

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**B.E. in Computer Science and Design**  
**Scheme of Teaching and Examinations 2021**  
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**  
**(Effective from the academic year 2021 - 22)**

III SEMESTER												
Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Transform Calculus, Fourier Series and Numerical Techniques	Maths	3	0	0		03	50	50	100	3
2	IPCC 21CS32	Data Structures and Applications	Any CS Board Department	3	0	2		03	50	50	100	4
3	IPCC 21CS33	Analog and Digital Electronics		3	0	2		03	50	50	100	4
4	PCC 21CS34	Computer Organization and Architecture		3	0	0		03	50	50	100	3
5	PCC 21CSL35	Object Oriented Programming with JAVA Laboratory		0	0	2		03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	0	0	1		01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB: HSMC	1	0	0		01	50	50	100	1
	HSMC 21KKBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21CS38X/21 CSL38X	Ability Enhancement Course - III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course				01	50	50	100	1
				1	0	0						
				If offered as lab. course				02				
				0	0	2						
<b>Total</b>									<b>400</b>	<b>400</b>	<b>800</b>	<b>18</b>
9	Scheduled activities for III to VIII semesters	NMDC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the course namely National Service Scheme, Physical Education (PE)(Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from (for 5 semesters) between III semester to VIII semester. SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the colander prepared for the NSS, PE and Yoga activities.							
		NMDC 21PE83	Physical Education (PE) (Sports and Athletics)	PE								
		NMDC 21YO83	Yoga	Yoga								
<b>Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs</b>												
1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0
<p><b>Note:</b> BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, INT –Internship, HSMC: Humanity and Social Science &amp; Management Courses, AEC–Ability Enhancement Courses. UHV: Universal Human Value Course.  <b>L</b> –Lecture, <b>T</b> – Tutorial, <b>P</b>- Practical/ Drawing, <b>S</b> – Self Study Component, <b>CIE</b>: Continuous Internal Evaluation, <b>SEE</b>: Semester End Examination. <b>TD</b>-Teaching Department, <b>PSB</b>: Paper Setting department  <b>21KSK37/47</b> Samskrutika Kannada is for students who speak, read and write Kannada and <b>21KKBK37/47</b> Balake Kannada is for non-Kannada speaking, reading, and writing students.</p> <p><b>Integrated Professional Core Course (IPCC):</b> Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.</p>												

**21INT49 Inter/Intra Institutional Internship:** All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internship of 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

**Non-credit mandatory courses (NCCM):**

**(A) Additional Mathematics I and II:**

**(1)** These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

**(2)** Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

**(3)** Successful completion of the courses Additional Mathematics I and II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics I and II shall be indicated as Unsatisfactory.

**(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:**

**(1)** Securing 40 % or more in CIE, 35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

**(2)** In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

**(3)** In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

**(4)** Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

**(5)** These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

**Ability Enhancement Course - III**

21CSL381	Mastering Office	21CS383	
21CS382	Programming IN C++	21CS384	

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**B.E. in Computer Science and Design**  
**Scheme of Teaching and Examinations 2021**  
**Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)**  
**(Effective from the academic year 2021 - 22)**

IV SEMESTER												
Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question and Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21CS41	Mathematical Foundations for Computing	Maths	2	2	0		03	50	50	100	3
2	IPCC 21CS42	Design and Analysis of Algorithms	Any CS Board Department	3	0	2		03	50	50	100	4
3	IPCC 21CS43	Microcontroller and Embedded Systems		3	0	2		03	50	50	100	4
4	PCC 21CS44	Operating Systems		2	2	0		03	50	50	100	3
5	AEC 21BE45	Biology For Engineers	BT, CHE, PHY	2	0	0		02	50	50	100	2
6	PCC 21CSL46	Python Programming Laboratory	Any CS Board Department	0	0	2		03	50	50	100	1
7	HSMC 21KSK37/47	Sanskrutika Kannada	HSMC	1	0	0		01	50	50	100	1
	HSMC 21KKB37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India & Professional Ethics										
8	AEC 21CS48X/21C SL48X	Ability Enhancement Course- IV	TD and PSB: Concerned department	If offered as theory Course				01	50	50	100	1
				1	0	0						
				If offered as lab. course				02				
				0	0	2						
9	UHV 21UH49	Universal Human Values	Any Department	1	0	0		01	50	50	100	1
10	INT 21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period of II and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2
<b>Total</b>								<b>550</b>	<b>450</b>	<b>1000</b>	<b>22</b>	

**Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs**

1	NCMC 21MATDIP41	Additional Mathematics - II	Maths	02	02	--	--	--	100	--	100	0
---	-----------------	-----------------------------	-------	----	----	----	----	----	-----	----	-----	---

**Note:** BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC –Ability Enhancement Courses, HSMC: Humanity and Social Science and Management Courses, UHV- Universal Human Value Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

21KSK37/47 Sanskrutika Kannada is for students who speak, read and write Kannada and 21KKB37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

**Non – credit mandatory course (NCCM):****Additional Mathematics - II:**

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfil the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics II shall be indicated as Unsatisfactory.

**Ability Enhancement Course - IV**

21CSL481	Web Programming	21CSL483	R Programming
21CS482	Unix Shell Programming	21CS484	

**Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68 Innovation/ Entrepreneurship/ Societal based Internship.**

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

(2) Innovation/ Entrepreneurship Internship shall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprise (MSME), Innovation centers or Incubation centers. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tack ticks for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) Societal or social internship.

Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship, is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**B.E. in Computer Science and Design**  
**Scheme of Teaching and Examinations 2021**  
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**  
**(Effective from the academic year 2021 - 22)**

V SEMESTER													
Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits	
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks		
				L	T	P	S						
1	BSC 21CD51	Object oriented Modelling and Design	Any CS Board Department	3	0	0		03	50	50	100	3	
2	IPCC 21CS52	Computer Networks		3	0	2		03	50	50	100	4	
3	PCC 21CS53	Database Management Systems		3	0	0		03	50	50	100	3	
4	PCC 21CS54	Artificial Intelligence and Machine Learning		3	0	0		03	50	50	100	3	
5	PCC 21CSL55	Database Management Systems Laboratory with Mini Project		0	0	2		03	50	50	100	1	
6	AEC 21XX56	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by university	2	0	0		02	50	50	100	2	
7	HSMC 21CIV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	1	0	0		1	50	50	100	1	
8	AEC 21CS58X/21 CSL58X	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses				01	50	50	100	1	
				1	0	0							
				If offered as lab. courses				02					
				0	0	2							
<b>Total</b>								<b>400</b>	<b>400</b>	<b>800</b>	<b>18</b>		
<b>Ability Enhancement Course - IV</b>													
21CSL581	Angular JS and Node JS		21CS583										
21CS582	C# and .Net Framework		21CS584										
<p>Note: BSC: Basic Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, AEC –Ability Enhancement Course INT – Internship, HSMC: Humanity and Social Science &amp; Management Courses.  L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.</p> <p><b>Integrated Professional Core Course (IPCC):</b> refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). Theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.</p>													

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**B.E. in Computer Science and Design**  
**Scheme of Teaching and Examinations 2021**  
**Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)**  
**(Effective from the academic year 2021 - 22)**

**VI SEMESTER**

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	HSMC 21CS61	Software Engineering and Project Management	Any CS Board Department	2	2	0		03	50	50	100	3
2	IPCC 21CS62	Fullstack Development		3	0	2		03	50	50	100	4
3	PCC 21CS63	Computer Graphics and Fundamentals of Image Processing		3	0	0		03	50	50	100	3
4	PEC 21XX64x	Professional Elective Course-I		3	0	0		03	50	50	100	3
5	OEC 21XX65x	Open Elective Course-I	Concerned Department	3	0	0		03	50	50	100	3
6	PCC 21CSL66	Computer Graphics and Image Processing Laboratory	Any CS Board Department	0	0	2		03	50	50	100	1
7	MP 21CDMP67	Mini Project		Two contact hours /week for interaction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.				--	100	--	100	3	
<b>Total</b>								<b>500</b>	<b>300</b>	<b>800</b>	<b>22</b>	

**Professional Elective - I**

21CD641	Design of IOT system	21CS643	Advanced Computer Architecture
21CS642	Advanced JAVA Programming	21CS644	Data science and Visualization

**Open Electives – I offered by the Department to other Department students**

21CS651	Introduction to Data Structures	21CS653	Introduction to Cyber Security
21CS652	Introduction to Database Management Systems	21CS654	Programming in JAVA

**Note:** HSMC: Humanity and Social Science & Management Courses, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, PEC: Professional Elective Courses, OEC–Open Elective Course, MP –Mini Project, INT –Internship.

