structure, microprocessor initiated operations, internal data operations, externally initiated operations, memory devices, I/O devices, logic devices, interrupts, 8085 interrupt structure, interfacing memory, interfacing I/O devices, DMA controller, memory-mapped and IO-mapped I/O, introduction to 8086, 8086 instruction set, 8086 interrupts.

Recommended Book(s) and References:

1. Ramesh Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, Fifth Edition, Penram International Publishing
2. Douglas V Hall, “Microprocessor and Interfacing”, Revised Second Edition, Tata McGraw-Hill Publishing
3. Samir G. Pandya, Microprocessor Assembly Language Programming, LAP LAMBERT Academic Publishing
4. Brian R. Hall, Assembly Programming and Computer Architecture for Software Engineers, Prospect Press, Edition 1.0

CourseCode	CourseName	L-T-P	Credits
CS185	Technical Communication and Employability Skills	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Improvising interpersonal communication.
CLO.2 Understanding corporate etiquettes, communication, teamwork, and work ethics.
CLO.3 Polishing Business Communication & Presentation Skills.
CLO.4 Enhance verbal and non-verbal reasoning.
CLO.5 Improve professional behaviour in working culture of organizations.

Course Outline:

Personal Introduction, Give your strengths and weaknesses, Grooming session, Interview Skills, Personal Interview, Behavioral Interview, Panel Interview, Body Language, Formal dressing, Verbal Communication, Nonverbal communication, Social Etiquette (LinkedIn), Social Etiquette (Facebook), Office Etiquette (Virtual) Group Discussion on General Topic Group Discussion on Politics Listening Skills Email Writing Report Writing Preparing MOM Resume Writing cover letter and CV writing Preparing presentation CloudFormation Physical & Logical Resources Simple Non Portable Template Database Models Synonyms Antonyms Aptitude Questions Problems on Alphabet Series Problems on Inserting of Missing Character Problems on Number Sequence Problems on Alpha Numeric Sequence Problems on Syllogisms Problems on Alphabet Test Problems on Analogy Classification Counting of Figures Problems on Number Series Problems on Time Sequence Problems on Ranking Sequence Problems on Arithmetical Reasoning Problems on Quantitative Analysis Problems on Problem on Ages Problems on Clocks Problems on Calendars Problems on Cube Cutting Problems on Cubes & Dices Problems on Coding – Decoding - 1& 2 Problems on Sense of Direction Problems on Blood Relations

Recommended Book(s) and References:

1. Dilip Mohapatra & Swati Karve, C2C Campus to Corporate, Authors press, 2020.
2. Gangadhar Joshi, Campus to Corporate Your Roadmap to Employability, SAGE Texts, 2015.
3. R. S. Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand Publishing, 2018.
4. R. S. Aggarwal, Quantitative Aptitude Tests in Competitive Exams, S. Chand Publishing, 2021.

CourseCode	CourseName	L-T-P	Credits
CS187	Advanced Digital Marketing	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Familiarise with methodologies, tools and technologies involved in digital marketing.
CLO.2 Evaluate and apply key concepts related to digital marketing including consumer behaviour, online marketing communications, and social media marketing.
CLO.3 Critically assess role that digital marketing can play in business strategy.
CLO.4 Plan and compose tactical marketing decisions as a group considering effective product, pricing, distribution and promotion decisions as necessary to meet the needs of a client brief.
CLO.5 Reflect on the practical implementation of a digital marketing strategy and role within the group work from a critical and evaluative individual perspective.

Course Outline:

Introduction to digital marketing, Digital environment analysis (macro and micro), Digital marketing strategy, the digital marketing mix, Relationship marketing, Managing the online customer experience, Campaign planning for digital media, Marketing communications using digital media channels, Evaluation and improvement of digital channel performance, Emerging trends in digital media marketing,social media marketing.

Recommended Book(s) and References:

1. Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited.
2. The Beginner's Guide to Digital Marketing (2015). Digital Marketer. Pulizzi,J.(2014) Epic Content Marketing, Mcgraw Hill Education

CourseCode	CourseName	L-T-P	Credits
CS190	Blockchain Technologies	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Describe the basic concepts and technology used for blockchain.
CLO.2 Describe the primitives of the distributed computing and cryptography related to blockchain.
CLO.3 Illustrate the concepts of Bitcoin and their usage.
CLO.4 Implement Ethereum block chain contract.
CLO.5 Apply security features in blockchain technologies.
CLO.6 Use smart contract in real world applications.

Course Outline:

Introduction: Overview of Block chain, History of Blockchain, Peer to Peer Network, Smart Contract, Wallet, Digital Currency, Ledgers, Types of Blockchain Platform: Consensus Mechanism, Permissioned Blockchain, Permisionless Blockchain , Different Consensus Mechanism- Proof of Work, Proof of Stake, Proof of Activity, Proof of Burn, Proof of Elapsed Time, Proof of Authority, Proof of Importance. Crypto currency and Wallet: Types of Wallets, Desktop Wallet, App based Wallet, Browser based wallet, Metamask, Creating a account in Metamask, Use of faucet to fund wallet, transfer of cryptocurrency in metamask. Smart contract and Ethereum: Overview of Ethereum, Writing Smart Contract in Solidity, Remix IDE, Different networks of ethereum, understanding blocks practically at blockhcain.com, how to compile and deploy smart contract in remix. Understanding Hyperledger Fabric: Overview of Open source Hyperledger project, Hyperledger Fabric-Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric.

Recommended Book(s) and References:

1. Narayanan, Bonneau, Felten, Miller and Goldfeder, “Bitcoin and Cryptocurrency Technologies– A Comprehensive Introduction”, Princeton University Press.
2. Josh Thompson, ‘Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming’, Create Space Independent Publishing Platform, 2017.
3. Imran Bashir, “Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained”, Packt Publishing.
4. Merunas Grincalaitis, “Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols”, Packt Publishing.
5. Sandip Chakraborty, Dr. Praveen Jayachandran, “Blockchain Architecture Design And Use Cases” [MOOC], NPTEL: https://nptel.ac.in/courses/106/105/106105184/

CourseCode	CourseName	L-T-P	Credits
CS502	Department Elective- Advanced Unity Programming	0-0-8	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Develop Responsive User Interface.
CLO.2 Complete Navigation and Pathfinding Tasks.
CLO.3 Create Animator Blend Tree.
CLO.4 Make enriched Game design.
CLO.5 Develop games using Unity programming skills.

Course Outline:

Responsive User Interface, Navigation and Pathfinding, Finite State machine, Blend Tree, Behavior Tree, ML-Agent, Optimization, Ad, In App purchase, BCI and IoT, Projects.

Recommended Book(s) and References:

1. Unity Artificial Intelligence Programming: Add Powerful, Believable, and Fun AI Entities in Your Game with the Power of Unity 2018!, 4th Edition
2. Unity AI Game Programming, Ray Barrera, Aung Sithu Kyaw, Clifford Peters, Thet Naing Swe
3. Learn Unity ML-Agents – Fundamentals of Unity Machine Learning: Incorporate New Powerful ML
4. Unity AI Programming Essentials, Dan Violet Sagmiller, Curtis Bennett

Course Code	Course Name	L-T-P	Credits
CS121	Software Quality Assurance and Testing	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand software testing and quality assurance as a fundamental component of software life cycle
CLO.2 Infer various software models concepts and skills for making the software.
CLO.3 Analyse software creating requirements to determine the entities involved in the system and their relationship to one another.
CLO.4 To make sure that the result meets the business and user requirements Software testing plays an instrumental role.
CLO.5 Also, to satisfies the BRS that is Business Requirement Specification and SRS that is System Requirement Specifications and finally gain the confidence of the customers by providing them a quality product.

Course Outline:

Software quality, role of testing, verification and validation, unit testing, control flow testing, system integration testing, regression tests, documentation, system test design, system test planning and automation, monitoring test execution, acceptance criteria, software quality, ISO 9126` quality characteristics, ISO 9000:2000 software quality standard.

Recommended Book(s):

1. Sagar Naik, Piyu Tripathy, Software Testing and Quality Assurance: Theory and Practice, University of Waterloo, Wiley, 2008.
2. Naresh Chauhan, Software Testing: Principles and Practices , 2012, Oxford University Press.
3. J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, Glenford.
4. Ron Patton, Software Testing, 2nd Edition, 2005

Course Code	Course Name	L-T-P	Credits
CS122	Business Intelligence and Data Warehousing	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Speculate various models and algorithms in data warehousing.
CLO.2 Analyze various database problems and to find out the relevant information out of big data.
CLO.3 Implement major algorithms that generates frequent itemset.
CLO.4 Differentiate between OLAP AND OLTP.
CLO.5 Use clustering techniques for maintaining database integrity.
CLO.6 Model an application's data requirements using conceptual model tools skills like BI tools and strategies

Course Outline:

Data warehouse design and management, business analytics and data warehousing, OLAP, cube, data mining for BI, knowledge management, KM strategies.

Recommended Book(s):

1. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufman Publishers, Third edition.
2. R.N. Prasad and Seema Acharya, "Fundamentals of Business Analytics", Wiley India Publishers, First edition.
3. Christian Bauer,Gavin King,Gary Gregory, Linda Demichiel, "Java Persistence with Hibernate", Dreamtech Press,Second edition
4. Jason Bell, "Machine Learning for Big Data: Hands-On for Developers and Technical Professionals", Wiley, Second edition.

Course Code	Course Name	L-T-P	Credits
CS147	Android Application Development	2-0-2	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Install and configure Android application development tools.
CLO.2 Design and develop user interfaces for the Android platform.
CLO.3 Save state information across important operating system events.
CLO.4 Apply Java programming skills and concepts to Android application development.
CLO.5 Design the structure of Android apps, understand layout files and the conversion to view objects.

Course Outline:

Introduction to Android and its environment, write a simple program to output a message, write a program to implement the usage of layouts and widgets, write a program that explains the usage of activity and intends, implementation of list view, create a framework for user interfaces, database connectivity with the developed user interface, implementation of JSON parsing.

Recommended Book(s):

1. Reto Meier, Android Application Development, Createspace Independent Publisher, 2nd edition
2. Lee, Wei-Meng, Beginning android 4 application development, Wrox, 1st edition
3. Barry Burd, Android Application Development All-In-One for Dummies, For Dummies, 2nd edition
4. John Horton, Android Programming with Kotlin for Beginners, Packt Publishing, 1st edition

Course Code	Course Name	L-T-P	Credits
CS148	iOS Programming	2-0-2	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Demonstrate the skill of understanding of the fundamentals of Swift, building modern mobile apps, iOS, Xcode, and other tools in the Xcode development environment.

CLO.2 Demonstrate and understanding of how to handle and store data using clearly defined types.

CLO.3 Write code that makes decisions about what lines of code should be executed.

CLO.4 Create a basic iOS app to get familiar using Xcode.

