Academic Programme Guide
of
Bachelor 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.
Academic Year: 2019-20

Approved by 23rd Academic Council vide agenda item No. 23.7 dated 03-07-2019

INDEX

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 four-year B.E Computer Science and Engineering 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 provide the solution for the complex engineering problems by using the concepts of Computer Science and Engineering.

PEO 2. To work independently and efficiently in multi-disciplinary teams by communicating effectively.

PEO 3. To acquire the additional knowledge and skills through enduring edification.

PEO 4. To contribute effectively towards sustainable solution for environment and society.

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. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. Function effectively as an individual, and as a member or leader in diverse teams, and multidisciplinary settings.
PO10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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 B.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. This programme also offers "Engineering Projects in Community Services" (EPICS) course to the students where they learn to serve the community by organising various activities for their benefit and deepen their knowledge and perspectives. 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 B.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 B.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 BE program is four years - divided into 8 semesters. University conducts end term examination at the end of each semester, except in the case of Industry Oriented Hands-on Experience (IOHE) or Internship at Industry, which is evaluated by a jury appointed by the University.

The maximum duration of completion of the degree is 6 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 Industry Oriented Hands-on Experience (IOHE): 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).

c) Courses for Global Exposure: To provide global exposure to students, the short duration courses are offered by professors from Universities across the globe. The students may choose or may be offered these courses to earn additional credits. These courses are decided for each batch as per the expertise of the teaching faculty and will be informed to the students before offering in a semester.

Model Programme Structure

Semester-1			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Calculus and Statistical Analysis	4-1-0	5
2	Engineering Graphics	1-0-4	3
3	Computer Programming – I	2-0-6	5
4	Engineering Exploration-I	0-0-4	2
		22	**15**

Semester-2			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Differential Equations and Transformations	4-1-0	5
2	Basics of Electronics Engineering	3-1-2	5
3	Computer Programming – II	2-0-6	5
4	Modern and Computational Physics	3-1-0	4
5	Introduction to Linux	0-0-4	2
6	Engineering Exploration	0-0-4	2
7	Human Values and Professional Ethics	1-0-0	1
		32	**24**

Semester-3			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Discrete Structures	4-0-0	4
2	Basics of Electrical Engineering	3-1-0	4
3	Object-Oriented Programming	2-0-6	5
4	Introduction to Web Technologies	2-0-4	4

		22	**17**

Semester-4			
S.No	**Course Title`**	**L-T-P**	**Credits**
1	Digital Electronics and Logic Design	3-0-4	5
2	Advanced Web Programming	2-0-4	4
3	Database Management System	3-0-4	5
4	Operating System	3-1-0	4
5	Engineering Exploration	0-0-4	2
6	Cyber Security	2-0-0	0
		30	**20**

Semester-5			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Modern and Computational Physics (Lab)	0-0-2	1
2	Data Structures	3-0-4	5
3	Numerical Ability and Logical Reasoning	4-0-0	4
4	Professional Elective – I & II	**	16#
5	Professional Elective – III & IV	**	
		29#	**26#**

Semester-6			
S.No	**Course Title**	**L-T-P**	**Credits**
1	Professional Elective – V	**	8#
2	Professional Elective – VI	**	
3	Computer System Architecture	3-1-0	4
4	Object Oriented Software Engineering	3-0-2	4
5	Computer Networks	3-0-4	5
		26#	**21#**

Semester-7			
S.No	**Title of the Course**	**L-T-P**	**Credits**
1	Open Elective – I	**	6#
2	Open Elective – II	**	
3	Lab Oriented Project	0-0-6	3
4	Professional Practices-Coding	0-0-6	3
OR			
1	Co-opt Training Module-I	-	12
		15#	**12***

Semester-8			
S.No	**Title of the Course**	**L-T-P**	**Credits**
1	Industry Oriented Hands-on Experience	- - -	12
OR			
1	Co-opt Training Module-II	- - -	12
		-	**12***

*** Students can either go for industry oriented hands-on experience OR for co-opt project at industry to earn these 12 credits.**

 # Credits and LTP can vary according to student's choice-based credit system
**** 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 weight-age 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' (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 evaluation 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:

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

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

$$SGPA = \frac{Total\ grade\ pts.}{Total\ no.of\ credits} = \frac{92}{11} = 8.36$$

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

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

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 Department and 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 Department to 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 B.E. degree in Computer Science and Engineering, a student must complete all the courses in which he/she has registered with minimum 150 credits and a minimum CGPA of 4.5.

12. Program Overview

- In addition to these courses, a student must take three 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)			**5**
CS501	Cyber Security	2-0-0	0
CL101/102/ 103/104	English / Spanish / German / French	0-0-4	2
HR101	Human Values and Professional Ethics	1-0-0	1
GE101	Numerical Ability and Logical Reasoning	4-0-0	4

Basic Science Courses (BSC)		**19**

AM121	Calculus and Statistical Analysis	4-1-0	5
AM122	Differential Equations and Transformations	4-1-0	5
AM103	Discrete Structures	4-0-0	4
PH121	Modern and Computational Physics	3-1-0	4
PH111	Modern and Computational Physics Lab	0-0-2	1

Engineering Science Courses (ESC)			**27**
EC101	Basics of Electronics Engineering	3-1-0	4
EC102	Basics of Electronics Engineering Lab	0-0-2	1
EC105	Digital Electronics and Logic Design	3-0-0	3
EC106	Digital Electronics and Logic Design Lab	0-0-4	2
ME102	Engineering Graphics	1-0-4	3
EE101	Basics of Electrical Engineering	3-1-0	4
CS104	Computer Programming-I	2-0-6	5
CS105	Computer Programming-II	2-0-6	5

Professional Core Courses (PC)			**46**
CS106	Object Oriented Programming	2-0-6	5
CS107	Object Oriented Software Engineering	3-0-2	4
CS110	Introduction to Linux	0-0-4	2
CS111	Introduction to Web Technologies	2-0-4	4
CS112	Advanced Web Programming	2-0-4	4
CS114	Data Structures	3-0-4	5
CS115	Operating Systems	3-1-0	4
CS116	Database Management System	3-0-4	5
CS117	Computer Networks	3-0-4	5
CS118	Computer System Architecture	3-1-0	4
CS119	Design & Analysis of Algorithm	3-0-2	4

Professional Electives (PE) * (Elective-I to VI)			
A. Specialization Tracks			
a) Full-Stack			
CS179	Programming Abstractions	2-0-4	4
CS126	Algorithm Design & Implementation	2-0-4	4
CS145	Front-end Development	2-0-4	4
CS159	Back-end Development	2-0-4	4
CS254H	Professional Practices - System Design	2-0-0	2
b) Data Science			
CS108	Python Basics	2-0-4	4
CS133	Data Visualization and Query Language	2-0-4	4
CS134	Business Analytics	2-0-4	4
CS254J	Professional Practices- Dashboard Designing	2-0-0	2
CS138	Machine Learning	2-0-4	4
c) Cyber Security			

CS129/CSQ 3105	Introduction to Cyber Security	2-0-4	4
CS130	Cyber Security for Forensics & Investigation	2-0-4	4
CS131/CSQ 3103	Malware and Reverse Engineering – I	2-0-4	4
CS132/CSQ 3104	Malware and Reverse Engineering – II	2-0-4	4
d) Game Development			
GPP101	Fundamentals of Game Programming	2-0-4	4
GPP103/GID5358	Graphics Programming	1-0-2	2
GPL104/ GD5360	Game Design – BG	1-0-2	2
GPL102/ GID5359	Game Design – 2D & 3D	2-0-4	4
GPP107	Unity Game Development	2-0-4	4
CS254I	Professional Practices- Unreal Basis	2-0-0	2
e) Digital Marketing			
CS141	Digital & Social Media Marketing Building Blocks and Content Development & Marketing	2-0-4	4
CS142	Search Engine Marketing (SEO & PPC), Web Analysis and Email Marketing & Management	2-0-4	4
CS143	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	2-0-4	4
CS144	Affiliate Marketing and Online Reputation Management (ORM)	2-0-4	4
f) Entrepreneurship Development Program			
EP101	Entrepreneurship and Opportunity	2-0-4	4
EP102	Consumer & Market Research for Entrepreneurs	2-0-4	4
CS142	Search Engine Marketing (SEO & PPC), Web Analysis and Email Marketing & Management	2-0-4	4
CS143	Social Media Marketing & Optimization and Digital Marketing Strategy & Lead Generation	2-0-4	4
g) UI/UX Design			
CS168	UX Design & Digitization	1-0-2	2
CS169	User Interface Design	1-0-2	2
CS170	Empathy & Its Tools	2-0-4	4
CS173	Visual Design and Photoshop Basics	2-0-4	4
CS189	Visual Design Advanced	2-0-4	4