L –Lecture, T – Tutorial, P - Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

**Integrated Professional Core Course (IPCC):** Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

**Professional Elective Courses (PEC):**

A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum students' strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

**Open Elective Courses:**

Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.

Selection of an open elective shall **not be allowed** if,

- (i) The candidate has studied the same course during the previous semesters of the program.
- (ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
- (iii) A similar course, under any category, is prescribed in the higher semesters of the program.

In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business

(MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by submitting a copy of the syllabus along with the details of expertise available to teach the same in the college. The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

**Mini-project work:** Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

**CIE procedure for Mini-project:**

**(i) Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**(ii) Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project. The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**No SEE component for Mini-Project.**

### VII semester Classwork and Research Internship /Industry Internship (21INT82)

#### Swapping Facility

Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester.

**(2)** Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

#### Elucidation:

At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for internship. In other words, a good percentage of the class shall attend VII semester classwork and similar percentage of others shall attend to Research Internship or Industrial Internship.

Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The internship can also be rural internship.

The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent University examination after satisfying the internship requirements.

#### INT21INT82 Research Internship/ Industry Internship/Rural Internship

**Research internship:** A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

**Industry internship:** Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

**Rural internship:** A long-term goal, as proposed under the AICTE rural internship programme, shall be counted as rural internship activity.

The student can take up Interdisciplinary Research Internship or Industry Internship.

The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**B.E. in Computer Science and Design**  
**Scheme of Teaching and Examinations 2021**  
**Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)**  
**(Effective from the academic year 2021 - 22)**

**Swappable VII and VIII SEMESTER****VII SEMESTER**

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question and Answer Paper Setting Board (PSB)	Teaching Hours /Week				Examination			Credits	
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks		Total Marks
				L	T	P	S					
1	PCC 21CD71	Robotic Process Automation Design and Development	Any CS Board Department	3	0	0		3	50	50	100	3
2	PCC 21CS72	Cloud Computing		2	0	0		3	50	50	100	2
3	PEC 21XX73X	Professional elective Course-II		3	0	0		3	50	50	100	3
4	PEC 21XX74X	Professional elective Course-III		3	0	0		3	50	50	100	3
5	OEC 21XX75X	Open elective Course-II	Concerned Department	3	0	0		3	50	50	100	3
6	Project 21CDP76	Project work		Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
<b>Total</b>								<b>350</b>	<b>350</b>	<b>700</b>	<b>24</b>	

**VIII SEMESTER**

Sl. No	Course and Course Code	Course Title	Teaching Department	Teaching Hours /Week				Examination			Credits		
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks		Total Marks	
				L	T	P	S						
1	Seminar 21CD81	Technical Seminar		One contact hour /week for interaction between the faculty and students.				--	100	--	100	01	
2	INT 21INT82	Research Internship/ Industry Internship		Two contact hours /week for interaction between the faculty and students.				03 (Batch wise )	100	100	200	15	
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester to VIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
<b>Total</b>								<b>250</b>	<b>150</b>	<b>400</b>	<b>16</b>		

**Professional Elective - II**

21CD731	Multimedia Design	21CS734	Blockchain Technology
21CD732	Animation & Game design	21CD735	Operating System Concepts and Design
21IS733	User Interface Design		

**Professional Elective - III**

21CS741	Software Architecture and Design Patterns	21CD744	Big Data Analytics
21CD742	Compiler Design	21CD745	Design Thinking
21CD743	Virtual Reality		



**Open Electives - II offered by the Department to other Department students**

21CS751	Programming in Python	21CS754	Introduction to Data Science
21CS752	Introduction to AI and ML	21CS755	
21CS753	Introduction to Big Data		

**Note:** PCC: Professional Core Course, PEC: Professional Elective Courses, OEC–Open Elective Course, AEC –Ability Enhancement Courses.  
L–Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

**Note: VII and VIII semesters of IV year of the programme**

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester.