CLO.5 Test and debug apps in a Mac, using the Simulator from Xcode.

Course Outline:

Basic introduction of ios, xcode, basic intro of Objective C open xcode, files, learning Objective C methods, basic introduction to create simple UI in iphone, UI Features, Create UI label programmatically, create UIButton programmatically, UI Webview, UIScrollview, UISwitch, activity IndicatorView, create login &registration view, local validations, evaluation, UITableVIew, UITableview delegate methods, UITableview data source methods, UIPickerview, UIPickerview delegate methods, UIDatepicker.

Recommended Book(s):

1. Ahmad Sahar, “iOS 13 programming for beginners”, Packt, Fourth edition,
2. Mark Wahlbeck, “iOS 13 and Swift 5 programming”,Devslopes, Second edition
3. Matt Neuburg, “iOS 13 programming fundamentals with Swift”, O'Reilly Media, Inc,third edition
4. Jon Hoffman, Mastering Swift 5: Deep dive into the latest edition of the Swift programming language, Packt Publishing Limited, 5th Edition

Course Code	Course Name	L-T-P	Credits
CS149	Internet of Things	2-0-2	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Know the architectural overview of the IoT applications.
CLO.2 Possess an ability and skill to design and develop hardware infrastructure of IoT application.
CLO.3 Apply communication protocols for IoT application development.
CLO.4 Possess an ability to push the data onto the cloud services.
CLO.5 Analyze the sensor data and take necessary action associated with it.

Course Outline:

Introduction to Internet of Things (IoT), components of IoT, acquiring data, sensing and actuation, sensor networks, machine-to-machine communication, utilizing data, implementing IoT, IoT analytics, case studies.

Recommended Book(s):

1. Arshdeep Bahga and VijayMadisetti, “Internet of Things: A Hands-on Approach”, Universities Press,first edition
2. Oliver Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, Wiley Edition, Third Edition
3. Jacob Millman, Christos Halkias and Chethan D. Parikh, Integrated Electronics: Analog and Digital Circuits and Systems”,Tata McGraw-Hill Education, Second Edition India, 2010.
4. Morris Mano and Michael D. Cilette, “Digital Design” Pearson, Fifth Edition.

Course Code	Course Name	L-T-P	Credits
CS150	Mobile Ad-hoc and Sensor Networks	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Implement skill-based knowledge of routing mechanisms and the three classes of approaches: proactive, on-demand, and hybrid

CLO.2 Study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.

CLO.3 Identify the issues and challenges in providing QoS

CLO.4 Explain about the energy management in ad-hoc networks

CLO.5 Demonstrate various types of mesh networks.

Course Outline:

Introduction, characteristics of MANET, application of MANET, challenges, data transmission, TCP over ad-hoc networks, basics of wireless sensor networks, data retrieval in sensor networks, security in ad-hoc wireless networks, sensor networks platforms and tools, TinyOS, TOSSIM.

Recommended Book(s):

1. Siva Ram Murthy and B.S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Pearson Education, Third Edition.
2. C.K. Toh, "Ad Hoc Mobile Wireless Networks Protocols and Systems, Pearson Education, First edition.
3. Fei Hu, Xiaojun Cao," Wireless Sensor Networks — Principles and Practice", Press, Taylor & Francis Group, First Edition.
4. Shih-Liri Wu, Yu-Chee Tseng, "Wireless Ad hoc Networking", Auerbach Publications, Taylor & Francis Group, First Edition.

Course Code	Course Name	L-T-P	Credits
CS152	Advanced Computer Architecture	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Know the classes of computers, and new trends and developments in computer architecture.
CLO.2 Understand pipelining, instruction set architectures, memory addressing.
CLO.3 Understand multithreading by using ILP and supporting thread- level parallelism (TLP).
CLO.4 Build skills to understand the performance and efficiency in advanced multiple- issue processors.
CLO.5 Build skills to understand the performance of multi-core processors using SPEC benchmarks.
CLO.6 Understand storage systems, RAID, I/O performance, and reliability measures.

Course Outline:

Fundamental of computer design, pipelining, memory hierarchy, instruction level parallelism, multithreading, vector processing, multiprocessors, advanced memory hierarchy design, storage system.

Recommended Book(s):

1. William Stallings, "Computer Organization and Architecture", Prentice Hall of India, Sixth Edition.
2. Tannenbaum A. S., "Structured Computer Organization", Pearson Education, 2002.
3. Patterson & Hennessy, "Computer Organization and Design", Morgan Kaufmann, 2007
4. Ramesh S. Gaonkar, "Microprocessor, Architecture, Programming, and Applications with the 8085", Penram International Publication, 5/e

Course Code	Course Name	L-T-P	Credits
CS153	Digital Image Processing	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand fundamental steps of digital image processing
CLO.2 Examine various types of images, intensity transformations and spatial filtering.
CLO.3 Skill to understand and compare various image enhancement techniques
CLO.4 Skill to understand and implement basic image segmentation techniques
CLO.5 Skill to understand and implement and compare various image restoration techniques

Course Outline:

Introduction, image fundamentals, image enhancement in spatial domain, image enhancement in frequency domain, image restoration, color image processing, image segmentation.

Recommended Book(s):

1. Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing", Pearson Education, Third Edition
2. W.K. Pratt, "Digital Image Processing,"McGraw Hill, Second Edition
3. R.C. Gonzalez and R. E. Woods, "Digital Image Processing", Addison Wesley/ Pearson Education, Second Edition
4. Gonzalez, "Digital Image Processing", Pearson International Edition, Third Edition

Course Code	Course Name	L-T-P	Credits
CS154	Computer Graphics	3-0-0	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Explain the core concepts of computer graphics, including viewing, projection, perspective, modelling and transformation in two and three dimensions.
CLO.2 Apply the concepts of color models, lighting and shading models, textures, ray tracing, hidden surface elimination, anti-aliasing, and rendering.
CLO.3 Interpret the mathematical foundation of the concepts of computer graphic skills.
CLO.4 Describe the fundamentals of animation, parametric curves and surfaces, and spotlighting.
CLO.5 Identify a typical graphics pipeline and apply graphics programming skills to design and create computer graphics.
CLO.6 Create effective programs to solve graphics programming issues, including 3D transformation, objects modelling, color modelling, lighting, textures, and ray tracing.

Course Outline:

History of computer graphics, graphics architecture and software, vision and imaging, color models, geometric transformations, three-dimensional graphics, ray tracing, illumination, shading, rasterization, compositing.

Recommended Book(s):

1. Donald Hearn and Pauline Baker, “Computer Graphics” Pearson Education, Second Edition
2. Schaum’s outline,” Computer Graphics”, McGraw-Hill India, First Edition
3. David Rogers, “Mathematical Elements of Computer Graphics” McGraw-Hill, Second edition
4. John F. Hughes,” Computer Graphics: Principles and Practice”, Pearson Publication, Third Edition

Course Code	Course Name	L-T-P	Credits
CS161	Java Programming	0-0-6	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Implement the concept of object-oriented techniques and methodologies using Java.
CLO.2 Use Exception Handling skill for a Robust Application in Java.
CLO.3 Demonstrate an understanding of Java Input/Output and Multithreading.
CLO.4 Use and Implement several Data structures using Collection Framework.
CLO.5 Use database connectivity for a complete Java application.
CLO.6 Use Html, JavaScript, CSS, Servlets, JSP and XML to develop web-based applications.

Course Outline:

Java introduction, history, overview of JDK, JVM, garbage collection, benefits and applications of OOP, basic concepts and characteristics of OOP, abstract methods and classes, packages and interfaces, exception handeling, wrapper classes, Junit, stream classes, object serialization, collection interface, generic classes, Java threads, multithreading, thread controlling, RDBMS, Oracle 11g, DML, DDL, JDBC, HTML, CSS, servlets, JSP, XML, DTD, AJAX.

Recommended Book(s):

1. Schildt, Herbert, and Danny Coward, “Java: the complete reference. New York: McGraw-Hill Education", Ninth Edition
2. Sierra, Kathy, and Bert Bates,” Headfirst java”, " O'Reilly Media, Inc.", Third Edition
3. Herbert Schildt, “Java:The Complete Reference”, Seventh Edition
4. Edward G. Finnegan, OCA Java SE8 Programmer I Study Guide, Oracle Press

Course Code	Course Name	L-T-P	Credits
CS162	Full Stack Development	0-0-6	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Use their learned skills, knowledge and abilities to develop web sites for the internet
CLO.2 Apply basic design principles to present ideas, information, products, and services on websites
CLO.3 Apply basic programming principles to the construction of websites
CLO.4 Effectively manage website projects using available resources
CLO.5 Demonstrate communication skills, service management skills, and presentation skills

Course Outline:

SDLC overview, agile, object-oriented design & programming, UML diagrams, use case, package, state cart diagram, RDBMS fundamentals, normal forms, Oracle DB design, single row functions, multiple rows and group functions, join, sub queries and set operators, DDL, DCL, DML, TCL, other schemas, index and synonyms, Java fundamentals, Java API, string, inheritance, polymorphism, exception handling, IO streams, collections, generics, multi-threading, JSP, JSTL, servlets, HTML5, CSS3, responsive, spring, beans, JDBC, hibernate, session mapping, XML, Java blue print patterns, unit testing with Junit5, negative-positive test cases.

Recommended Book(s):

1. Chris Northwood, The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer, Apress, 1st ed. edition
2. Shama Hoque, Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js, Packt Publishing Limited, 2nd edition
3. Frank Zammetti, Modern Full-Stack Development:Using TypeScript, React, Node.js, Webpack, and Docker, Apress, 1st edition
4. Sebastian Grebe, Hands-On Full-Stack Web Development with GraphQL and React: Build scalable full-stack applications while learning to solve complex problems with GraphQL, Packt Publishing Limited

Course Code	Course Name	L-T-P	Credits
CS203	Integrated Project	0-0-4	2
CS205	Integrated Project – II	0-0-4	2
CS204	Lab Oriented Project	0-0-6	3
CS251	Co-op project at Industry (Module-1)	-	12
CS252	Co-op project at Industry (Module-2)	-	12
CS253	Industry Oriented Hands-on Experience	-	12
CS248	Research Project Dissertation	-	12

Course Learning Outcomes:

CLO.1 To acquire presentation and communication skills
CLO.2 Undertake problem identification, formulation and solution to make students employable.
CLO.3 Design engineering solutions to complex problems utilizing a systems approach
CLO.4 To implement learning in real life problem for skill development
CLO.5 To propose multiple solution to any given problem and find best out of those.

Course Code	Course Name	L-T-P	Credits
HR101	Human Values and Professional Ethics	2-0-0	0

Course Learning Outcomes:

Students will be able to:

CLO.1 Get awareness on human values and professional ethics
CLO.2 Understand the core values that shape their ethical behaviour.
CLO.3 Enhance skills active part in social, political, economic and cultural activities with responsibility.
CLO.4 Gain thorough knowledge in the field of human rights and this will add to the academic qualification
CLO.5 Strengthen the ability to contribute to the resolution of human rights issues and problems.