Open Elective Courses (any three)			**6**
CS121	Software Quality Assurance and Testing	3-0-0	3
CS122	Business Intelligence and Data Warehousing	2-0-0	2
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	2-0-2	3
CS243	Artificial Intelligence and Machine Learning	2-0-2	3
CS4003	Network Security	3-0-0	3
CS151	Introduction to Cloud Computing	2-0-0	2

Special Courses(SC)*			
a) Project			
CS204	Lab Oriented Project	0-0-6	3
CS244	Professional Practices – Coding	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
b) Engineering Exploration			**6**
c) Value Addition Courses			
	Global Engineering Week Courses	-	2^{+}

Course type		**HSM**	**BSC**	**ESC**	**PC**	**PE**	**OE**	**SC**	**Total**
Credits	**Co-op**	5	19	27	46	$24^{\#}$	-	30*	**$151^{\#}$**
	Other	5	19	27	46	$24^{\#}$	6	24*	**$151^{\#}$**

***Students can also earn these credits by opting different courses.**
$^{+}$ Additional Credits
 # Credits can vary based on the Choice based credit system

Mandatory Courses:
A few courses as prescribed by the UGC are offered as mandatory courses.

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 Outline

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 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 Editon"
2. G.R.F. Snyder, T. Pardoe, "Network Security", Cengage Learning, Second Editon
3. Basta, W.Halton, "Computer Security: Concepts, Issues and Implementation, Cengage Learning India", Wiley& Sons Inc, Second Editon
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 Learning Publication.
7. C K Shyamala, N Harin i, Dr T R Padmanabhan, "Cryptography and Network Security:",Wiley India,First Editon
8. Forouzan Mukhopadhyay,"Cryptography and Network Security", MC Graw Hill, Second Edition.
9. Mark Stamp,"Information Security, Principles and Practice", Wiley India, First Editon

Course Code	Course Name	L-T-P	Credits
CL101	English-I	0-0-4	2

Course Learning Outcomes:

Students will be able to:

CLO.1 Apply grammatical structures in presenting contextual ideas clearly to aid communication.

CLO.2 Elucidate vocabulary progressively and effectively use as per the social condition.

CLO.3 Exhibit the language functionally in real-life situations and social settings, evolving skills to make them competent to deal with industries scenarios.

CLO.4 Determine and demonstrate the usage of the language effectively in both academic and professional setups.

CLO.5 Apply knowledge to new situations to solve problems using required knowledge or skills.

Course Outline:

English in your country, job hunting, world of sport, discussing experiences, planning a trip, wedding bells, telephoning, catching up, around town, Dos and Don'ts, customer care, people are different, facts and figures, the workplace, Medicare. Brief History of Words – Using the Dictionary and Thesaurus– Changing Words from One Form to Another – Confusables, Direct and Indirect Speech- Predicting the Content- Understanding the Gist – - Understanding Discourse Coherence – Sequencing Sentences.

Recommended Book(s):

1. Cunningham, S. & Moor, P. (2003). Cutting Edge Advanced New Edition Students (Vol. 1st). Pearson Longman.
2. Lawrence J. Zwier. (2017). English for everyday Activities (Issue January). New Readers Pr.
3. Richard, J. C. (2005). Person to Person—Communicative Speaking and Listening Skills. Oxford University Press.
4. Shapira, N., & Adelson-Goldstein, J. (1999). The Oxford Picture Dictionary: English-Edition. Oxford University Press.

Course Code	Course Name	L-T-P	Credits
HR101	Human Values and Professional Ethics	1-0-0	1

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 Editon
2. R.R. Gaur, R. Sangal, G.P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", Excel Books, First ediion.
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 Chand publishing , Fourth edition

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 solving skills, 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. Abhijit Guha. (2018). 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. (2018). Quantitative Aptitude & Verbal – Nonverbal Reasoning. Arihant Publication.
4. Subject, E. (2018). ESE/GATE/PSUs Numerical Ability, Logical Reasoning & Analytical Ability. ACE Engineering Publications.

Course Code	Course Name	L-T-P	Credits
AM121	Calculus and Statistical Analysis	4-1-0	5

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. Statistical Inference: Estimation, Interval estimation, Testing of Hypothesis

Recommended Book(s):

1. Erwin Kreyszig,"Advanced Engineering Mathematics", Wiley India Pvt. Ltd, Second Editon
2. Srimanta Pal & Subodh C. Bhunia,"Engineering Mathematics", Oxford University Press, First Editon
3. The Engineering Mathematics, Chitkara University Publication, Vol. I. Second Edition,

4. B.V. Ramana, "Higher Engineering Mathematics, Tata McGraw-Hill Education, Third Editon
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 text book 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 Use 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:

CLO.1 Apply the knowledge obtained to investigate and solve a variety of live problems related to Sets, Relations and Functions.
CLO.2 Solve real life problems using combinatorics.
CLO.3 Understand and apply the theory and techniques of Lattice, Logic and Boolean algebra
CLO.4 Comprehend Graph Theory and its relevance within the context of computer science and finding solutions of live problems related to shortest path etc.
CLO.5 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. Sequences and Summations, Mathematical reasoning and induction: Proof strategies, Mathematical Induction, Recursive definitions, Structural Induction, Counting: basic rules, Pigeonhole principle, Permutations and Combinations, Binomial coefficients and Pascal triangle.

Recommended Book(s):

1. C.L. Liu,"Elements of Discrete Mathematics", McGraw-Hill,Third Editon.
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	3-1-0	4

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 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 Differentiate between characteristics and properties of various magnetic and superconducting materials and establish their applications in engineering disciplines.

CLO.4 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 Editon
4. Practical physics by Squirres , Cambridge University press.

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, Engg.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, Engg.Physics Practicals, Laxmi Publications Pvt Ltd, Second edition

Course Code	Course Name	L-T-P	Credits
EC101	Basics of Electronics Engineering	3-1-0	4

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 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 Editon.

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 Understand 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 Understand 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 Understand the concept of memories and Programmable Logic Devices and their classification.

CLO.6 Understand the concept of memories and Programmable Logic Devices and their classification.

Course Outline:

Binary Arithmetic Addition, subtraction, multiplication, Representation of sign (sign magnitude, two's complement); Floating point representation - Boolean Algebra, Boolean algebraic axioms, Boolean functions, truth tables, canonical forms, Standard forms vs. non-standard forms, Logic networks, 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 EDITON
3. M. Morris Mano, Digital Design, Prentice Hall of India Pvt. Ltd., New Delhi, Sixth impression /Pearson Education (Singapore) Pvt. Ltd., New Delhi, Fourth Editon
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	0-0-4	2

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 Gain skill of practical implementation of design methodologies skills for implementing combinational and sequential circuits.
CLO.5 Implement 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. Design, and verify the 4-bit synchronous counter. Design, and verify the 4-bit asynchronous counter.

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 Editon.
4. M. Morris Mano, "Digital Design", Prentice Hall of India Pvt. Ltd., New, Fourth Editon.
5. Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", Tata McGraw Hill Publishing Company Limited, New Delhi, 2003, Fifth Editon

Course Code	Course Name	L-T-P	Credits
ME102	Engineering Graphics	1-0-4	3

Course Learning Outcomes:

Students will be able to:

CLO.1 Improve the technical writing skills.
CLO.2 Improve the basic sketching and drawing.
CLO.3 Use engineering scale effectively
CLO.4 Use dimensioning effectively.
CLO.5 Use development of surfaces.
CLO.6 Communicate through Engineering Graphics.

Course Outlines:

Introduction of Engineering Drawing & drawing instruments, Drawing techniques, lettering, dimensions, projection of points & lines, projection of solids, development of surfaces of cylinders, cones, pyramids & prisms, orthographic projection, isometric projection, views.