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

**PROJECT WORK (21XXP76):** The objective of the Project work is

- (i) To encourage independent learning and the innovative attitude of the students.
- (ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
- (iii) To impart flexibility and adaptability.
- (iv) To inspire team working.
- (v) To expand intellectual capacity, credibility, judgment and intuition.
- (vi) To adhere to punctuality, setting and meeting deadlines.
- (vii) To instil responsibilities to oneself and others.
- (viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

**CIE procedure for Project Work:**

(1) **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) **Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**SEE procedure for Project Work:** SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

**TECHNICAL SEMINAR (21XXS81):** The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

- (i) Carry out literature survey, systematically organize the content.
- (ii) Prepare the report with own sentences, avoiding a cut and paste act.
- (iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- (iv) Present the seminar topic orally and/or through PowerPoint slides.
- (v) Answer the queries and involve in debate/discussion.
- (vi) Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

**Evaluation Procedure:**

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

**Marks distribution for CIE of the course:**

Seminar Report:50 marks

Presentation skill:25 marks

Question and Answer: 25 marks. ■ No SEE component for Technical Seminar

**Non – credit mandatory courses (NCMC):**

**National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:**

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum programme period.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

### III Semester

<b>TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES</b>			
Course Code:	<b>21MAT31</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Objectives:</b>			
<p>CLO 1. To have an insight into solving ordinary differential equations by using Laplace transform techniques</p> <p>CLO 2. Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis.</p> <p>CLO 3. To enable the students to study Fourier Transforms and concepts of infinite Fourier Sine and Cosine transforms and to learn the method of solving difference equations by the z-transform method.</p> <p>CLO 4. To develop the proficiency in solving ordinary and partial differential equations arising in engineering applications, using numerical methods</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p>Definition and Laplace transforms of elementary functions (statements only). Problems on Laplace transform of <math>e^{at}f(t)</math>, <math>t^n f(t)</math>, <math>\frac{f(t)}{t}</math>. Laplace transforms of Periodic functions (statement only) and unit-step function – problems.</p> <p>Inverse Laplace transforms definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) and problems. Laplace transforms of derivatives, solution of differential equations.</p> <p><b>Self-study:</b> Solution of simultaneous first-order differential equations.</p>			
<b>Teaching-Learning Process</b>	Chalk and talk method /		
<b>Module-2</b>			
<p>Introduction to infinite series, convergence and divergence. Periodic functions, Dirichlet's condition. Fourier series of periodic functions with period <math>2\pi</math> and arbitrary period. Half range Fourier series. Practical harmonic analysis.</p> <p><b>Self-study:</b> Convergence of series by D'Alembert's Ratio test and, Cauchy's root test</p>			
<b>Teaching-Learning Process</b>	Chalk and talk method / Powerpoint Presentation		

<b>Module-3</b>	
<p>Infinite Fourier transforms definition, Fourier sine and cosine transforms. Inverse Fourier transforms, Inverse Fourier cosine and sine transforms. Problems.</p> <p>Difference equations, z-transform-definition, Standard z-transforms, Damping and shifting rules, Problems. Inverse z-transform and applications to solve difference equations.</p> <p><b>Self-Study:</b> Initial value and final value theorems, problems.</p>	
<b>Teaching-Learning Process</b>	Chalk and talk method / Powerpoint Presentation
<b>Module-4</b>	
<p>Classifications of second-order partial differential equations, finite difference approximations to derivatives, Solution of Laplace's equation using standard five-point formula. Solution of heat equation by Schmidt explicit formula and Crank- Nicholson method, Solution of the Wave equation. Problems.</p> <p><b>Self-Study:</b> Solution of Poisson equations using standard five-point formula.</p>	
<b>Teaching-Learning Process</b>	Chalk and talk method / Powerpoint Presentation
<b>Module-5</b>	
<p>Second-order differential equations - Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae).</p> <p>Calculus of Variations: Functionals, Euler's equation, Problems on extremals of functional. Geodesics on a plane, Variational problems.</p> <p><b>Self-Study:</b> Hanging chain problem</p>	
<b>Teaching-Learning Process</b>	Chalk and talk method / PowerPoint Presentation
<p><b>Course Outcomes (Course Skill Set)</b></p> <p>At the end of the course the student will be able to:</p> <ul style="list-style-type: none"> <li>CO 1. To solve ordinary differential equations using Laplace transform.</li> <li>CO 2. Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.</li> <li>CO 3. To use Fourier transforms to analyze problems involving continuous-time signals and to apply Z-Transform techniques to solve difference equations</li> <li>CO 4. To solve mathematical models represented by initial or boundary value problems involving partial differential equations</li> <li>CO 5. Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.</li> </ul>	
<p><b>Assessment Details (both CIE and SEE)</b></p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together</p> <p><b>Continuous Internal Evaluation:</b></p> <p>Three Unit Tests each of <b>20 Marks (duration 01 hour)</b></p> <ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol> <p>Two assignments each of <b>10 Marks</b></p> <ol style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol> <p>Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b></p>	