Course Outline:

Concept of human values and value education, aim of education and value education; Evolution of value-oriented, education, Personal development, Self-analysis and introspection; sensitization towards gender equality, physically challenged, intellectually challenged. Respect to - age, experience, maturity, family members, neighbours, co-workers. Social and environmental sensitivity, Principles for Harmony, Customs and Traditions, Aspirations and Harmony (I, We & Nature– Emotional Competencies – Conscientiousness, Trust, respect and harmony – in the family and nature, Duties and Rights, Problem Solving, Value Education and Professional Values– Religious, social and constitutional values, Impact of global development on ethics and values, Conflict of cross-cultural influences, mass media, cross-border education, materialistic values, professional challenges and compromise, Human rights, Indian and International Perspectives, Definitions under Indian and International documents, Human rights of women and children and Institutions for implementation of Human Rights at international and national level

Recommended Book(s):

1. S. Dinesh Babu,"Professional Ethics and Human Values", Firewall Media, First Edition
2. R.R. Gaur, R. Sangal, G.P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", Excel Books, First edition.
3. R.S. Naagarazan, 'Professional ethics and Human values', New Age International Private Limited, First edition
4. Ritu Soryan, Human Values And Professional Ethics (Paperback), S Chandpublishing, Fourth edition

Course Code	Course Name	L-T-P	Credits
DM101	Disaster Management	2-0-0	0

Course Learning Outcomes:

Students will be able to:

CLO.1 To increase the knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences

CLO.2 To increase the knowledge and understanding of the International Strategy for Disaster Reduction (UN- ISDR) and to increase skills and abilities for implementing the Disaster Risk Reduction (DRR) Strategy

CLO.3 To ensure skills and abilities to analyse potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects

CLO.4 Learn the role of institutions and also analyze the inter-relationship between disasters and developmental projects and their vulnerabilities.

CLO.5 Gain skills required for the safety of lives during the occurrence of disasters.

Course Outline:

Disasters, Classification, Causes, Impacts (including social, economic, political, environmental, health, psychosocial, etc. Differential impacts- in terms of caste, class, gender, age, location, disability), Principles of disaster management, Approaches to Disaster Risk reduction, Disaster cycle, Phases, Culture of safety, prevention, mitigation and preparedness, Community based DRR, Components of Disaster Relief: Water, Food, Sanitation, Shelter, and Health, Structural and non-structural measures, Hazard Profile (India), Disaster Risk Management in India, Hazard and Vulnerability profile of India, Institutional arrangements (Mitigation, Response and Preparedness, DM Act and Policy, Other related policies, plans, programmes and legislation), Role of Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), states, Centre, and other stake-holders, Disaster and Development, Factors affecting Vulnerabilities, impact of Development projects such as dams, embankments, changes in Land-use etc., urban disasters, Waste Management. Global trends in disasters & Adaptation, Pandemics Climate change and Adaptation, Relevance of indigenous knowledge, appropriate technology and local resources.

Recommended Book(s):

1. Alexander, D,"Natural Disasters", ULC press Ltd, London, First Edition
2. Carter, W. N. Disaster Management,"A Disaster Management Handbook", Asian Development Bank, Bangkok, 1991, First edition.
3. Alexander David, "Introduction in 'Confronting Catastrophe'', Oxford University Press, Second edition
4. Chakrabarty, U. K. Industrial Disaster Management and Emergency Response, Asian Books Pvt. Ltd., New Delhi 2007, First edition.

Course Code	Course Name	L-T-P	Credits
ES101	Environmental Sciences	2-0-0	0

Course Learning Outcomes:

Students will be able to:

CLO.6 Understand the concepts about natural resources, ecosystems, biodiversity, energy resources, environmental pollution and waste management which are required to understand the interrelationships of the natural world.

CLO.7 Identify and analyze environmental problems both natural (disasters such as floods and earthquakes) and man-made (industrial pollution and global warming).

CLO.8 Understand and hone skills to the societal and environmental impacts of energy and examine alternative solutions for meeting the growing energy needs.

CLO.9 Apply the above knowledge, as an activity to do various Case studies, required to understand the interrelationships of the natural world and real-world issues.

CLO.10 Gain knowledge for employability in the field of environmental conservation, water sciences, waste management etc.

Course Outline:

Definition, scope, importance, need for public awareness, natural resources, renewable and non-renewable resources, water resources, ecosystems, biodiversity & its conservation, threats to biodiversity, environmental pollution, disaster management, environment protection acts, welfare program.

Recommended Book(s):

7. Bharucha, E. (2004). Textbook of Environmental Studies for Undergraduate Courses, First Edition, University Grants Commission, Universities Press (India) Private Limited.
8. Randhawa, M. (2014). The Basics of Environmental Sciences, Chitkara University publications, First edition
9. Rajagopalan, R. (2016). Environment And Ecology – A Complete Guide. Lexis Nexis, First edition.
10. Wright. Richard T. and Bourse. Dorothy F. (2016). Environmental Science: Toward A Sustainable Future, Benjamin-Cummings Pub Co, 13th edition.
11. Keen, M., Brown, Valerie A., Dyball, R. (2005). Social Learning in Environmental Management: Towards a Sustainable Future, Routledge, 1st edition.
12. Cunningham, William P. and Cunningham, Mary A. (2012). Principles of Environmental Science, McGraw-Hill Science Engineering, 7th edition.

Course Code	Course Name	L-T-P	Credits
CS501	Cyber Security	2-0-0	0

Course Learning Outcomes:

Students will be able to:

CLO.1 Acquire Information and risk models including confidentiality, integrity and availability
CLO.2 Skill to analyze on Threats and attacks and exploit vulnerabilities
CLO.3 To gain knowledge on Cyber security architecture and operations
CLO.4 Understand how Cyber security is conceptualized and carried out
CLO.5 Articulate informed opinion about issues related to cyber security

Course Outline:

Introduction to Security, Security principles, threats and attack techniques, Basics of Cryptography, Cryptographic mechanisms, Classical Encryption Techniques, Symmetric and Asymmetric cryptography, Introduction to cybercrime, cybercrime and information security, Classifications of cybercrimes, Cybercrime and the Indian ITA 2000, Cyber offenses, Botnets- The fuel for cybercrime, Phishing, Password cracking, key loggers and SQL injection, attacks on wireless networks, Cost of cybercrimes and IPR issues, lessons for organization, web threats for organization, security and privacy implications from cloud computing, social media marketing, security risks and perils for organizations, social computing and the associated challenges for organizations, protecting people's privacy in the organization, organizational guidelines for internet usage, safe computing guidelines and computer usage policy, incident handling, Cyber Forensics, Best practices for organizations, Media and Asset Protection, Importance of endpoint security in organizations, cybercrime and cyber terrorism, Intellectual property in the cyberspace, the ethical dimensions of cybercrimes, the Psychology, mindset and skills of hackers and other cybercriminals, Cybercrime, Illustrations of financial frauds in cyber domain, digital signature related crime scenarios.

Recommended Book(s):

1. M. Merkow, J. Breithaupt, "Information Security Principles and Practices", Pearson Education, Second Edition"
2. G.R.F. Snyder, T. Pardoe, "Network Security", Cengage Learning, Second Edition
3. Basta, W.Halton, "Computer Security: Concepts, Issues and Implementation, Cengage Learning India", Wiley& Sons Inc, Second Edition
4. William Stallings," Network Security Essentials", Pearson Publication, Fourth Edition
5. Bruce Schneier, "Applied Cryptography", Wiley& Sons Inc, Second Edition
6. Network security and Cryptography' by Bernard Menezes, First Edition, Cengage LearningPublication.
7. C K Shyamala, N Harin i, Dr T R Padmanabhan, "Cryptography and Network Security:",Wiley India,First Edition
8. Forouzan Mukhopadhyay," Cryptography and Network Security", MC Graw Hill, Second Edition.
9. Mark Stamp,"Information Security, Principles and Practice", Wiley India, First Edition

Appendix A: Mapping of Programme Outcomes (Pos) with Course Learning Outcomes (CLOs)

Course Code	Course Name	Course Learning Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CL103	English for Technical Professionals	CLO1: To learn effective interpersonal and team communication skills that are useful for engineers in the practice of their profession	H									M	M	
		CLO2: To learn micro-skills of communication.	H	M										
		CLO3: To discuss professional and technical written communication along with the creative aspects of writing slogans, paragraphs, dialogues and developing outlines	H										M	
		CLO4: To develop the skills of reading, note making, note taking and summarizing		H	H			M					M	
ES101	Environmental Sciences	CLO1: Students will be able to understand the concepts about natural resources, ecosystems, biodiversity, energy resources, environmental pollution and waste management which are required to understand the interrelationships of the natural world.						H	M					
		CLO2: Students will be able to identify and analyze environmental problems both natural (disasters such as floods and earthquakes) and		M				H	H					

		man-made (industrial pollution and global warming).												
		CLO3: Students will be able to understand the societal and environmental impacts of energy and examine alternative solutions for meeting the growing energy needs and skills.						H	H	M				
		CLO4: Apply the above knowledge, as an activity to do various Case studies, required to understand the interrelationships of the natural world and also to students to real-world issues.						M	H		M	M		
		CLO5: Gain knowledge for employability in the field of environmental conservation, water sciences, waste management etc.							H		M			
GE101	Numerical Ability and Logical Reasoning	CLO1: Student will be able to improve answers during the Aptitude test and develop an all-around personality with a mature outlook.	H	M		M								
		CLO2: Student will be able to enhance their logical thinking, verbal reasoning and numerical reasoning.	H	H									M	
		CLO3: To enhance the employability skills among the students so that they will take part effectively and confidently not only in campus placements programs but also in other	H	H							H	M		H

		exams like CAT, GMAT, SSC, Bank Po, UPSC etc.												
		CLO4: To enhance the problem-solvingskills, to improve the basic mathematical skills and to help students who are preparing for any type of competitive examinations.								H			M	
		CLO5: Enhance the Aptitude Round Clearing ability in interview process										M	H	
GE102	Introduction to Emerging Technologies	CLO.1 Identify a new technology that will solve a problem in an organization	H											
		CLO.2 Skillset to examine the challenges and opportunities in designing projects that implement new and emerging technologies such as 5G technologies										M		
		CLO.3 Understand the concepts such as neurons, activation functions, and optimizers in artificial intelligence field	M										H	
		CLO.4 Understand and contrast supervised and un-supervised learning algorithms.		H								H		