Recommended Book(s):

1. Wolff, David. (2018). OpenGL 4 Shading Language Cookbook: Build high-quality, real-time 3D graphics with OpenGL 4.6, GLSL 4.6 & C++17. (3rd ed). Ingram
2. Eric, Lengyel.(2014). Foundations of Game Engine Development. (Vol 1). Mathematics. Packt Press.
3. Kessenich, John & Sellers, Graham. (2016). OpenGL Programming Guide: The Official Guide to Learning OpenGL. (9th ed). Ingram.
4. Thorn, Alan & Doran, John. (2018). 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
EE101	Basics of Electrical Engineering	3-1-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand and analyse the concepts of DC circuits

CLO.2 Understand AC circuits and their power measurements

CLO.3 Understand fundamental principles of magnetic effects, magnetism and their application in electrical machines.

CLO.4 Understand the basic knowledge of transducers and measuring instruments

CLO.5 Gain skills to conduct experiments, understand the principle, construction and working of electrical devices

Course Outlines:

DC Circuits and related terminology, Series and Parallel combination of resistances, Kirchhoff's Laws: KVL and KCL, Mesh or loop Analysis and Nodal Analysis, Magnetic Circuits, Comparison between Electric and Magnetic circuits, Magnetic Effect of Electric Current, Law of EMI, Induced EMF, AC circuits, Concept of 3phase EMF generation, Analysis of AC circuits, RL, RC, RLC series circuits and its Power calculations, Resonance in series AC circuits, Three Phase AC circuits, Star and Delta connections, Electrical Machines, Transformer, DC Motor, Three Phase Induction Motors, Electrical measuring instruments and transducers, LVDT, RTD, Thermocouple, Thermistor, Piezoelectric transducer, Photoelectric transducer. Sinusoidal voltage and currents, their mathematical and graphical representation, concept of cycle period, frequency, instantaneous, peak, average, r.m.s. values, peak factor , and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors.

Recommended Book(s):

1. Muthusubramanian, R. (2009). Basic Electrical and Electronics Engineering. McGraw Hill Education.
2. Patil, B.R. (2016). Basic Electrical and Electronics Engineering. (2nd ed). Oxford Higher Education.
3. Nagsarkar, T.K. & Sukhija, M.S. (2017). Basic Electrical Engineering Oxford. (2nd ed). Pearson.
4. Kulshreshtha, D.C. (2015). Basic Electrical Engineering. TMH. First edition.

Course Code	Course Name	L-T-P	Credits
CS104	Computer Programming – I	2-0-6	5

Course Learning Outcomes:
Students will be able to:

CLO.1 Analyse the problem statement.
CLO.2 Choose the appropriate C programming constructs to solve the problems.
CLO.3 Demonstrate the advantages and disadvantages of specific techniques to be used.
CLO.4 Differentiate between efficient and inefficient way of programming skills.
CLO.5 Determine and demonstrate bugs in a program and recognize needed basic operations.
CLO.6 Formulate new solutions for programming problems or improve existing code to program effectively.

Course Outlines:

Introduction to problem solving techniques, flowchart, algorithm, introduction to C, Structure of a C program, compilation, linking, execution, comments in C, pre-processor directives, data types, variables, identifiers, constants, operators, control structures, loops, functions & pointers, call by value, call by reference, storage classes, arrays, dynamic memory allocation, 2-D arrays, arrays & pointers, strings, structure & union.

Recommended Book(s):

1. Thareja, Reema (2016). Programming in C (2nd ed). Oxford University Press.
2. Kernighan, Brain W. & Ritchie, Dennis (2014). The C Programming Language. (2nd ed). Pearson.
3. Schildt, Herbert (2015).The Complete Reference (4th ed), McGraw Hill Education.
4. Kamthane, (2014). Programming in C (3rd ed), Pearson.

Course Code	Course Name	L-T-P	Credits
CS105	Computer Programming – II	2-0-6	5

Course Learning Outcomes:

Students will be able to:

CLO.1 Formulate problem solutions by incorporating advanced C programming skills.
CLO.2 Choose the appropriate searching and sorting technique.
CLO.3 Demonstrate the advantages and disadvantages of specific techniques to be used.
CLO.4 Develop programs using basic data structures like stack and queue.
CLO.5 Formulate new solutions for programming problems or improve existing code to program effectively.

Course Outlines:

Complexity of programs, functions & pointers, recursion, C memory model, dynamic memory allocation, sorting & searching, bubble sort, merge sort, quick sort, linear search, binary search, 2-D arrays, strings, bit manipulation, C & OS interface, C preprocessor, structure & union, compilation process, file handling, inline function, function pointers, variable number of parameters in function, stacks, queues.

Recommended Book(s):

1. Kernighan, Brain W. & Ritchie, Dennis (2015). The C Programming Language (2nd ed), Pearson.
2. Kamthane, (2015). Programming. (3rd ed) Pearson.
3. Herbert, Schildt, C. (2012). The Complete Reference. (4th ed.). McGraw-Hill.
4. Gottfried, Byron (2018). Programming with C. (2nd ed). McGraw-Hill.

Course Code	Course Name	L-T-P	Credits
CS106	Object Oriented Programming	2-0-6	5

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 concepts and skills for a Robust Application in Java.
CLO.3 Demonstrate an understanding of Java Input and Output
CLO.4 Develop applications using multithreading concept of Java.
CLO.5 Use and Implement several Data structures using Collection Framework
CLO.6 Use database connectivity for a complete Java application.

Course Outline:

Introduction to object-oriented programming, benefits and applications of OOP, class and objects, methods, constructors, inheritance, polymorphism, abstract class and methods, encapsulation, static and dynamic binding, Java basics, control statements, looping constructs & arrays, working with arrays, strings, packages & interfaces, strings & StringBuilder, exception handling, IO streams, multithreading, synchronization, generics, generic interface, collection framework, stack, queue, linked list, sets, JDBC connectivity.

Recommended Book(s):

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

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, project organization & 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 Editon
2. Ian Sommerville," Software Engineering", Adison- Wesley Pub. Co, Sixth Editon
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
CS110	Introduction to Linux	0-0-4	2

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
CS111	Introduction to Web Technologies	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify the basis of designing a Web site; create Web pages, links, images, tables and pages layouts in HTML.
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.
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 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 Editon
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
CS112	Advanced Web Programming	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Use JavaScript advance skills like functions, objects and DOM to manipulate elements or to change appearance and visibility of HTML elements on web pages.

CLO.2 Implement form validation using regular expressions.

CLO.3 Make dynamic changes to a web page, validating and respond to user or browser events using JQuery.

CLO.4 Use and Implement AJAX to fetch data from the server in JQuery and React.

CLO.5 Set up a ReactJS development environment, creating components using JSX, work with forms and events and understand what props and state are in ReactJs.

Course Outline:

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

Recommended Book(s):

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

Course Code	Course Name	L-T-P	Credits
CS114	Data Structures	3-0-4	5

Course Learning Outcomes:

Students will be able to:

CLO.1 Analyse algorithms and algorithm correctness.
CLO.2 Analyse time complexities of algorithms using asymptotic analysis.
CLO.3 Summarize searching and sorting techniques.
CLO.4 Describe stack, queue and linked list operation. And can compare between different data structures. Pick an appropriate data structure for a design situation.
CLO.5 Gain skills to explain the major graph and tree algorithms and their analyses.
CLO.6 Employ graphs to model engineering problems, when appropriate.

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,AnitaHuray, "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 Editon.

Course Code	Course Name	L-T-P	Credits
CS115	Operating System	3-1-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Identify different types of Operating System and their components.
CLO.2 Design and implementation of new system calls for any open source operating system.
CLO.3 Implement existing resource management algorithms in Linux operating system.
CLO.4 Identify various system security and protection issues.
CLO.5 Completely administer the system using various Operating systems (Windows and Ubuntu) skills for managing its resources.

Course Outline:

Introduction to operating system, computer system architecture, single processor and multiprocessor systems, OS structure, components of OS, process management, I/O management, storage management, protection and security, OS services, process and threads, CPU scheduling, process synchronization, semaphores, deadlock, memory management, paging and segmentation, virtual memory, file system, case studies. I/O burst cycle, Context

Switching, Scheduling, Short Term, Long Term, Scheduling Criteria, Algorithms, First Come First Serve, Shortest Job First, Priority Scheduling, Round Robin

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 Editon

Course Code	Course Name	L-T-P	Credits
CS116	Database Management System	3-0-4	5

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. Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, examples, Specialization and Generalization. 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. Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra.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
CS117	Computer Networks	3-0-4	5

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
CLO.7 Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security.
CLO.8 Effectively communicate technical information verbally, in writing, and in presentations.