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.

**Reference Books:**

1. V. Ramana: "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.
2. Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics" Oxford University Press, 3rd Reprint, 2016.
3. N.P Bali and Manish Goyal: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
4. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw - Hill Book Co.Newyork, Latest ed.
5. Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic for Semester I and II", McGraw Hill Education(India) Pvt. Ltd 2015.
6. H.K.Dass and Er. Rajnish Verma: "Higher Engineering Mathematics" S.Chand Publication (2014).
7. James Stewart: "Calculus" Cengage publications, 7th edition, 4th Reprint 2019

**Weblinks and Video Lectures (e-Resources):**

1. [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
2. <http://academicearth.org/>
3. <http://www.bookstreet.in>.
4. VTU e-Shikshana Program
5. VTU EDUSAT Program

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Quizzes
- Assignments
- Seminars

### III Semester

<b>DATA STRUCTURES AND APPLICATIONS</b>			
Course Code:	<b>21CS32</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03
<b>Course Objectives:</b>			
CLO 1. Explain the fundamentals of data structures and their applications essential for implementing solutions to problems.			
CLO 2. Illustrate representation of data structures: Stack, Queues, Linked Lists, Trees and Graphs.			
CLO 3. Design and Develop Solutions to problems using Arrays, Structures, Stack, Queues, Linked Lists.			
CLO 4. Explore usage of Trees and Graph for application development.			
CLO 5. Apply the Hashing techniques in mapping key value pairs.			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"><li>1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li><li>2. Use of Video/Animation to explain functioning of various concepts.</li><li>3. Encourage collaborative (Group Learning) Learning in the class.</li><li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li><li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li><li>6. Introduce Topics in manifold representations.</li><li>7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li><li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li></ol>			
<b>Module-1</b>			
<b>Introduction:</b> Data Structures, Classifications (Primitive & Non-Primitive), Data structure operations (Traversing, inserting, deleting, searching, and sorting). Review of Arrays. Structures: Array of structures Self-Referential Structures. Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, dynamically allocated arrays and Multidimensional Arrays. Demonstration of representation of Polynomials and Sparse Matrices with arrays.			
<b>Textbook 1: Chapter 1: 1.2, Chapter 2: 2.2 - 2.7, Text Textbook 2: Chapter 1: 1.1 - 1.4, Chapter 3: 3.1 - 3.3, 3.5, 3.7, Chapter 4: 4.1 - 4.9, 4.14 Textbook 3: Chapter 1: 1.3</b>			
<b>Laboratory Component:</b>			
<ol style="list-style-type: none"><li>1. Design, Develop and Implement a menu driven Program in C for the following Array Operations<ol style="list-style-type: none"><li>a. Creating an Array of N Integer Elements</li><li>b. Display of Array Elements with Suitable Headings</li><li>c. Exit.</li></ol>Support the program with functions for each of the above operations.</li><li>2. Design, Develop and Implement a menu driven Program in C for the following Array operations<ol style="list-style-type: none"><li>a. Inserting an Element (ELEM) at a given valid Position (POS)</li><li>b. Deleting an Element at a given valid Position POS)</li><li>c. Display of Array Elements</li></ol></li></ol>			