		CLO.5 Understand the context of information security with respect to social engineering and cyber security.			H								M	
AM121	Calculus and Statistical Analysis	CLO1: Students will be able to introduce and form matrices to present mathematical solutions in a concise and informative manner. Use matrices to solve the problems of system of linear equations and solve various live problems using matrices.	H	H		H								
		CLO2: Students will be able to find local extreme values of functions of several variables, test for saddle points, examine the conditions for the existence of absolute extreme values. Solve constraint problems using Lagrange multipliers and solve related application problems.	H	H										
		CLO3: Students will be able to apply the principles of Integral Calculus to solve a variety of practical problems in Engineering and applied Sciences.	H		M									H
		CLO4: Students will be able to interpret statistical inference skills with the help of probability & distributions and hypothesis testing for means, variances and proportions of large as well as small data and employ	H	H										M

		appropriate regression models in determining statistical relationships.												
		CLO5: To equip with the skills to understand advanced level mathematics and its applications that would enhance analytical thinking to solve engineering problems.	H		H									M
AM122	Differential Equations and Transformations	CLO1: Students will be able to analyse and correlate many real-life problems mathematically and thus find the appropriate solutions for them using Fourier series and Transforms (Fourier and Laplace transform).	H	H									H	
		CLO2: Using ordinary differential equations student will be able to solve various practical problems in Science and Engineering.	H	H		M								
		CLO3: Possess an ability to recognize and find families of solutions for most real physical processes such as heat transfer, elasticity, quantum mechanics, water flow and others, which are governed by partial differential equations subject to boundary conditions.	H	H										
		CLO4: Student will be able to analyse functions of complex variables, techniques of complex integrals and compute integrals over complex surfaces ability to recognize and find	H	H		H								

		families of solutions for most real physical processes such as heat transfer, elasticity, quantum mechanics, water flow and others, which are governed by partial differential equations subject to boundary conditions.												
		CLO5: To develop skills required to find the appropriate differential equations that can be used as mathematical models.		H		H								
AM103	Discrete Structures	CLO1: To demonstrate the application of Discrete mathematical principles in investigating and solving a variety of real time problems related to Sets, Relations and Functions.	H	H										
		CLO2: To develop a skill to analyze and solve real time scientific problems using combinatorics	H	H										
		CLO3: To analyze a given problem and to be able to apply the theory and techniques of Lattice, Logic and Boolean algebra		H	M									
		CLO4: To comprehend Graph Theory and its relevance within the context of computer science and finding solutions of problems through shortest path algorithms	H	M	H									

		CLO5: To develop skill to model and analyse computational processes using combinatorial methods, graph theory and algorithms	H	H										
PH121/ PH111	Modern and Computational Physics	CLO1: Students will be able to analyse and solve mathematical problems relating to Gradient, Divergence and Curl of scalar and vector fields and establish their relationship with propagation of Electromagnetic waves in free space using Maxwell's equation.	H	H					H					
		CLO2: Should differentiate between different types of LASERs and optical fibres their operation, advantages, and disadvantages and solve related problems and their application in engineering domain.	H		H									
		CLO3: Should differentiate between characteristics and properties of various magnetic and superconducting materials and establish their applications in engineering disciplines.	H		M									
		CLO4: Should describe the dual nature of waves and particles in context of Quantum Mechanics and to apply the Schrodinger Wave Equation in solving different physical systems and processes.	H	H										

		CLO5: Develop skills for critical thinking and problem solving involving the various concepts of physics.		H	M									
PH111	Modern and Computational Physics Lab	CLO.1 Possess an ability to apply knowledge of fundamental physical concepts and appropriate mathematics involved in the course.		H	M									
		CLO.2 Possess an ability to analyze a physical problem, and suggest the possible solution of that problem.				M								
		CLO.3 Apply fundamental principles of physics together with analytic tools to evaluate and describe physical situations appropriate to address a research problem.		H										
		CLO.4 Develop the skill to explore physical systems by setting up experiments, collecting and analyzing data, identifying sources of uncertainty, and interpreting their results in terms of the fundamental principles and concepts of physics.		H	M									
		CLO.5 Possess an ability to evaluate and analyze scientific measurement and error analysis.			M									
EC101	Basics of Electronics Engineering	CLO1: Students will be able to understand the basic concepts of semiconductor devices for use in electronic circuits.		M	H									
		CLO2: Students will be able to gain skills to interpret the characteristics of various types of diodes and transistors to describe the		H	M									

		operation of related circuits for evolving engineering solutions.												
		CLO3: Students will be able to acquire the knowledge of digital logic gates for implementing basic digital circuits.	H		H									
		CLO4: Students will be able to recognize the primary functions of integrated circuits such as timer and voltage regulator.		H			M							
		CLO5: Students will be able to familiarize with generic IoT device and applications using case studies.		M			H						H	
EC102	Basics of Electronics Engineering Lab	CLO1: Students would know the basics of electronics elements, their functionality and applications.		M	H									
		CLO2: Possess skills to analyze and characterize the electronic circuits and have basic understanding for their implementation.			H									
		CLO3: They would be able to analyze and characterize the electronic circuits and have basic understanding for their implementation.	H		M									

		CLO4: Possess an ability to perceive the concept of logic gates and integrated circuits in electronics.					M						H	
		CLO5: Students will be able to gain practical knowledge of primary functions of integrated circuits such as timer and voltage regulator.						M					H	
EC105	Digital Electronics and Logic Design	CLO1: Understand the underlying differences between analog and digital systems, and interconversion between the two.	H		M									
		CLO2: Understand and apply mathematical skills to solve digital design problems involving Boolean logic.	M	M	H									
		CLO3: Understand the underlying differences between combinational and sequential circuits.		M										
		CLO4: Understand and apply the design methodologies skills for implementing combinational and sequential circuits.	H		M									
		CLO5: Understand the concept of memories and Programmable Logic Devices and their classification.			M								M	
		CLO6: Understand the concept of memories and Programmable Logic Devices and their classification		M									M	

EC106	Digital Electronics and Logic Design Lab	CLO1: To understand the digital logic and create various systems by using these logics	H											
		CLO2: To develop an understanding of design and simulation of digital logic circuits		H	M									
		CLO3: To get a basic understanding of layout of electronic circuits			H								M	
		CLO4: Practical implementation of design methodologies skills for implementing combinational and sequential circuits.		M	H									
		CLO5: Implenetation of the concept of memories and Programmable Logic Devices and their classification.			H								M	
CS140	Problem Solving using Python Programming	CLO1: Students will be able to run basic python programs.		H	H									
		CLO2: To be able to use python skills in various fields of Data Science, Machine Learning and Artificial Intelligence.			H	H							H	H
		CLO3: Logic building using looping and decision statements.			H	M					H			H
		CLO4: To develop problem solving abilities using Python.		H	H						M		H	

		CLO5: To learn building packages and modules for reusability.			H	H								H
		CLO6: To learn GUI development using Widgets in Python.		H	H		H						H	
CS124	Object Oriented Programming Using C++	CLO.1 Identify common network security vulnerabilities/attacks			H		H							
		CLO.2 Explain the foundations of Cryptography and network security				H	H							
		CLO.3 Gain skills to critically evaluate the risks and threats to networked computers.		H		H								
		CLO.4 Demonstrate detailed knowledge of the role of encryption to protect data.		H	H		H						H	
		CLO.5 Analyze security issues arising from the use of certain types of technologies.			H		H						H	M
		CLO.6 Identify the appropriate procedures required to secure networks.		H	H		H						H	

CST125	Fundamentals of Web Technology	CLO.1 Identify the basis of designing a Web site; create Web pages, links, images, tables and pages layouts in HTML.	H											
		CLO.2 Describe and identify the use of JavaScript and successfully place it into Web pages and also recognize the skills and uses of JavaScript.			H								H	
		CLO.3 Use JavaScript to manipulate elements in the DOM to change appearance and visibility.		M								H		
		CLO.4 Describe how intended website design features will specifically benefit a target user group content strategy. H	H											
		CLO.5 Demonstrate and develop web-portals independently or in teams.			H									H
CSP125	Fundamentals of Web Technology Lab	CLO.1 Develop web based application using suitable client side and server side web technologies			H									

		CLO.2 Develop solution to complex problems using appropriate method, technologies, frameworks										H		
		CLO.3 Develop solution to complex problems using web services and content management	H											
CS110	Introduction to Linux	CLO1: Student should be able to identify and use UNIX/Linux utilities to create and manage simple file processing operations, organize directory structures with appropriate security, and develop shell scripts to perform more complex tasks.		H	H									
		CLO2: Student should be able to effectively use the UNIX/Linux system to accomplish typical personal, office, technical, and software development tasks.		H	H									H
		CLO3: Student should be able to monitor system performance and network activities.		H	H		H						H	
		CLO4: Student should be able to effectively use software development tools including libraries, preprocessors, compilers, linkers, and make files.		H									H	
		CLO5: Student should be able to comprehend technical skills to prepare simple readable user documentation and adhere to style guidelines				M	H							

CS114	Data Structures	CLO1: Students will be able to analyse algorithms and algorithm correctness.		H	H		M							
		CLO2: Students will be able to analyse time complexities of algorithms using asymptotic analysis.		H	H	M								
		CLO3: Students will be able to summarize searching and sorting techniques.			H									M
		CLO4: Students will be able to describe stack, queue and linked list operation. And can compare between different data structures. Pick an appropriate data structure for a design situation.		H	H						M			
		CLO5: Students will be able gain skills to explain the major graph and tree algorithms and their analyses. Employ graphs to model engineering problems, when appropriate.		H	H						M		H	M
CS115	Operating System	CLO1: Students will be able to identify different types of Operating System and their components.		H	M									
		CLO2: Design and implementation of new system calls for any open source operating system.		M	H									

		CLO3: Implementation of existing resource management algorithms in Linux operating system.			H		H						H	
		CLO4: Students will be able to identify various system security and protection issues.		H	H									M
		CLO5: Students will be able to completely administer the system using various Operating systems (Windows and Ubuntu) skills for managing its resources.		H	H								H	
CST102	Principles of Computer Networks	CLO1: Students will be able to describe and analyze the hardware, software, components of a network and the interrelations.		H	H									
		CLO2: Explain networking protocols and their hierarchical relationship hardware and software.		M			H						H	
		CLO3: Compare protocol models and select appropriate protocols for a particular design.		H	M								M	
		CLO4: Manage multiple operating systems, systems software, network services and security.					H							
		CLO5: Explain concepts and theories of networking and apply them to various situations, classifying networks, analyzing	M	H	M		M						M	

		performance and implementing new technologies.												
		CLO6: Imparting skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure					M			H				
CSP102	Principals of Computer Networking Lab	CLO.1 Understand the practical approach to network communication protocols.	H		H									H
		CLO.2 Understand network layers, structure/format and role of each network layer.			M									
		CLO.3 Able to design and implement various network application such as data transmission between client and server, file transfer, real-time multimedia transmission.					H							
		CLO.4 Understand the various Routing Protocols/Algorithms and Internetworking.				M							M	
		CLO.5 Imparting skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure	H							M				
CS118	Computer System Architecture	CLO1: Understanding of the basic components of a computer system.		H	M									H
		CLO2: Analyze the working of computer organization and control unit		H	M									
		CLO3: Design a CPU in terms of its organization and program Control		H	M									