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, Eigth Edition
4. Todd Lammle,"CCNA Cisco Certified Network Associate Study Guide", Wiley, Second Edition

Course Code	Course Name	L-T-P	Credits
CS118	Computer System Architecture	3-1-0	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Understand Basic structure of computer
CLO.2 Perform Computer's Arithmetic Operations
CLO.3 Understand control unit operations
CLO.4 Learn the design skills of memory organization that uses different word size operations
CLO.5 Understand concept of cache memory technique.
CLO.6 Conceptualize instruction level parallelism.

Course Outline:

Evolution of computers, Von Neumann machine, Flynn's classification, basic computer organization, instruction codes, introduction to 8085 microprocessor, add, subtract, multiply algorithms, micro programmed control, central processing unit, input-output organization, DMA, IO interface, IOP, memory organization, virtual memory.

Recommended Book(s):

1. M. Morris Mano, 'Computer System Architecture', Pearson Education, Third Editon
2. John P Hayes, "Computer Architecture and Organization", Prentice Hall,Third Editon
3. David A Patterson, "Computer Architecture A Quantitative Approach", Pearson Education,Fifth Editon
4. J.P. Hayes, "Computer System Architecture", Pearson Education Asia, Third Edition

Course Code	Course Name	L-T-P	Credits
CS119	Design & Analysis of Algorithm	3-0-2	4

Course Learning Outcomes:

CLO.1 Analyze algorithms and algorithm correctness.
CLO.2 Analyze time complexities of algorithms using asymptotic analysis.
CLO.3 Summarize searching and sorting techniques.
CLO.4 Describe stack, queue and linked list operation. Compare different data structures and pick an appropriate data structure for a design situation.
CLO.5 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
CS179	Programming Abstractions	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Write high quality code.
CLO.2 Understand the concept of scalability, security and extensible code for software applications.
CLO.3 Learn debugging issues and end to end testing.
CLO.4 Learn skills to deliver features in an agile development environment.
CLO.5 Solve problems iteratively and recursively and design both structured and object-oriented program.

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 handeling, templates and generic programming, containers, iterators, vectors, lists, maps, project.

Recommended Book(s):

1. E Balagurusamy,"Object Oriented Programming with C++", Tata McGraw-Hill, second Editon
2. Robert Lafore,"Object Oriented Programming in Turbo C++", The WAITE Group Press, Fourth Editon
3. Herbert Schlitz, ," Compete Reference C++", TMH, Fourth Editon
4. Yashavant Kanetkar and Aditya Kanetkar,"Let Us C", BPB, Publicatio, Second Edition

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 Have good idea of 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 Editon.

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

Course 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 Learning skills to 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 Understand 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 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 Editon.
2. Zed A.Shaw, Learn python the hard way, Pearson publications, Third Edition
3. Dierbach, Charles, "Python, A Computational Problem-Solving Focus", Wiley,Third Editon
4. Ljubomir,"Introduction to programming using python: An application development focus. Percovic", Wiley, Third Editon

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 Analyze 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

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 Use basic functions and packages in Python.
CLO.3 Understand statistical concepts, skills and different hypothesis tests.
CLO.4 Learn how to prepare data using Python.
CLO.5 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.

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 Able to 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 Editon
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 Editon.
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/CS Q3105	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 skills.
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 skills.

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 Editon
2. J Brooks," Cybersecurity Essentials", Wiley, Second Editon

3. Hacking: A Beginners' Guide to Computer Hacking, Basic Security, And Penetration Testing, John Slavio
4. Kevin 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 wrong-doing.
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 Editon
2. Cyber Forensics in India: A Legal Perspective by Nishesh Sharma, Universal Law Publishing, First Editon
3. Marjie T Britz, "Cyber Forensics and Cyber Crime An Introduction" Pearson, Second Editon
4. Cengage, "Hands on Ethical Hacking and Network Defence", pearson, Second Editon

Course Code	Course Name	L-T-P	Credits
CS131/CSQ 3103	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 analysis skills.
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/CSQ 3104	Malware and Reverse Engineering – II	2-0-4	4

Course Learning Outcomes:

Students will be able to:

CLO.1 Apply malware analysis methodology and technology skills.
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/GID5358	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/GD 5360	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 Editon
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 /GID5359	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", Papeback,CRC 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 Develop 2D & 3D games using the learned skills.
CLO.2 Develop 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, post production, 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 Understand 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 Gain 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 Editon
2. Venakataramana Rolla, "Digital Marketing Practice Guide for SMBs: SEO,SEM and SMM Practice Guide",Wiley, Second Editon
3. Damian Ryan," Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation", Kogan page, Fourth Editon

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 Editon.

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 Gain the 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 Identify 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 Editon.
2. Adam Clarke,”Search engine optimization 2016: Learn SEO with smart internet marketing strategies”, Pearson, Second Editon
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 Editon
4. Mike Moran and Bill Hunt, “Search Traffic to Your Company's Website”, (IBM Press), Third Editon

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 Understand 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 Gain 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 Editon
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 Understand 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 Gain 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 will be able 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 Digitization	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 centred 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, pronciples 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 colour, 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 behaviour and build better relationship skills.
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
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 Make sure that the result meets the business and user requirements Software testing plays an instrumental role.
CLO.5 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 Univesity 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 editon
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 editon
2. Oliver Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Wiley Edition, Third Editon
3. Jacob Millman, Christos Halkias and Chethan D. Parikh, Integrated Electronics: Analog and Digital Circuits and Systems",Tata McGraw-Hill Education, Second Editon India, 2010.
4. Morris Mano and Michael D. Cilette, "Digital Design" Pearson, Fifth Editon.

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 Gain 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 Editon.
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 Editon.
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. Forouzan, "Data Communications and Networking", McGraw-Hill Fifth 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
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 Gain skill to understand and compare various image enhancement techniques
CLO.4 Gain skill to understand and implement basic image segmentation techniques
CLO.5 Gain 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 Editon
2. W.K. Pratt, "Digital Image Processing , "McGraw Hill, Second Editon
3. R.C. Gonzalez and R. E. Woods, "Digital Image Processing",:Addison Wesley/ Pearson Education, Second Editon
4. Gonzalez, "Digital Image Processing", Pearson International Edition, Third Editon

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 colour 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, colour 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 Editon
2. Schaum's outline," Computer Graphics", McGraw-Hill India, First Editon
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 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," Head first 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
CS162	Full Stack Development	0-0-6	3

Course 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, inherritance, polymorphism, exception handling, IO streams, collections, generics, multi-threading, JSP, JSTL, servlets, HTML5, CSS3, responsive, spring, beans, JDBC, hibernate, session mapping, XML, Java blue rpint 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
CS245	Big Data Analytics	2-0-2	3

Course Outcomes:

Students will be able to:

CLO.1 Speculate various models and algorithms in Big Data Analytics.
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 Use clustering techniques for maintaining database integrity.
CLO.5 Model an application's data requirements using conceptual model tools skills like BI tools and strategies

Course Outline:

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop

Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

Recommended Book(s):

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007. •
2. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013) •
3. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.
4. Anand Rajaraman and Jef rey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.
5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.

Course Code	Course Name	L-T-P	Credits
CS243	Artificial Intelligence and Machine Learning	2-0-2	3

Course Outcomes:

Students will be able to:

CLO.1 To give understanding of the main abstractions and reasoning for intelligent systems.
CLO.2 To enable the students to understand the basic principles of Artificial Intelligence in various applications..
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 Able to explore new techniques and ideas that can be used to improve the effectiveness of current AI tools.

Course Outline:

Overview of AI problems, AI problems as NP, NP-Complete and NP Hard problems. Strong and weak, neat and scruffy, symbolic and sub-symbolic, knowledge-based and data-driven AI. Search Strategies: Problem spaces (states, goals and operators), problem solving by search, Heuristics and informed search, Minmax Search, Alpha-beta pruning. Constraint satisfaction (backtracking and local search methods). Knowledge representation and reasoning: propositional and predicate logic, Resolution and theorem proving, Temporal and spatial reasoning. 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. Artificial Intelligence by Elaine Rich, Kevin Knight and Shivashankar B Nair, Tata McGraw Hill.
2. Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, Pearson Education.