<p>d. Exit. Support the program with functions for each of the above operations.</p>	
<p><b>Teaching-Learning Process</b></p>	<p>Problem based learning (Implementation of different programs to illustrate application of arrays and structures. <a href="https://www.youtube.com/watch?v=3Xo6P_V-qns&amp;t=201s">https://www.youtube.com/watch?v=3Xo6P_V-qns&amp;t=201s</a>  <a href="https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html">https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html</a> <a href="https://ds1-iiith.vlabs.ac.in/data-structures-1/List%20of%20experiments.html">https://ds1-iiith.vlabs.ac.in/data-structures-1/List%20of%20experiments.html</a></p>
<p><b>Module-2</b></p>	
<p><b>Stacks:</b> Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays. Different representation of expression. Stack Applications: Infix to postfix conversion, Infix to prefix conversion, evaluation of postfix expression, recursion.</p> <p><b>Queues:</b> Definition, Array Representation of Queues, Queue Operations, Circular Queues, Queues and Circular queues using Dynamic arrays, Dequeues, Priority Queues.</p> <p><b>Textbook 1: Chapter 3: 3.1 -3.4, 3.6 Textbook 2: Chapter 6: 6.1 -6.4, 6.5, 6.7-6.13</b></p>	
<p><b>Laboratory Component:</b></p> <ol style="list-style-type: none"> <li>Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) <ol style="list-style-type: none"> <li>Push an Element on to Stack</li> <li>Pop an Element from Stack</li> <li>Demonstrate <i>Overflow</i> and <i>Underflow</i> situations on Stack</li> <li>Display the status of Stack</li> <li>Exit</li> </ol> <p>Support the program with appropriate functions for each of the above operations</p> </li> <li>Design, Develop and Implement a Program in C for the following Stack Applications <ol style="list-style-type: none"> <li>Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^</li> <li>Solving Tower of Hanoi problem with n disks</li> </ol> </li> </ol>	
<p><b>Teaching-Learning Process</b></p>	<p>Active Learning, Problem based learning <a href="https://nptel.ac.in/courses/106/102/106102064/">https://nptel.ac.in/courses/106/102/106102064/</a> <a href="https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html">https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html</a></p>
<p><b>Module-3</b></p>	
<p><b>Linked Lists:</b> Definition, classification of linked lists. Representation of different types of linked lists in Memory, Traversing, Insertion, Deletion, Searching, Sorting, and Concatenation Operations on Singly linked list, Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists – Polynomials, Sparse matrix representation. Programming Examples.</p> <p><b>Textbook 1: Chapter 4: 4.1 – 4.4, 4.5.2, 4.7, 4.8, Textbook 2: Chapter 5: 5.1 – 5.9</b></p>	
<p><b>Laboratory Component:</b></p> <ol style="list-style-type: none"> <li>Singly Linked List (SLL) of Integer Data <ol style="list-style-type: none"> <li>Create a SLL stack of N integer.</li> <li>Display of SLL</li> <li>Linear search. Create a SLL queue of N Students Data Concatenation of two SLL of integers.</li> </ol> </li> <li>Design, Develop and Implement a menu driven Program in C for the following operationson Doubly Linked List (DLL) of Professor Data with the fields: ID, Name, Branch, Area of specialization <ol style="list-style-type: none"> <li>Create a DLL stack of N Professor's Data.</li> </ol> </li> </ol>	