		CLO4: Understand the concept of pipeline and Input Output Organization for consistent execution of instructions & Data Transfer		H	M		M							M
		CLO5: Understand the working of Memory organization.		H	M									
CS119	Design & Analysis of Algorithm	CLO1: Analyze algorithms and algorithm correctness.		M										
		CLO2: Analyze time complexities of algorithms using asymptotic analysis.		H										
		CLO3: Summarize searching and sorting techniques.			H		H						H	H
		CLO4: Describe stack, queue and linked list operation. Compare different data structures and pick an appropriate data structure for a design situation.	H		H		H							
		CLO5: Explain the major graph and tree algorithms and their analysis skills. Employ graphs to model engineering problems.		H	H									
CS111	Introduction to Web Technologies	CLO1: Identify the basis of designing a Web site; create Web pages, links, images, tables and pages layouts in HTML.			H									
		CLO2: Describe and identify the use of JavaScript and successfully place it into Web			H		H							

		pages and also recognize the skills and uses of JavaScript.												
		CLO3: Use JavaScript to manipulate elements in the DOM to change appearance and visibility.			H		H						H	
		CLO4: Describe how intended website design features will specifically benefit a target user group content strategy.			H									
		CLO5: Demonstrate and develop web-portals independently or in teams.					H							
CS163	Advanced Web Development	CLO1: Use JavaScript advance skills like functions, objects and DOM to manipulate elements or to change appearance and visibility of HTML elements on web pages.		H	H	H								
		CLO2: Implement form validation using regular expressions.			H		H						H	
		CLO3: Make dynamic changes to a web page, validating and respond to user or browser events using JQuery.			H									
		CLO4: Use and Implement AJAX to fetch data from the server in JQuery and React.			H	H	H							
		CLO5: Set up a ReactJS development environment, creating components using JSX,					H						H	

		work with forms and events and understand what props and state are in ReactJs.												
CST101	Database Management Concepts	CLO1: Design and implement database system by implementing SQL commands for RDBMS and analyze database requirements to determine the entities involved in the system and their relationship to one another.		M	H								H	
		CLO2: Describe relational algebra expression and tuple relation expression from queries.		M	H	M								
		CLO3: Implement the concept of normalization and functional dependency while designing the databases.		M	M									
		CLO4: Apply the concept of transaction, concurrency control, security and recovery in database.			H		H							
		CLO5: Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills.		M	H								H	
		CLO6: Explain and evaluate the fundamental theories and requirements that influence the design of distributed database systems.	H		H		H						H	
CST109		CLO.1 Describe the basics of digital computer and programming languages	H					M						

	Problem Solving Using C	CLO.2 Demonstrate problem solving techniques using flowchart, algorithm/pseudo code to solve the given problem		H									M	
		CLO.3 Design and Implement C program using Control Statements and Functions			H								M	
		CLO.4 Design and Implement C program using Pointers and File operations.			H								M	
		CLO.5 Identify the need for embedded C in real-time applications					H	M						
		CLO.6 Students will be able to develop solutions through independent and innovative learning.	M		H									M
		CLO.1 Identify and use UNIX/Linux utilities to create and manage simple file processing operations, organize directory structures with appropriate security, and develop shell scripts to perform more complex tasks				H	M							
		CLO.2 Effectively use the UNIX/Linux system to accomplish typical personal, office, technical, and software development tasks		M			H							H
		CLO.3 Monitor system performance and network activities.		M			H						M	
		CLO.4 Effectively use software development tools including libraries, preprocessors, compilers, linkers, and make files		H									M	
		CLO.5 Comprehend technical skills to prepare simple readable user documentation and adhere to style guidelines				M	H						M	
CS107	Object Oriented Software Engineering	CLO1: Acquire strong fundamental knowledge in science, mathematics, fundamentals of computer science, software		M										M

		engineering and multidisciplinary engineering to begin in practice as a software engineer.												
		CLO2: Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.		M	H									
		CLO3: Deliver quality software products by possessing the leadership skills as an individual or contributing to the team development and demonstrating effective and modern working strategies by applying both communication and negotiation management skill.		M	H		H							
		CLO4: Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.			M	H	H							
		CLO5: To learn and understand various object oriented concepts along with their applicability contexts			M	H	H							
CS135	Advanced Java	CLO1: Students will be able to design the website			H									

		CLO2: Students can develop project using Spring framework skills			H								H	
		CLO3: Students can maintain and enhance existing web platform		H		H								M
		CLO4: Use and Implement several Data structures using Collection Framework.			H								H	
		CLO5: Use database connectivity for a complete Java application.		H		H								M
CS146	Web Application Development	CLO1: Students will be able to apply the web application development skills to design the responsive website		H	H		H							
		CLO2: Students can develop multi/ single page interactive website			H		H							H
		CLO3: Students can maintain and enhance existing web application		H		H								
		CLO4: Experiment the web programming concepts to modify the design and layouts of web pages.			H		H							H
		CLO5: Examine the adaptability of scripting languages in web development.		H		H								

CS147	Android Application Development	CLO1: Student should be able to install and configure Android application development tools.				H	M							
		CLO2: Student should be able to design and develop user interfaces for the Android platform.		M	H		H							
		CLO3: Student should be able to save state information across important operating system events.			H	H								M
		CLO4: Student should be able to apply Java programming skills and concepts to Android application development.		M	H		H							M
		CLO5: Students should be able to design the structure of Android apps, understand layout files and the conversion to view objects.		M			H							M
CS148	iOS Programming	CLO1: Student should be able to demonstrate the skill of understanding of the fundamentals of Swift, building modern mobile apps, iOS, Xcode, and other tools in the Xcode development environment.			H		H							
		CLO2: Student should be able to demonstrate and understanding of how to handle and store data using clearly defined types.			H	M	H							

		CLO3: Student should be able to write code that makes decisions about what lines of code should be executed.		M	H	M								H
		CLO4: Student should be able to create a basic iOS app to get familiar using Xcode.			H		H							
		CLO5: Student should be able to test and debug apps in a Mac, using the Simulator from Xcode.				H	M							
CS149	Internet of Things	CLO1: Students would know the architectural overview of the IoT applications.		M	H	M								
		CLO2: Possess an ability and skill to design and develop hardware infrastructure of IoT application.		M	H		H							
		CLO3: They would be able to apply communication protocols for IoT application development.		M	H		H							
		CLO4: Possess an ability to push the data onto the cloud services.			H	M	H							
		CLO5: They would be able to analyze the sensor data and take necessary action associated with it.		H	H	H								

CS136	Introduction to DevOps	CLO1: Student should be able to explain the need to do DevOps.		M	H									H
		CLO2: Student should be able to understand the DevOps foundations, principles, and practices.		M		H								
		CLO3: Understand, analyze, and map value streams.		H	M	M								
		CLO4: Explain and implement the deployment pipeline skills.		M	H		H							
		CLO5: Illustrate the concept of Continuous Delivery.			M	M	H							
		CLO6: Create a problem-solving culture.			H	M	H							
CS179	Programming Abstractions	CLO1: Explain the basic concepts of object-oriented programming language and their representation.	H											
		CLO2: Illustrate dynamic memory allocation functions, access specifiers and the friend functions.	M											M
		CLO3: Demonstrate the use of constructors, destructors and also the behavior of inheritance and its implementation.	M											M

		CLO4: Implement polymorphism and overloading of operators	M	M	H						M			M
		CLO5: Apply the I/O operations to handle backup system using files and to develop general purpose templates.	M	H	H	M	M				M			M
		CLO6: Handle raised exception while implementing various object-oriented concepts	M	H	H	H	M				M			M
CS192	Front End Engineering	CLO1: Develop a deep understanding of HTML, CSS, and JavaScript, and be able to apply this knowledge to create responsive and accessible web pages	H				M					M	M	
		CLO2: Learn how to use front-end frameworks, API's and Async programming to build front end applications.	M	M									H	
		CLO3: Understand the basics of responsive design, and be able to create websites that work well on a variety of devices and screen sizes	H	M									M	
		CLO4: Develop strong problem-solving skills, and be able to break down complex problems into smaller, more manageable parts	M	H	M	H	H						M	

		CLO5: Learn how to collaborate effectively with other developers, designers, and stakeholders on web development projects		H	M	M	M	M			M		M	M
		CLO6: Project development and GIT hub	M		M		M	M			M		H	M
CS126	Algorithm Design & Implementation	CLO1: At the end of this course students will be well versed with Object Oriented Concepts and Java skills.		M	H	H	M							
		CLO2: Students have good idea of graph traversal algorithms and hashing techniques.						M		H				
		CLO3: Students will be able to write program in Java to solve graph-based problems.					M	H	H	M				
		CLO4: Students will be able apply graph searching algorithms to real life problems.	M	H										
		CLO5: Students will be able to simulate real world problems to Java based software solutions.	M	H	H	H	H							
CS108	Python Basics	CLO1: Designing real life scenario problems, identifying and analysing solutions for it.		H	H									
		CLO2: Accurately and efficiently designing the solutions in python.		M	H	M	H							

		CLO3: To be able to use python skills in various fields of Data Science, Machine Learning and Artificial Intelligence.			H	H								
		CLO4: Use indexing and slicing to access data in Python programs.		M	H	M	H							
		CLO5: Design loops and decision statements in Python.			H	H								
CS133	Data Visualization and Query Language	CLO1: Students will infer skills for various performance measures and benchmarking progress towards business goals.			H	H		M						
		CLO2: Students will analyze automated dashboard project to determine the entities involved in the system and their relationship to one another.			H	H		M						
		CLO3: Students will create database and work on complex queries.		M	H		H							
		CLO4: Students will be able to differentiate various mapping tools.			H	H		M						
		CLO5: Students will be able to learn web mapping services requirements.		M	H		H							
CS134	Business Analytics	CLO1: Understand and critically apply the concepts and methods of business analytics		M	M									M

		CLO2: To use basic functions and packages in Python.			H		H							
		CLO3: To understand statistical concepts, skills and different hypothesis tests.		M		H								M
		CLO4: To learn how to prepare data using Python.			H		H							
		CLO5: To learn how to prepare data using Python		M		H								M
CS138	Machine Learning	CLO1: Students will understand and implement classical models and algorithms in machine learning as well as python programming concepts.		M	H	H								
		CLO2: Students will analyze the data, identify the problems.		H			H							
		CLO3: Students will learn the skills to analyze relevant models and algorithms to turn available data into valuable and useful Information.		M	H	H								
		CLO4: Students will be able to understand the comparative study of the related approaches.			H		H	H						