3. Artificial Intelligence: A Modern Approach by S. Russell and P. Norvig, Prentice Hall.
4. Tom M Mitchell, "Machine Learning" Tata MacGraw Hills, Second Editon
5. Garrett Grolemund and Hadley Wickham, "R for Data Science", Shroff/O'Reilly; First Edition
6. Oliver Theobald," Machine Learning For Absolute Beginners: A Plain English Introduction", pearson publication, Second Editon.
7. Jiawei Han and Micheline Kamber, T," Data Mining: Concepts and Techniques'", Morgan Kaufman Publishers. Third Edition

Course Code	Course Name	L-T-P	Credits
CS4003	Network Security	3-0-0	3

Course Outcomes:

Students will be able to:

CLO.1 Explain about the OSI Security architecture and various Crytographic techniques.
CLO.2 Describe about the data encryption standard, block ciphers and block ciphers mode of operation.
CLO.3 Describe the principles of various public key cryptosystems
CLO.4 Explain the need for authentication and various authentication system methods.
CLO.5 Illustrate the different types of threats and attacks in data networks and explain about Internet and Mobile security

Course Outline:

Services, Mechanisms and Attacks-The OSI Security Architecture – Network Security Model – Classical Encryption Techniques, Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography. Block Ciphers- Simplified Data Encryption Standard -Data Encryption Standard– Block cipher principlesblock cipher modes of operation – Triple DES-Simplified Advanced Encryption Standard Advanced Encryption Standard (AES).

Recommended Book(s):

1. Behrouz A Ferouzan, Cryptography & Network Security, Tata McGraw Hill-2007
2. Man Young Rhee, Internet Security: Cryptographic Principles", "Algorithms and Protocols, Wiley Publications-2003
3. Charles Pfleeger, Security in Computing, Prentice Hall of India -2006
4. Ulysess Black, Internet Security Protocols, Pearson Education Asia -2000

Course Code	Course Name	L-T-P	Credits
CS151	Introduction to cloud computing	2-0-0	2

Course Outcomes:

Students will be able to:

CLO 1. Analyze the Cloud computing setup with its vulnerabilities and applications using different architectures

CLO2 Understand the concepts, characteristics, delivery models and benefits of cloud computing.

CLO3 Identify legal and societal issues involved in addressing the security issues of cloud computing.

CLO4 Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application.

CLO5 Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.

Course Outline:

Cloud Infrastructure:At Amazon, The Google Perspective, Microsoft Windows Azure, Open Source Software Platforms, Cloud storage diversity, Inter cloud, energy use and ecological impact, responsibility sharing, user experience, Software licensing.Cloud Computing :Applications and Paradigms: Challenges for cloud, existing cloud applications and new opportunities, architectural styles, workflows, The Zookeeper, HPC on cloud.

Recommended Book(s):

1. Hausman, K. K., Cook, S. L., & Sampaio, T. (2013). Cloud Essentials: CompTIA Authorized Courseware for Exam CLO-001. John Wiley & Sons.
2. Hurwitz, J. S., & Kirsch, D. Cloud computing for dummies. John Wiley & Sons.
3. Thomas, E., Zaigham, M., & Ricardo, P. (2013). Cloud Computing Concepts, Technology & Architecture.
4. Srinivasan, A. (2014). Cloud Computing: A practical approach for learning and implementation. Pearson Education India.

Course Code	Course Name	L-T-P	Credits
CS244	Professional Practices- Coding	0-0-6	3
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

Course Learning Outcomes:

Students will be able to:

CLO.1 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 Implement learning in real life problem for skill development
CLO.5 Propose multiple solution to any given problem and find best out of those.

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

Course Code	Course Name	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CS501	Cyber Security	CLO.1 Acquire Information and risk models including confidentiality, integrity and availability					M				M	H		
		CLO.2 Skill to analyze on Threats and attacks and exploit vulnerabilities	H	H	M		M				H		H	
		CLO.3 Gain knowledge on Cyber security architecture and operations		M	H	H	H				H		H	M
		CLO.4 Understand how Cyber security is conceptualized and carried out	H	H	M		M				H		H	
		CLO.5 Articulate informed opinion about issues related to cyber security		M	H	H	H				H		H	M
HR101	Human Values & Professional Ethics	CLO.1 Get awareness on human values and professional ethics					M				M	H		
		CLO.2 Understand the core values that shape their ethical behaviour.	H	H	M		M				H		H	
		CLO.3 Enhance skills active part in social, political, economic and cultural activities with responsibility.		M	H	H	H				H		H	M
		CLO.4 Gain thorough knowledge in the field of human rights and this will add to	H	H	M		M				H		H	

		the academic qualification												
		CLO.5 Strengthen the ability to contribute to the resolution of human rights issues and problems.		M	H	H	H				H		H	M
GE101	Numerical Ability and Logical Reasoning	CLO.1 Improve answers during the Aptitude test and develop an all-around personality with a mature outlook.	H	M		M								
		CLO.2 Enhance their logical thinking, verbal reasoning and numerical reasoning.	H	H									M	
		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.	H	H							H	M		H
		CLO.4 Enhance the problem solving skills, to improve the basic mathematical skills and to help students who are preparing for any type of competitive examinations.								H			M	
		CLO.5 Enhance the Aptitude Round Clearing ability in interview process										M	H	
AM121	Calculus and	CLO.1 Introduce and form matrices	H	H		H								

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

		CLO.5 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	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).	H	H										H	
		CLO.2 Use ordinary differential equations student will be able to solve various practical problems in Science and Engineering.	H	H		M									
		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.	H	H											
		CLO.4 Analyse functions of complex variables, techniques of complex integrals and compute integrals over	H	H		H									

		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.		H		H									
AM103	Discrete Structures	CLO.1 Students will be able to apply the knowledge obtained to investigate and solve a variety of live problems related to Sets, Relations and Functions.	H	H											
		CLO.2 Students will be able to solve real life problems using combinatorics.	H	H											
		CLO.3 Students will be able to understand and apply the theory and techniques of Lattice, Logic and Boolean algebra		H	M										
		CLO.4 Students will be able to comprehend Graph Theory and its relevance within the	H	M	H										

		context of computer science and finding solutions of live problems related to shortest path etc.													
		CLO.5 Students will be able to able to develop skill to model and analyse computational processes using combinatorial methods, graph theory and algorithms	H		H										
PH121	Modern and Computational Physics	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.	H	H					H						
		CLO.2 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										
		CLO.3 Differentiate between characteristics and properties of various magnetic and superconducting materials	H		M										

		and establish their applications in engineering disciplines.												
		CLO.4 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										
		CLO.5 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				M								

		and analyze scientific measurement and error analysis.												
		CLO.6 Apply the fundamental concepts of physics to related engineering problems.			M									
EC101	Basics of Electronics Engineering	CLO.1 Understand the basic concepts of semiconductor devices for use in electronic circuits.		M	H									
		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.		H	M									
		CLO.3 Acquire the knowledge of digital logic gates for implementing basic digital circuits.	H		H									
		CLO.4 Recognize the primary functions of integrated circuits such as timer and voltage regulator.		H			M							
		CLO.5 Familiarize with generic IoT device and applications using case studies.		M			H						H	
EC102	Basics of Electronics Engineering Lab	CLO.1 Know the basics of electronics elements, their functionality and applications.		M	H									

		CLO.2 Possess skills to analyze and characterize the electronic circuits and have basic understanding for their implementation.			H									
		CLO.3 Analyze and characterize the electronic circuits and have basic understanding for their implementation.	H		M									
		CLO.4 Possess an ability to perceive the concept of logic gates and integrated circuits in electronics.					M						H	
		CLO.5 Gain practical knowledge of primary functions of integrated circuits such as timer and voltage regulator.						M					H	
EC105	Digital Electronics and Logic Design	CLO.1 Understand the underlying differences between analog and digital systems, and interconversion between the two.	H		M									
		CLO.2 Understand and apply mathematical skills to solve digital design problems involving Boolean logic.	M	M	H									
		CLO.3 Understand the underlying differences between combinational and sequential circuits.		M										
		CLO.4 Understand and apply the design methodologies skills	H		M									

		for implementing combinational and sequential circuits.												
		CLO.5 Understand the concept of memories and Programmable Logic Devices and their classification.			M								M	
		CLO.6 Understand the concept of memories and Programmable Logic Devices and their classification.		M									M	
EC106	Digital Electronics and Logic Design Lab	CLO.1 Understand the digital logic and create various systems by using these logics	H											
		CLO.2 Develop an understanding of design and simulation of digital logic circuits		H	M									
		CLO.3 Get a basic understanding of layout of electronic circuits			H								M	
		CLO.4 Gain skill of practical implementation of design methodologies skills for implementing combinational and sequential circuits.		M	H									
		CLO.5 Implement the concept of memories and Programmable Logic Devices and their classification.			H								M	
ME102	Engineering Graphics	CLO.1 Improve the technical writing skills.		H	H									
		CLO.2 Improve the basic sketching and drawing.			H	H							H	H

		CLO.3 Use engineering scale effectively			H	M					H			H
		CLO.4 Use dimensioning effectively.		H	H						M		H	
		CLO.5 Use development of surfaces.			H	H								H
		CLO.6 Communicate through Engineering Graphics.		H	H		H						H	
EE101	Basics of Electrical Engineering	CLO.1 Understand and analyse the concepts of DC circuits	H	H										
		CLO.2 Understand AC circuits and their power measurements		H	H									
		CLO.3 Understand fundamental principles of magnetic effects, magnetism and their application in electrical machines.		H	M					H				
		CLO.4 Understand the basic knowledge of transducers and measuring instruments	H	H						M				
		CLO.5 Gain skills to conduct experiments, understand the principle, construction and working of electrical devices		H	H									
CS104	Computer Programming-I	CLO.1 Analyse the problem statement.	H											
		CLO.2 Choose the appropriate C programming constructs to solve the problems.	H	H										
		CLO.3 Demonstrate the advantages and disadvantages of specific techniques to be used.	H	M					H					
		CLO.4 Differentiate between efficient and inefficient way	H						M					

		of programming skills.												
		CLO.5 Determine and demonstrate bugs in a program and recognize needed basic operations.					M							
		CLO.6 Formulate new solutions for programming problems or improve existing code to program effectively.	H	H										
CS105	Computer Programming-II	CLO.1 Formulate problem solutions by incorporating advanced C programming skills.		H										
		CLO.2 Choose the appropriate searching and sorting technique.		H	H									
		CLO.3 Demonstrate the advantages and disadvantages of specific techniques to be used.		H	M					H				
		CLO.4 Develop programs using basic data structures like stack and queue.		H						M				
		CLO.5 Formulate new solutions for programming problems or improve existing code to program effectively.		H	H									
CS106	Object Oriented Programming	CLO.1 Implement the concept of object-oriented techniques and methodologies using Java			H		H							
		CLO.2 Use Exception Handling concepts and skills for a Robust Application in Java.				H	H							
		CLO.3 Demonstrate an understanding of Java Input		H		H								

		and Output												
		CLO.4 Develop applications using multithreading concept of Java.		H	H		H						H	
		CLO.5 Use and Implement several Data structures using Collection Framework			H		H						H	M
		CLO.6 Use database connectivity for a complete Java application.		H	H		H						H	
CS107	Object Oriented Software Engineering	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.			H		H							
		CLO.2 Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.				H	H							
		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.		H		H								
		CLO.4 Apply new software models,		H	H		H						H	

		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			H		H						H	M
CS110	Introduction to Linux	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	H									
		CLO.2 Effectively use the UNIX/Linux system to accomplish typical personal, office, technical, and software development tasks.		H	H									H
		CLO.3 Monitor system performance and network activities.		H	H		H						H	
		CLO.4 Effectively use software development tools including libraries, preprocessors, compilers, linkers, and make files.		H									H	

		CLO.5 Comprehend technical skills to prepare simple readable user documentation and adhere to style guidelines.				M	H							
CS111	Introduction to Web Technologies	CLO.1 Identify the basis of designing a Web site; create Web pages, links, images, tables and pages layouts in HTML.	H	H									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		H						H		
		CLO.3 Use JavaScript to manipulate elements in the DOM to change appearance and visibility.	H									H		
		CLO.4 Describe how intended website design features will specifically benefit a target user group content strategy.			M	H								
		CLO.5 Demonstrate and develop web-portals independently or in teams.						M						

CS112	Advanced Web Programming	CLO.1 Use JavaScript advance skills like functions, objects and DOM to manipulate elements or to change appearance and visibility of HTML elements on web pages.	M											
		CLO.2 Implement form validation using regular expressions.	H	H									H	
		CLO.3 Make dynamic changes to a web page, validating and respond to user or browser events using JQuery.	H	H		H						H		
		CLO.4 Use and Implement AJAX to fetch data from the server in JQuery and React.	H									H		
		CLO.5 Set up a ReactJS development environment, creating components using JSX, work with forms and events and understand what props and state are in ReactJs.									M			
CS114	Data Structures	CLO.1 Students will be able to analyse algorithms and algorithm correctness.		H	H		M							
		CLO.2 Students will be able to analyse time complexities of algorithms using asymptotic		H	H	M								

		analysis.												
		CLO.3 Students will be able to summarize searching and sorting techniques.			H									M
		CLO.4 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			
		CLO.5 Students will be able gain skills to explain the major graph and tree algorithms and their analyses.												
		CLO.6 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		H	H								H	

		Operating systems (Windows and Ubuntu) skills for managing its resources.												
CS116	Database Management System	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.					H							
		CLO.2 Describe relational algebra expression and tuple relation expression from queries.						M					H	
		CLO.3 Implement the concept of normalization and functional dependency while designing the databases.			M									
		CLO.4 Apply the concept of transaction, concurrency control, security and recovery in database.			M									
		CLO.5 Implement procedures, functions, cursors and triggers and become proficient in PL/SQL programming skills.					M			H				
		CLO.6 Explain and evaluate the fundamental theories and requirements that influence the design of distributed database systems.								H				

CS117	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 performance and implementing new technologies.	M	H	M		M						M	
		CLO6: Imparting skills to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure					M			H				
		CLO7: Identify infrastructure components and the roles they serve, and design infrastructure including devices, topologies, protocols, systems software, management and security.								M				
		CLO8: Effectively communicate technical information verbally, in writing, and in										M		

		presentations.												
CS118	Computer System Architecture	CLO1: Ability to Understand Basic structure of computer		H	M									H
		CLO2: Ability to perform Computer's Arithmetic Operations		H	M									
		CLO3: Ability to understand control unit operations		H	M									
		CLO4: Ability to learn the design skills of memory organization that uses different word size operations		H	M		M							M
		CLO5: Ability to understand concept of cache memory technique.		H	M									
		CLO6: Ability to conceptualize instruction level parallelism.	M	H	M		H							H
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		H	H									

		algorithms and their analysis skills. Employ graphs to model engineering problems.												
CS179	Programming Abstractions	CLO1: At the end of this course students will be able to write high quality code.		M	H		M							
		CLO2: They will understand the concept of scalability, security and extensible code for software applications.		M	H		H							M
		CLO3: Learn debugging issues and end to end testing.		M			H							M
		CLO4: Learn skills to deliver features in an agile development environment.												
		CLO5: Solve problems iteratively and recursiveley and design both structured and object-oriented program.		H	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	M	H	H	H	H							

		solutions.												
CS145	Front-end Development	CLO1: Identify the basis of designing a website, create webpages, links, images, tables and page layouts in HTML.		H	H									
		CLO2: Learning skills to describe and identify the use of Javascript and successfully place it into webpages and also recognize the uses of Javascript.		M	H	M	H							
		CLO3: Use Javascript to manipulate elements in the DOM to change appearance and visibility.			H	H								
		CLO4: Describe how intended website design features will specifically benefit a target user group content strategy.		M	H	M	H							
		CLO5: Design loops and decision statements in Python. Understand the role and functions of Web servers and server frameworks.			H	H								
CS159	Back-end Development	CLO1: Gain skills to build full stack end applications using Javascript, Nodejs, Expressjs and MongoDB.			H	H		M						
		CLO2: Understand the concept of full stack development and APIs.			H	H		M						
		CLO3: Learn debugging issues and end-		M	H		H							

		to-end testing..												
		CLO4: Deliver features in an agile development environment.			H	H		M						
		CLO5: Architect solutions to programming problems by combining visual components and classes, and develop a fully functioning website and deploy on a web server.		M	H		H							
CS254H	Professional Practices-System Design	CLO1: Distinguish concepts related to processes, threads, process scheduling, race conditions and critical sections.		M	M									M
		CLO2: Examine and categorize various memory management techniques like caching, paging, segmentation, virtual memory, and thrashing.			H		H							
		CLO3: Design and implement file management system.		M		H								M
		CLO4: To learn how to prepare data using Python. Construct the SQL queries for given specifications.			H		H							
		CLO5: Explain the functions of the different layer of the OSI Protocol.		M		H								M
CS108	Python Basics	CLO1: Designing real life scenario problems, identifying and analysing		M	H	H								