		CLO5: Students will be able to explore new techniques and ideas that can be used to improve the effectiveness of current AI tools.			H		H	H						
CS129	Introduction to Cyber Security	CLO1: Review and practice computer and network etiquette and ethics found in working environments						H		H				
		CLO2: Perform risk assessment		H	H									H
		CLO3: Install, configure, use and manage anti malware software on a working network			H	H								
		CLO4: Evaluate best practices in security concepts and skills to maintain confidentiality, integrity and availability of computer systems			H		H							
		CLO5: Articulate informed opinion about issues related to cyber security			H		H							
CS130	Cyber Security for Forensics & Investigation	CLO1: Understand the importance of a systematic procedure for investigation of data found on digital storage media that might provide evidence of wrong-doing.		M	M									
		CLO2: Understand the file system storage mechanisms of two common desktop operating systems (i.e. versions of Microsoft Windows and LINUX).			H	H								

		CLO3: Use tools for faithful preservation of data on disks for analysis.		M	H	H		M		H	M			
		CLO4: Find data that are hidden on a computer disk.					H	M		H		M		
		CLO5: Learn the skills to use of computer forensics tools used in data analysis, such as searching, absolute disk sector viewing and editing, recovery of files, password cracking, etc.					H	M		M				
CS131	Malware and Reverse Engineering – I	CLO1: Student will be able to apply malware analysis methodology and technology		M	H									
		CLO2: Student will be able to apply static malware analysis skills.		M	H									
		CLO3: Able to identify basic and some malware functionality			H		H							
		CLO4: Identify known anti-reverse engineering techniques			M		H							
		CLO5: Student will be able to conduct an analysis without revealing that the investigation is taking place and/or revealing their identity.		H		H								

CS132	Malware and Reverse Engineering – II	CLO1: Student will be able to apply malware analysis methodology and technology skills.		M	H									
		CLO2: Student will be able to apply advanced static malware analysis.		M	H									
		CLO3: Able to identify basic and some advanced malware functionality			H		H							
		CLO4: Identify known anti-reverse engineering techniques			M		H							
		CLO5: Student will be able to conduct an analysis without revealing that the investigation is taking place and/or revealing their identity.	H	H		H								
GPP101	Fundamentals of Game Programming	CLO1: Students will develop the skill to be able to program for a game.			H									
		CLO2: Students can develop their own games.	H	M	H	H							H	
		CLO3: Students can perform their games on multiple platforms.	H	M	H		H						H	
		CLO4: Skill development by apply mathematical and game programming knowledge and skills to solve development tasks.	H	M	H	H							H	

		CLO5: Seek new knowledge of games development through self-directed study.	H	M	H		H						H	
GPP103	Graphics Programming	CLO1: Students will be able to program computer graphics renderers.		H	H									
		CLO2: Students will learn the skills to develop OpenGL applications.		H	H	H							H	
		CLO3: Students can perform transformations on objects in graphics application.		H			H							
		CLO4: Analyze, synthesize, and utilize design processes and strategy from concept to delivery to creatively solve communication problems.		H	H	H							H	
		CLO5: Create and develop skill in communication solutions that address audiences and contexts, by recognizing the human factors that determine design decisions.		H			H							
GPL104	Game Design – BG	CLO1: Generate the skill of innovative ideas, and go beyond the obvious and predefined.		H	H									
		CLO2: Listen to, evaluate, and respond critically to the ideas of others.		H		H	H							
		CLO3: Identify steps, develop and manage a successful professional workflow.		M	H	H							H	

		CLO4: Synthesize trends, theories, and movements in the development of new ideas		H		H	H							
		CLO5: Identify and apply foundational theories and approaches that inform contemporary for skill development and creative work		M	H	H							H	
GPL102	Game Design – 2D & 3D	CLO1: Generate the skill of innovative ideas, and go beyond the obvious and predefined.		H	H									
		CLO2: Listen to, evaluate, and respond critically to the ideas of others.		H		H	H							
		CLO3: Identify steps, develop and manage a successful professional workflow.		M	H	H							H	
		CLO4: Generate innovative ideas, and go beyond the obvious and predefined.		H		H	H							
		CLO5: Synthesize trends, theories, and movements in the development of new ideas.		M	H	H							H	
GPP107	Unity Game Development	CLO1: Development of 2D & 3D games using the learned skills.			H	H	H						H	
		CLO2: Development of Special effects and Multiplayer games			H	M								

		CLO3: Apply mathematical and game programming knowledge and skills to solve development tasks.				M	M							
		CLO4: Build familiarity and appreciation of the programmatic components of an industry standard game development engine.								H			H	
		CLO5: Seek new knowledge and skill development of games development through self-directed study.			H	H	H						H	
CS141	Digital & Social Media Marketing Building Blocks and Content Development & Marketing	CLO1: Understanding of the key concepts, skills and trends associated with Digital Marketing & Internet Technologies for becoming entrepreneurs.					H	H		M		M		
		CLO2: Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.					H	M		H	M	H		
		CLO3: Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing & Internet Technologies.				H	H				H		H	
		CLO4: Explain emerging trends in digital marketing and critically assess the use of					H	M		H	M	H		

		digital marketing tools by applying relevant marketing theories and frameworks.												
		CLO5: Interpret for skill development the traditional marketing mix within the context of a changing and extended range of digital strategies and tactics.				H	H				H		H	
CS142	Search Engine Marketing (SEO & PPC), Web Analysis and Email Marketing & Management	CLO1: Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.					H	H		M		M		
		CLO2: Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.					H	M		H	M	H		
		CLO3: Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing skills & Internet Technologies for entrepreneurs.				H	H				H		H	
		CLO4: Analyze the confluence of marketing, operations, and human resources in real-time delivery.					H	M		H	M	H		
		CLO5: Demonstrate cognitive knowledge of the skills required in CLO6: conducting online research and research on online				H	H				H		H	

		markets, as well as in identifying, assessing and selecting digital market opportunities												
CS143	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	CLO1: Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.					H	H		M		M		
		CLO2: Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies for entrepreneurs.					H	M		H	M	H		
		CLO3: Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing skills & Internet Technologies.				H	H				H		H	
		CLO4: Find out the significance of Search Engine Marketing and Social Media Optimization					H	M		H	M	H		
		CLO5: Analyze various ranking factors of online applications with Search Engine Optimization Techniques.				H	H				H		H	
CS144	Affiliate Marketing and Online Reputation	CLO1: Understanding of the key concepts and trends associated with Digital Marketing & Internet Technologies.					H	H		M		M		

	Management (ORM)	CLO2: Hands-on familiarity with the leading tools and techniques used in the customer–facing aspects of Digital Marketing & Internet Technologies.					H	M		H	M	H		
		CLO3: Conceptual and practical education in the best practices used by industry leaders to produce superior business results in the management of Digital Marketing skills & Internet Technologies.	H			H	H				H		H	
		CLO4: Find out the significance of Search Engine Marketing and Social Media Optimization useful for entrepreneurship					H	M		H	M	H		
		CLO5: Analyze various ranking factors of online applications with Search Engine Optimization Techniques.	H			H	H				H		H	
CS120	Theory of Computation	CLO1: Students will become familiar with skills of basic automata theory of computer system.		H			H							
		CLO2: Students would be able to understand the working and data flow in computer components.	H	H	H	H								
		CLO3: To understand the challenges for Theoretical Computer Science and its	H	H		H								

		contribution to other sciences such as biology, economics, physics, and many other fields.												
		CLO4: Students will able to deal with the problems efficiently on a model of computation using an algorithm.			H		H							
		CLO5: Describe unrecognizable languages and undecidable problems.			H		H							
CS121	Software Quality Assurance and Testing	CLO1: Understand software testing and quality assurance as a fundamental component of software life cycle												
		CLO2: Infer various software models concepts and skills for making the software.		H	H									
		CLO3: Analyse software creating requirements to determine the entities involved in the system and their relationship to one another.			H	H								
		CLO4: To make sure that the result meets the business and user requirements Software testing plays an instrumental role.		H	H			H					H	
		CLO5: Also, to satisfies the BRS that is Business Requirement Specification and SRS that is System Requirement Specifications and finally gain the confidence of the			H		H						H	

		customers by providing them a quality product.												
CS122	Business Intelligence and Data Warehousing	CLO1: Speculate various models and algorithms in data warehousing.		H	H									
		CLO2: Analyze various database problems and to find out the relevant information out of big data.		H	M									
		CLO3: Implement major algorithms that generates frequent itemset.		M	H	H								
		CLO4: Differentiate between OLAP AND OLTP.				H								
		CLO5: Use clustering techniques for maintaining database integrity.		M						M			H	
		CLO6: Model an application's data requirements using conceptual model tools skills like BI tools and strategies	M	M	H		H						H	
CS123	ArtificialIntelligenceandExpertSystem	CLO1: Learning the basic concepts and skills of Artificial Intelligence.	H											
		CLO2: Represent Knowledge using propositional calculus and predicate calculus.		H										

		CLO3: Use inference rules to produce predicate calculus expression.		H	H									
		CLO4: Demonstrate awareness of informed search and uninformed search techniques.			H	H								
		CLO5: Explain about AI techniques for planning, knowledge representation and management.		H	H	H	H							
		CLO6: Outline the process involved in Expert systems and in building such systems.			H	H								
CS124	Network Security	CLO1: Identify common network security vulnerabilities/attacks		H	H									
		CLO2: Explain the foundations of Cryptography and network security		M	H									
		CLO3: Gain skills to critically evaluate the risks and threats to networked computers.			H	H								
		CLO4: Demonstrate detailed knowledge of the role of encryption to protect data.	H	H	H	H								
		CLO5: Analyze security issues arising from the use of certain types of technologies.	H	H		H								
		CLO6: Identify the appropriate procedures required to secure networks.		H		H	H							

CS125	Soft Computing	CLO.1 Develop intelligent systems leveraging the paradigm of soft computing techniques			H							M		
		CLO.2 Implement, evaluate and compare solutions by various soft computing approaches for finding the optimal solutions				H								M
		CLO.3 Recognize the feasibility of applying a soft computing methodology for a particular problem.		H					M					
		CLO.4 Design the methodology to solve optimization problems using fuzzy logic, genetic algorithms and neural networks			H			M						
CS139	Parallel and Distributed Computing	CLO.1 Develop and apply knowledge of parallel and distributed computing skills and methodologies.		M	H									
		CLO.2 Apply design, development, and performance analysis of parallel and distributed applications.		H	H	H								
		CLO.3 Use the application of fundamental Computer Science methods and algorithms in the development of parallel applications.		M	H									
		CLO.4 Explain the design, testing, and performance analysis of a software system, and to be able to communicate that design to others.		H	H	M								
		CLO.5 Develop and apply knowledge of parallel and distributed computing techniques and methodologies.		H	H	M								
EP101	Entrepreneurship and Opportunity	CLO.1 Students will be able to sell themselves and their ideas and become entrepreneurs.						H		H	H			
		CLO.2 Students master oral and visual presentation skills and establish a foundation of confidence in the skills necessary to cause others to act.									H	H		