		solutions for it.												
		CLO2: Accurately and efficiently designing the solutions in python.		H			H							
		CLO3: Use python skills in various fields of Data Science, Machine Learning and Artificial Intelligence.		M	H	H								
		CLO4: Use indexing and slicing to access data in Python programs.			H		H	H						
		CLO5: Design loops and decision statements in Python.			H		H	H						
CS133	Data Visualization and Query Language	CLO1: Infer skills for various performance measures and benchmarking progress towards business goals.						H		H				
		CLO2: Analyze automated dashboard project to determine the entities involved in the system and their relationship to one another.		H	H									H
		CLO3: Create database and work on complex queries.			H	H								
		CLO4: Differentiate various mapping tools.			H		H							
		CLO5: Learn web mapping services			H		H							

		requirements.												
CS134	Business Analytics	CLO1: Understand and critically apply the concepts and methods of business analytics		M	M									
		CLO2: Use basic functions and packages in Python.			H	H								
		CLO3: Understand statistical concepts, skills and different hypothesis tests.		M	H	H		M		H	M			
		CLO4: Learn how to prepare data using Python.					H	M		M				
CS254J	Professional Practices-Dashboard Designing	CLO1: Learn Design thinking		M	H									
		CLO2: Convert information into actionable outcomes.		M	H									
		CLO3: Prototyping data models.			H		H							
		CLO4: Create dashboards using PowerBI			M		H							
		CLO5: Learn basic and advanced fundamentals of Excel		H		H								
CS138	Machine Learning	CLO1: Understand and implement classical models and algorithms in machine learning as well as python programming concepts.		M	H									
		CLO2: Analyze the data, identify the		M	H									

		problems.												
		CLO3: Learn the skills to analyze relevant models and algorithms to turn available data into valuable and useful Information.			H		H							
		CLO4: Understand the comparative study of the related approaches.			M		H							
		CLO5: Able to explore new techniques and ideas that can be used to improve the effectiveness of current AI tools.	H	H		H								
CS129/CSQ3105	Introduction to Cyber Security	CLO1: Review and practice computer and network etiquette and ethics found in working environments			H									
		CLO2: Perform risk assessment skills.	H	M	H	H							H	
		CLO3: Install, configure, use and manage anti malware software on a working network	H	M	H		H						H	
		.CLO4: Evaluate best practices in security concepts and skills to maintain confidentiality, integrity and availability of computer systems	H	M	H	H							H	
		CLO5: Articulate informed opinion about issues related to cyber security skills.	H	M	H		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.		H	H									
		CLO2: Understand the file system storage mechanisms of two common desktop operating systems (i.e. versions of Microsoft Windows and LINUX).		H	H	H							H	
		CLO3: Use tools for faithful preservation of data on disks for analysis.		H			H							
		CLO4: Find data that are hidden on a computer disk.		H	H	H							H	
		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			H							
CS131/CSQ3103	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/CSQ3104	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	H	M	H	H							H	

		mathematical and game programming knowledge and skills to solve development tasks.												
		CLO5: Seek new knowledge of games development through self-directed study.	H	M	H		H						H	
GPP103/ GID5358	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/ GD5360	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		M	H	H							H	

		successful professional workflow.												
		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 /GID5359	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				M	M							

		development tasks.												
		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	
CS254I	Professional Practices-Unreal Basis	CLO1: Demonstration of asymptotic notations of games.	H	H	H						H			
		CLO2: Compare and contrast the operation and complexity of various level design and game play.	H	M										
		CLO3: Analyze the fundamental concepts of complexity of level design and game play.		M	M									
		CLO4: Create suitable solutions to solve complex game level puzzles.						H			H			
		CLO5: Create Solutions for problems related to real world gaming.	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					H	M		H	M	H		

		customer–facing aspects of Digital Marketing & Internet Technologies.												
		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 digital marketing tools by applying relevant marketing theories and frameworks.					H	M		H	M	H		
		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					H	M		H	M	H		

		marketing, operations, and human resources in real-time delivery.												
		CLO5: Demonstrate cognitive knowledge of the skills required in CLO6: conducting online research and research on online markets, as well as in identifying, assessing and selecting digital market opportunities				H	H				H		H	
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 useful for entrepreneurs.				H	H				H		H	
CS144	Affiliate	CLO1: Understanding of the key concepts					H	H		M		M		

	Marketing and Online Reputation Management (ORM)	and trends associated with Digital Marketing & Internet Technologies.												
		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 useful for entrepreneurs.	H			H	H				H		H	
EP101	Entrepreneurship and Opportunity	CLO1: Sell themselves and their ideas and become entrepreneurs.		H			H							
		CLO2: Master oral and visual presentation skills and establish a foundation of confidence in the skills necessary to cause others to act.	H	H	H	H								
		CLO3: Find problems worth solving.	H	H		H								
		CLO4: Advance their entrepreneurship			H		H							

		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.												
		CLO5: 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.			H		H							
EP102	Consumer & Market Research for Entrepreneurs	CLO1: Identify and evaluate entrepreneurial opportunities, manage risks and learn from the results.												
		CLO2: Understand the process that enables entrepreneurs with limited resources.		H	H									
		CLO3: Understand and apply fundamental aspects as a means of personal empowerment.			H	H								
		CLO4: Help a company or business development, through proper planning, organization, and both human and		H	H			H					H	

		material resources control, and thus satisfy all specific needs within the market, at the right time.												
		CLO5: Satisfy customer's specific needs through a required product or service.			H		H						H	
CS168	UX Design and Digitization	CLO1: Understand what interaction design is, the importance of user-centred design and methods of user information gathering.		H	H									
		CLO2: Understand how the sensory, cognitive and physical capabilities of users inform the design of interactive products.		H	M									
		CLO3: Understand the process of interaction design, including requirements elicitation, prototyping, evaluation and the need for iteration.		M	H	H								
		CLO4: Differentiate between OLAP AND OLTP. Analyse and critique the design of interactive products.				H								
		CLO5: Learn skills to select, adapt and apply suitable interaction design approaches and techniques towards the design of an interactive product.		M						M			H	
CS169	User Interface	CLO1: Construct navigation that enables	H											

	Design	users to easily accomplish tasks.												
		CLO2: Determine which data to display in order to meet user needs.		H										
		CLO3: Enable users make social connections through their mobile devices.		H	H									
		CLO4: Focus on patterns that bring clarity.			H	H								
		CLO5: Learn the skills of design strategy development that provides solutions to meet business and user goals.		H	H	H	H							
CS170	Empathy and its Tools	CLO1: Use empathy to change behaviour and build better relationship skills.		H	H									
		CLO2: Develop empathy through role-play activities.		M	H									
		CLO3: Explain what it means to have different perspectives.			H	H								
		CLO4: Empathy prepares students to be leaders in their community.	H	H	H	H								
		CLO5: Understand the key difference(s) between empathy and sympathy.	H	H		H								

CS173	Visual Design and Photoshop Basics	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		H										
		CLO.3 Create learning materials including infographics and visual content to fortify learning objectives		H										
		CLO.4 Understand how to create better layouts using grids and guides using Photoshop		H	H	M								
		CLO.5 Understand how to use layers, effects, gradients, scaling, cloning, levels, and layer masks in Photoshop			H	M								
		CLO.6 Apply selections and alpha channels to isolate and extract parts of an image using Photoshop				H	H	M						
CS189	Visual Design Advanced	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		M	H									
		CLO.2 Discover how to edit your own		H	H	H								

		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		M	H									
		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		H	H	M								
		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		H	H	M								
CS121	Software Quality Assurance and Testing	CLO.1 Understand software testing and quality assurance as a fundamental component of software life cycle						H		H	H			
		CLO.2 Infer various software models concepts and skills for making the software.									H	H		
		CLO.3 Analyse software creating requirements to determine the entities involved in the system and their			H			H		H				

		relationship to one another.												
		CLO.4 Make sure that the result meets the business and user requirements Software testing plays an instrumental role.		M	H			M						M
		CLO.5 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.		M			H				H	H		
CS122	Business Intelligence and Data Warehousing	CLO.1 Speculate various models and algorithms in data warehousing.		H	H									
		CLO.2 Analyze various database problems and to find out the relevant information out of big data.		H	H									
		CLO.3 Implement major algorithms that generates frequent itemset		M	H									
		CLO.4 Differentiate between OLAP AND OLTP.			H	H								
		CLO.5 Use clustering techniques for maintaining database integrity.					H							
		CLO.6 Model an application's data requirements using conceptual model			H	H								

		tools skills like BI tools and strategies												
CS147	Android Application Development	CLO.1 Install and configure Android application development tools.		H		H								
		CLO.2 Design and develop user interfaces for the Android platform.		H		H								
		CLO.3 Save state information across important operating system events.		H									H	
		CLO.4 Apply Java programming skills and concepts to Android application development.			H	H							H	
		CLO.5 Design the structure of Android apps, understand layout files and the conversion to view objects.			H	H	H							
CS148	iOS Programming	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.	H	M	M									
		CLO.2 Demonstrate and understanding of how to handle and store data using clearly defined types.		M	M									
		CLO.3 Write code that makes decisions about what lines of code should be executed.		M	H	H								