		CLO.3 Students will be able to find problems worth solving.			H			H		H				
		CLO.4 Students advance their entrepreneurship skills in customer development, customer validation, competitive analysis, and iteration while utilizing design thinking and process tools to evaluate in real-world problems and projects.		M	H			M						M
		CLO.5 Students increase their awareness and deliberately practice the entrepreneurship skills and disciplines necessary to increase confidence and agency; foster self-efficacy and self-advocacy; improve communication and problem-solving skills, manage strong impulses and feelings; and identify personal purpose.		M			H					H	H		
CS150	Mobile Ad-hoc and Sensor Networks	CLO.1 Skill based knowledge of routing mechanisms and the three classes of approaches: proactive, on-demand, and hybrid		H	H									
		CLO.2 To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.		H	H									
		CLO.3 Identify the issues and challenges in providing QoS		M	H									
		CLO.4 Explain about the energy management in ad-hoc networks			H	H								
		CLO.5 Demonstrate various types of mesh networks.			H	H								
CS151	Cloud Computing	CLO.1 Students will be able to identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.		H		H								

		CLO.2 Students will be able to explain the core issues of cloud computing such as security, privacy, and interoperability.		H		H								
		CLO.3 Students will be able to identify problems, and explain, analyze, and evaluate various cloud computing solutions.		H									H	
		CLO.4 Students will be able to provide the appropriate cloud computing solutions and recommendations according to the applications used.			H	H							H	
		CLO.5 Students will be able to build skills to generate new ideas and innovations in cloud computing.			H	H	H							
CS152	Advanced Computer Architecture	CLO.1 Students will know the classes of computers, and new trends and developments in computer architecture.	H	M	M									
		CLO.2 Students will understand pipelining, instruction set architectures, memory addressing.		M	M									
		CLO.3 Students will be able to understand multithreading by using ILP and supporting thread- level parallelism (TLP).		M	H	H								
		CLO.4 Students will build skills to understand the performance and efficiency in advanced multiple- issue processors.	H		H	M	H							
		CLO.5 Students will build skills to understand the performance of multi-core processors using SPEC benchmarks.		M	H	M								H
		CLO.6 Students will be able to understand storage systems, RAID, I/O performance, and reliability measures.	M		H		H							

CS153	Digital Image Processing	CLO.1 Understand fundamental steps of digital image processing	H	M										
		CLO.2 Examine various types of images, intensity transformations and spatial filtering.			H									
		CLO.3 Skill to understand and compare various image enhancement techniques			H	H								
		CLO.4 Skill to understand and implement basic image segmentation techniques		M	H	H	M							
		CLO.5 Skill to understand and implement and compare various image restoration techniques	H				M							
CS154	Computer Graphics	CLO.1 Students will be able to explain the core concepts of computer graphics, including viewing, projection, perspective, modelling and transformation in two and three dimensions.	H	M	H								M	
		CLO.2 Students will be able to apply the concepts of colour models, lighting and shading models, textures, ray tracing, hidden surface elimination, anti-aliasing, and rendering.	H	M	M								M	
		CLO.3 Students will be able to interpret the mathematical foundation of the concepts of computer graphic skills.	H	H		M								
		CLO.4 Students will be able to describe the fundamentals of animation, parametric curves and surfaces, and spotlighting.	M	M		M								
		CLO.5 Students will be able to identify a typical graphics pipeline and apply graphics programming skills to design and create computer graphics.	M	M	H									
		CLO.6 Students will be able to create effective programs to solve graphics		H	H									

		programming issues, including 3D transformation, objects modelling, colour modelling, lighting, textures, and ray tracing.													
HR101	Human Values and Professional Ethics	CLO.1 The students will be able to get awareness on human values and professional ethics						H	M	H					
		CLO.2 The students will understand the core values that shape their ethical behaviour.								H	M	M			
		CLO.3 The Students will be able to take active part in social, political, economic and cultural activities with responsibility.						H				M			
		CLO.4 The students will gain thorough knowledge in the field of human rights and this will add to the academic qualification								H	M	M			
		CLO.5 To strengthen the ability to contribute to the resolution of human rights issues and problems.						H				M			
DM101	Disaster Management	CLO.1 To increase the knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences						H			H				
		CLO.2 To increase the knowledge and understanding of the International Strategy for Disaster Reduction (UN- ISDR) and to increase skills and abilities for implementing the Disaster Risk Reduction (DRR) Strategy						M	H		H				
		CLO.3 To ensure skills and abilities to analyse potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects						H	M						
		CLO.4 Learn the role of institutions and also analyze the inter-relationship between						M	H		H				

		disasters and developmental projects and their vulnerabilities.												
		CLO.5 Gain skills required for the safety of lives during the occurrence of disasters.						H	M					
CS501	Cyber Security	CLO.1 Acquire Information and risk models including confidentiality, integrity and availability		M	H	M								
		CLO.2 Skill to analyze on Threats and attacks and exploit vulnerabilities			H		H	M						
		CLO.3 To gain knowledge on Cyber security architecture and operations		M		H		M						
		CLO.4 Understand how Cyber security is conceptualized and carried out			H		H	M						
		CLO.5 Articulate informed opinion about issues related to cyber security		M		H		M						
CST106	Data Structures With C++	CLO.1 Summarize different categories of Data Structure						H			H			
		CLO.2 Identify different parameters to analyze the performance of an algorithm.						M	H		H			
		CLO.3 Explain the significance of dynamic memory management Techniques						H	M					
		CLO.4 Design algorithms to perform operations with Linear and Nonlinear data structures						M	H		H			
		CLO.5 Illustrate various technique to for searching, Sorting and hashing.						M	H		H			
		CLO.6 CLO.6 Choose appropriate data structures to solve real world problems efficiently	M	H										
CST107	Advanced Web Technology	CLO.1Manipulateelementsonawebpageandrespondingtouserinteractions			H		H	M						

		CLO.2Developweb,desktop,andmobileapplications skills		M		H		M						
		CLO.3 Use Angular JS to develop cross-platform applications			H		H	M						
		CLO.4 Explore core jQuery features which would help in designing GUI.		M		H		M						
		CLO.5 Use Angular JS to develop cross-platform applications	M		H									
CST108	Operating System With Linux	CLO.1 Gain extensive knowledge on principles, types and advance concepts of operating systems						H			H			
		CLO2. Recognize key mechanisms in design of operating systems modules						M	H		H			
		CLO3. Compare performance of processor scheduling algorithms						H	M					
		CLO4. Practice with operating system concepts such as process management, concurrent processes and threads, memory management, virtual memory concepts, deadlocks						M	H		H			
		CLO5. To identify various system security and protection issues						M	H		H			

		CLO6. To learn the latest trends in building mobile OS.	M	H										
CS203	Integrated Project	CLO.1 To acquire presentation and communication skills and become employable.					M				M	H		
		CLO.2 Undertake problem identification, formulation and solution to make students employable.	H	H	M		M				H		H	
		CLO.3 Design engineering solutions to complex problems utilizing a systems approach		M	H	H	H				H		H	M
		CLO.4 To implement learning in real life problem for skill development	H	H	M		M				H		H	
		CLO.5 To propose multiple solution to any given problem and find best out of those.		M	H	H	H				H		H	M
CS205	Integrated Project – II	CLO.1 To acquire presentation and communication skills and become employable.					M				M	H		
		CLO.2 Undertake problem identification, formulation and solution to make students employable.	H	H	M		M				H		H	
		CLO.3 Design engineering solutions to complex problems utilizing a systems approach		M	H	H	H				H		H	M
		CLO.4 To implement learning in real life problem for skill development	H	H	M		M				H		H	
		CLO.5 To propose multiple solution to any given problem and find best out of those.		M	H	H	H				H		H	M
CS204	Lab Oriented Project	CLO.1 To acquire presentation and communication skills					M				M	H		

		CLO.2 Undertake problem identification, formulation and solution to make students employable.	H	H	M		M				H		H	
		CLO.3 Design engineering solutions to complex problems utilizing a systems approach		M	H	H	H				H		H	M
		CLO.4 To implement learning in real life problem for skill development	H	H	M		M				H		H	
		CLO.5 To propose multiple solution to any given problem and find best out of those.		M	H	H	H				H		H	M
CS251	Co-op project at Industry (Module-1)	CLO.1 To acquire presentation and communication skills					M				M	H		
		CLO.2 Undertake problem identification, formulation and solution to make students employable.	H	H	M		M				H		H	
		CLO.3 Design engineering solutions to complex problems utilizing a systems approach		M	H	H	H				H		H	M
		CLO.4 To implement learning in real life problem for skill development	H	H	M		M				H		H	
		CLO.5 To propose multiple solution to any given problem and find best out of those.		M	H	H	H				H		H	M
CS252	Co-op project at Industry (Module-2)	CLO.1 To acquire presentation and communication skills					M				M	H		
		CLO.2 Undertake problem identification, formulation and solution to make students employable.	H	H	M		M				H		H	
		CLO.3 Design engineering solutions to complex problems utilizing a systems approach		M	H	H	H				H		H	M
		CLO.4 To implement learning in real life problem for skill development	H	H	M		M				H		H	

		CLO.5 To propose multiple solution to any given problem and find best out of those.		M	H	H	H				H		H	M
CS253	Industry Oriented Hands-on Experience	CLO.1 To acquire presentation and communication skills					M				M	H		
		CLO.2 Undertake problem identification, formulation and solution to make students employable.	H	H	M		M				H		H	
		CLO.3 Design engineering solutions to complex problems utilizing a systems approach		M	H	H	H				H		H	M
		CLO.4 To implement learning in real life problem for skill development	H	H	M		M				H		H	
		CLO.5 To propose multiple solution to any given problem and find best out of those.		M	H	H	H				H		H	M
CS145	Front-end Development	CLO.1 Students should be able to identify the basis of designing a website, create webpages, links, images, tables and page layouts in HTML.			H									
		CLO.2 Learning skills to describe and identify the use of Javascript and successfully place it into webpages and also recognize the uses of Javascript.							M					
		CLO.3 Use Javascript to manipulate elements in the DOM to change appearance and visibility.		H										
		CLO.4 Describe how intended website design features will specifically benefit a target user group content strategy.					H	M						
		CLO.5 Understanding the role and functions of Web servers and server frameworks.					H							