		CLO.4 Create a basic iOS app to get familiar using Xcode.	H		H	M	H							
		CLO.5 Test and debug apps in a Mac, using the Simulator from Xcode.		M	H	M								H
CS149	Internet of Things	CLO.1 Know the architectural overview of the IoT applications.	H	M										
		CLO.2 Possess an ability and skill to design and develop hardware infrastructure of IoT application.			H									
		CLO.3 Apply communication protocols for IoT application development.			H	H								
		CLO.4 Possess an ability to push the data onto the cloud services.		M	H	H	M							
		CLO.5 Analyze the sensor data and take necessary action associated with it.	H				M							
CS150	Mobile Ad-hoc and Sensor Networks	CLO.1 Gain skill based knowledge of routing mechanisms and the three classes of approaches: proactive, on-demand, and hybrid	H	M	H								M	
		CLO.2 Study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.	H	M	M								M	
		CLO.3 Identify the issues and	H	H		M								

		challenges in providing QoS												
		CLO.4 Explain about the energy management in ad-hoc networks	M	M		M								
		CLO.5 Demonstrate various types of mesh networks.	M	M	H									
CS152	Advanced Computer Architecture	CLO.1 Know the classes of computers, and new trends and developments in computer architecture.						H	M	H				
		CLO.2 Understand pipelining, instruction set architectures, memory addressing.								H	M	M		
		CLO.3 Understand multithreading by using ILP and supporting thread- level parallelism (TLP).						H				M		
		CLO.4 Build skills to understand the performance and efficiency in advanced multiple- issue processors.								H	M	M		
		CLO.5 Build skills to understand the performance of multi-core processors using SPEC benchmarks.					H							
		CLO.6 Understand storage systems, RAID, I/O performance, and reliability measures.						H				M		
CS153	Digital Image	Understand fundamental steps of digital						H			H			

	Processing	image processing												
		Examine various types of images, intensity transformations and spatial filtering.						M	H		H			
		Skill to understand and compare various image enhancement techniques						H	M					
		Skill to understand and implement basic image segmentation techniques						M	H		H			
		Skill to understand and implement and compare various image restoration techniques						H	M					
CS154	Computer Graphics	Students will be able to explain the core concepts of computer graphics, including viewing, projection, perspective, modelling and transformation in two and three dimensions.		M	H	M								
		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		H	M						
		Students will be able to interpret the mathematical foundation of the concepts of computer graphic skills.		M		H		M						

		Students will be able to describe the fundamentals of animation, parametric curves and surfaces, and spotlighting.			H		H	M						
		Students will be able to identify a typical graphics pipeline and apply graphics programming skills to design and create computer graphics.					M							
		Students will be able to create effective programs to solve graphics programming issues, including 3D transformation, objects modelling, colour modelling, lighting, textures, and ray tracing.		M		H		M						
CS161	Java Programming	CLO.1 Implement the concept of object-oriented techniques and methodologies using Java.					M				M	H		
		CLO.2 Use Exception Handling skill for a Robust Application in Java.	H	H	M		M				H		H	
		CLO.3 Demonstrate an understanding of Java Input/Output and Multithreading.		M	H	H	H				H		H	M
		CLO.4 Use and Implement several Data structures using Collection Framework	H	H	M		M				H		H	
		CLO.5 Use database connectivity for a complete Java application.					M							
		CLO.6 Use Html, JavaScript, CSS,		M	H	H	H				H		H	M

		Servlets, JSP and XML to develop web based applications.												
CS162	Full Stack Development	CLO.1 Use their learned skills, knowledge and abilities to develop web sites for the internet					M				M	H		
		CLO.2 Apply basic design principles to present ideas, information, products, and services on websites	H	H	M		M				H		H	
		CLO.3 Apply basic programming principles to the construction of websites		M	H	H	H				H		H	M
		CLO.4 Effectively manage website projects using available resources	H	H	M		M				H		H	
		CLO.5 Demonstrate communication skills, service management skills, and presentation skills		M	H	H	H				H		H	M
CS245	Big Data Analytics	Speculate various models and algorithms in Big Data Analytics.					M				M	H		
		Analyze various database problems and to find out the relevant information out of big data.	H	H	M		M				H		H	
		Implement major algorithms that generates frequent itemset.		M	H	H	H				H		H	M
		Use clustering techniques for	H	H	M		M				H		H	

		maintaining database integrity.												
		Model an application's data requirements using conceptual model tools skills like BI tools and strategies								H				
CS243	Artificial Intelligence & Machine Learning	To give understanding of the main abstractions and reasoning for intelligent systems.					M				M	H		
		To enable the students to understand the basic principles of Artificial Intelligence in various applications..	H	H	M		M				H		H	
		Learn the skills to analyze relevant models and algorithms to turn available data into valuable and useful Information.		M	H	H	H				H		H	M
		Understand the comparative study of the related approaches.	H	H	M		M				H		H	
		Able to explore new techniques and ideas that can be used to improve the effectiveness of current AI tools.								H				
CS4003	Network Security	Explain about the OSI Security architecture and various Crytographic techniques.	H	M	H								M	
		Describe about the data encryption standard, block ciphers and block	H	M	M								M	

		ciphers mode of operation.												
		Describe the principles of various public key cryptosystems	H	H		M								
		Explain the need for authentication and various authentication system methods.	M	M		M								
		Illustrate the different types of threats and attacks in data networks and explain about Internet and Mobile security	M	M	H									
CS151	Introduction to Cloud Computing	CLO 1. Analyze the Cloud computing setup with its vulnerabilities and applications using different architectures						H	M	H				
		CLO2 Understand the concepts, characteristics, delivery models and benefits of cloud computing.								H	M	M		
		CLO3 Identify legal and societal issues involved in addressing the security issues of cloud computing.						H				M		
		CLO4 Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application.								H	M	M		
		CLO5 Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.					H							

CS204	Lab Oriented Project	CLO.1 To acquire presentation and communication skills						H				M		
		CLO.2 Undertake problem identification, formulation and solution to make students employable.						H			H			
		CLO.3 Design engineering solutions to complex problems utilizing a systems approach						M	H		H			
		CLO.4 To implement learning in real life problem for skill development						H	M					
		CLO.5 Satisfy customer's specific needs through a required product or service.						M	H		H			
CS244	Professional Practices-Coding	CLO1 Formulate problem solutions by incorporating advanced programming skills.						H	M					
		CLO2 Choose the appropriate searching and sorting technique.		M	H	M								
		CLO 3 Demonstrate the advantages and disadvantages of specific techniques to be used.			H		H	M						
		CLO4 Develop programs using basic data structures like stack and queue.		M		H		M						
		CLO 5 Formulate new solutions for programming problems or improve			H		H	M						

		existing code to program effectively.												
CS251	Co-op project at Industry (Module-1)	CLO.1 To acquire presentation and communication skills					M							
		CLO.2 Undertake problem identification, formulation and solution to make students employable.		M		H		M						
		CLO.3 Design engineering solutions to complex problems utilizing a systems approach					M				M	H		
		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	H	H	M		M				H		H	
		CLO.2 Undertake problem identification, formulation and solution to make students employable.					M							
		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	CLO1 Design engineering solutions to complex problems utilizing a systems		M	H	H	H				H		H	M

	Experience	approach												
		CLO 2 To implement learning in real life problem for skill development	H	H	M		M				H		H	
		CLO 3 To propose multiple solution to any given problem and find best out of those.		M	H	H	H				H		H	M
		CLO 4. To any given problem and find best out of those		H	M		M				H	H		
		CLO 5 Undertake problems identification, foundation and solution to make students employable	M		H	H				H		H	M	