CS159	Back-end Development	CLO.1 Students will be able to gain skills to build full stack end applications using Javascript, Nodejs, Expressjs and MongoDB.							H						
		CLO.2 Students will understand the concept of full stack development and APIs.					H								
		CLO.3 Student will learn debugging issues and end-to-end testing.											M		
		CLO.4 Deliver features in an agile development environment.				H									
		CLO.5 Architect solutions to programming problems by combining visual components and classes, and develop a fully functioning website and deploy on a web server			H										
EP102	Consumer & Market Research for Entrepreneurs	CLO.1 Identify and evaluate entrepreneurial opportunities, manage risks and learn from the results.													
		CLO.2 Understand the process that enables entrepreneurs with limited resources.			H	M									
		CLO.3 Understand and apply fundamental aspects as a means of personal empowerment.				M									
		CLO.4 Help a company or business development, through proper planning, organization, and both human and material resources control, and thus satisfy all specific needs within the market, at the right time.					H								
		CLO.5 Satisfy customer's specific needs through a required product or service.								H					
EP103	New Venture Creation	CLO.1 Develop critical thinking skills and work in a team.			H										

		CLO.2 Transform a simple idea into a sustainable success.											H	
		CLO.3 Understand the market needs and apply fundamental aspects to position the developed product.					H							
		CLO.4 To understand the concept of entrepreneurship and skill sets of an entrepreneur.											H	
		CLO.5 To examine historical and theoretical perspective of entrepreneurship.					H							
EP104	The Entrepreneurial Innovator	CLO.1 Establish goals, identify resources and determine the steps required to accomplish their goals.								H				
		CLO.2 Identify and interact with local entrepreneurs and business owners within their own communities.					H							
		CLO.3 Develop initial competitive landscape and future growth for potential viable business idea.						H						
		CLO.4 Have the ability to discern distinct entrepreneurial traits	M											
		CLO.5 Know the parameters to assess opportunities and constraints for new business ideas									H			
CS168	UX Design and Digitalization	CLO.1 Understand what interaction design is, the importance of user-centred design and methods of user information gathering.			H									
		CLO.2 Understand how the sensory, cognitive and physical capabilities of users inform the design of interactive products.		H					H					
		CLO.3 Understand the process of interaction design, including requirements elicitation,			H									

		prototyping, evaluation and the need for iteration.													
		CLO.4 Analyse and critique the design of interactive products.									H				
		CLO.5 Learn skills to select, adapt and apply suitable interaction design approaches and techniques towards the design of an interactive product.				H									
CS169	User Interface Design	CLO.1 Construct navigation that enables users to easily accomplish tasks.										H			
		CLO.2 Determine which data to display in order to meet user needs.			H										
		CLO.3 Enable users make social connections through their mobile devices.									H				
		CLO.4 Focus on patterns that bring clarity.					H								
		CLO.5 Learn the skills of design strategy development that provides solutions to meet business and user goals.						H							
CS170	Empathy & its Tools	CLO.1 Use empathy to change behaviour and build better relationship skills.				H									
		CLO.2 Develop empathy through role-play activities.									H				
		CLO.3 Explain what it means to have different perspectives.							H						
		CLO.4 Empathy prepares students to be leaders in their community.			M										
		CLO.5 Understand the key difference(s) between empathy and sympathy.		M											

CS171	User Research & Its Application	CLO.1 Understand group of usability experts evaluating website against a list of established guidelines.									H			
		CLO.2 To conduct moderated discussion with a group of users, allow to learn about user attitudes, ideas, and desires.				H								
		CLO.3 Perform testing method focused on navigation, which can be performed on a functioning website, a prototype, or a wireframe.				H								
		CLO.4 Identifies user frustrations and problems with site through one-on-one sessions where a "real-life" user performs tasks on site.			M							H		
		CLO.5 Learn how to leverage various user research methods to meet user needs in product, website, or application.							H					
		CLO.6 Get hands-on experience with user experience exercises to practice user research skills.								H				
		CLO.7 Dive into a step-by-step approach to usability testing, including how to create a research plan, conduct studies, analyze results, and make effective UX design recommendations.						H						
CS172		CLO.1 Better understand characteristics and processes, as well as the differences between novice and expert design thinkers.				H								

	Design Thinking & Its Applications	CLO.2 Learn design thinking skills, focuses on the end-users and how to improve the user experience and make it more fulfilling.								H				
		CLO.3 To perform teams work collaboratively on a project, the joint advantage of experience, expertise and wisdom is available while developing solutions			M									
		CLO.4 Focus on finding solutions in an innovative way. So, while solving real problems this produces and delivers value to the end-users										H		
		CLO.5 Assists in creating successful brands and generating ROI from these brands.									H			
CS12X	Compiler Design	CLO.1 To understand the context and use of a compiler.				H								
		CLO.2 Skill to implement lexical analysis, parsing of the code and semantic analysis of the source csode.		H										
		CLO.3 Skill to implement back end, include intermediate code generation, run time environment, code generation and register allocation.		H										
		CLO.4 To understand the special aspects of compilers and runtime such as code optimization, garbage collection etc.				H		H						
		CLO.5 Knowledge and ability to devise, select, and use modern techniques and tools needed to design and implement compilers.				H		H						

CS135	AdvancedJava	CLO.1 Students will be able to design the website			H									
		CLO.2 Students can develop project using Spring framework skills			H								H	
		CLO.3 Students can maintain and enhance existing web platform		H		H								M
		CLO.4 Use and Implement several Data structures using Collection Framework.	H		H	H								
		CLO.5 Use database connectivity for a complete Java application.										M		
CS136	Introduction toDevOps	CLO.1 Student should be able to explain the need to do DevOps.		M	H									H
		CLO.2 Student should be able to understand the DevOps foundations, principles, and practices.		M		H								
		CLO.3 Understand, analyze, and map value streams.		H	M	M								
		CLO.4 Explain and implement the deployment pipeline skills.		M	H		H							
		CLO.5 Illustrate the concept of Continuous Delivery.			M	M	H							
		CLO.6 Create a problem-solving culture.			H	M	H							
CS139	Parallel andDistributedComputing	CLO.1 Develop and apply knowledge of parallel and distributed computing skills and methodologies.		M	H									
		CLO.2 Apply design, development, and performance analysis of parallel and distributed applications.		H	H	H								
		CLO.3 Use the application of fundamental Computer Science methods and algorithms in the development of parallel applications.		M	H									

		CLO.4 Explain the design, testing, and performance analysis of a software system, and to be able to communicate that design to others.	H	H	H	M								
		CLO.5 Develop and apply knowledge of parallel and distributed computing techniques and methodologies.		H	H	H								
CS146	WebApplicationDevelopment	CLO.1 Students will be able to apply the web application development skills to design the responsive website		H	H		H							
		CLO.2 Students can develop multi/ single page interactive website			H		H							H
		CLO.3 Students can maintain and enhance existing web application		H		H								
		CLO.4 Experiment the web programming concepts to modify the design and layouts of web pages.				H	M							
		CLO.5 Examine the adaptability of scripting languages in web development.				H								
CS151	CloudComputing	CLO.1 Students will be able to identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.		H		H								
		CLO.2 Students will be able to explain the core issues of cloud computing such as security, privacy, and interoperability.		H		H								
		CLO.3 Students will be able to identify problems, and explain, analyze, and evaluate various cloud computing solutions.		H									H	
		CLO.4 Students will be able to provide the appropriate cloud computing solutions and		H		H								

		recommendations according to the applications used.												
		CLO.5 Students will be able to build skills to generate new ideas and innovations in cloud computing.		H									H	
CS147	AndroidApplicationDevelopment	CLO.1 Student should be able to install and configure Android application development tools.				H	M							
		CLO.2 Student should be able to design and develop user interfaces for the Android platform.		M	H		H							
		CLO.3 Student should be able to save state information across important operating system events.			H	H								M
		CLO.4 Student should be able to apply Java programming skills and concepts to Android application development.		M	H		H							M
		CLO.5 Students should be able to design the structure of Android apps, understand layout files and the conversion to view objects.			H	H	M							M
CS149	InternetofThings	CLO.1 Students would know the architectural overview of the IoT applications.		M	H	M								
		CLO.2 Possess an ability and skill to design and develop hardware infrastructure of IoT application.		M	H		H							
		CLO.3 They would be able to apply communication protocols for IoT application development.		M	H		H							
		CLO.4 Possess an ability to push the data onto the cloud services.			H	M	H							

		CLO.5 They would be able to analyze the sensor data and take necessary action associated with it.			H	M	H							
CS150	Mobile Ad-hocand SensorNetworks	CLO.1 Skill based knowledge of routing mechanisms and the three classes of approaches: proactive, on-demand, and hybrid		H	H									
		CLO.2 To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.		H	H									
		CLO.3 Identify the issues and challenges in providing QoS		M	H									
		CLO.4 Explain about the energy management in ad-hoc networks			H	H								
		CLO.5 Demonstrate various types of mesh networks.					H					H		H
CS152	AdvancedComputerArchitecture	CLO.1 Students will know the classes of computers, and new trends and developments in computer architecture.	H	M	M									
		CLO.2 Students will understand pipelining, instruction set architectures, memory addressing.		M	M									
		CLO.3 Students will be able to understand multithreading by using ILP and supporting thread- level parallelism (TLP).		M	H	H								
		CLO.4 Students will build skills to understand the performance and efficiency in advanced multiple- issue processors.	H		H	M	H							
		CLO.5 Students will build skills to understand the performance of multi-core processors using SPEC benchmarks.		M	H	M								H

		CLO.6 Students will be able to understand storage systems, RAID, I/O performance, and reliability measures.	M		H		H							

CS161	Java Programming	CLO1: Implement the concept of object-oriented techniques and methodologies using Java.							H						
		CLO2: Use Exception Handling skill for a Robust Application in Java.					H								
		CLO3: Demonstrate an understanding of Java Input/Output and Multithreading.									M				
		CLO4: Use and Implement several Data structures using Collection Framework.				M									
		CLO5: Use database connectivity for a complete Java application.					M								
		CLO6: Use Html, JavaScript, CSS, Servlets, JSP and XML to develop web based applications.											H		
CS162	Full Stack Development	CLO1: Students will be able to gain skills to build full stack end applications using Javascript, Nodejs, Expressjs and MongoDB.						H							

		CLO2: Students will understand the concept of full stack development and APIs.			**H**									
		CLO3: Student will learn debugging issues and end-to-end testing.				H								
		CLO4: Deliver features in an agile development environment.	**M**										H	
		CLO5: Architect solutions to programming problems by combining visual components and classes, and develop a fully functioning website and deploy on a web server.									H			
CS160	Microprocessor and Assembly Language Programming	CLO1: Students will be provides with in-depth knowledge of basic components of microprocessor-based systems						H						
		CLO2: Students will be able to to implement microprocessor-based systems using 8085								M				
		CLO3: Students will gain skills to write programs using assembly language of 8085 microprocessor					M							

		CLO4: Identify and apply flag registers data to utilize the arithmetic and logic instructions			M	H									
		CLO5: Analyze programming problems and apply assembly instructions to solve the problems using logic, shift and rotate instructions			H										