<p>b. Create a DLL queue of N Professor's Data Display the status of DLL and count the number of nodes in it.</p>	
<p><b>Teaching-Learning Process</b></p>	<p>MOOC, Active Learning, Problem solving based on linked lists.  <a href="https://nptel.ac.in/courses/106/102/106102064/">https://nptel.ac.in/courses/106/102/106102064/</a>  <a href="https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html">https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html</a>  <a href="https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html">https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html</a>  <a href="https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html">https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html</a>  <a href="https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html">https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html</a></p>
<p><b>Module-4</b></p>	
<p><b>Trees 1:</b> Terminologies, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, and Searching operation on Binary search tree. Application of Trees-Evaluation of Expression.</p>	
<p><b>Textbook 1: Chapter 5: 5.1 –5.5, 5.7; Textbook 2: Chapter 7: 7.1 – 7.9</b></p>	
<p><b>Laboratory Component:</b></p> <ol style="list-style-type: none"> <li>Given an array of elements, construct a complete binary tree from this array in level order fashion. That is, elements from left in the array will be filled in the tree level wise starting from level 0. Ex: Input : arr[] = {1, 2, 3, 4, 5, 6} Output : Root of the following tree <pre> 1  / \ 2  3  / \ / \ 4  5 6 </pre> </li> <li>Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers <ol style="list-style-type: none"> <li>Create a BST of N Integers</li> <li>Traverse the BST in Inorder, Preorder and Post Order</li> </ol> </li> </ol>	
<p><b>Teaching-Learning Process</b></p>	<p>Problem based learning  <a href="http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html">http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html</a>  <a href="https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html">https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html</a>  <a href="https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html">https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html</a></p>
<p><b>Module-5</b></p>	
<p><b>Trees 2:</b> AVL tree, Red-black tree, Splay tree, B-tree.</p>	
<p><b>Graphs:</b> Definitions, Terminologies, Matrix and Adjacency List Representation of Graphs, Traversal methods: Breadth First Search and Depth FirstSearch.</p>	
<p><b>Hashing:</b> Hash Table organizations, Hashing Functions, Static and Dynamic Hashing.</p>	
<p><b>Textbook 1: Chapter 10:10.2, 10.3, 10.4, Textbook 2:7.10 – 7.12, 7.15 Chapter 11: 11.2, Textbook 1: Chapter 6 : 6.1–6.2, Chapter 8 : 8.1-8.3, Textbook 2: 8.1 – 8.3, 8.5, 8.7</b></p>	
<p><b>Textbook 3: Chapter 15:15.1, 15.2,15.3, 15.4,15.5 and 15.7</b></p>	

**Laboratory Component:**

1. Design, Develop and implement a program in C for the following operations on Graph (G) of cities
  - a. Create a Graph of N cities using Adjacency Matrix.
  - b. Print all the nodes reachable from a given starting node in a diagraph using DFS/BFS method.
2. Design and develop a program in C that uses Hash Function  $H:K \rightarrow L$  as  $H(K)=K \bmod m$ (remainder method) and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

**Teaching-Learning Process**

NPTL, MOOC etc. courses on trees and graphs.  
<http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html>

**Course Outcomes (Course Skill Set)**

At the end of the course the student will be able to:

- CO 1. Identify different data structures and their applications.
- CO 2. Apply stack and queues in solving problems.
- CO 3. Demonstrate applications of linked list.
- CO 4. Explore the applications of trees and graphs to model and solve the real-world problem.
- CO 5. Make use of Hashing techniques and resolve collisions during mapping of key value pairs

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to **20 marks**.

*Note: Minimum of 80% of the laboratory components have to be covered.*

- Rubrics for each Experiment taken average for all Lab components – 15 Marks.
- Viva-Voce– 5 Marks (more emphasized on demonstration topics)

The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question



papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks:**

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.
3. Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.

**Reference Books:**

1. Gilberg and Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning, 2014.
2. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd Ed, McGraw Hill, 2013
3. A M Tenenbaum, Data Structures using C, PHI, 1989
4. Robert Kruse, Data Structures and Program Design in C, 2nd Ed, PHI, 1996.

**Weblinks and Video Lectures (e-Resources):**

1. <http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html>
2. <https://nptel.ac.in/courses/106/105/106105171/>
3. <http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Real world problem solving using group discussion.
- Back/Forward stacks on browsers.
- Undo/Redo stacks in Excel or Word.
- Linked list representation of real-world queues -Music player, image viewer

### III Semester

<b>ANALOG AND DIGITAL ELECTRONICS</b>			
Course Code	<b>21CS33</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03
<b>Course Learning Objectives:</b>			
CLO 1. Explain the use of photo electronics devices, 555 timer IC, Regulator ICs and uA741			
CLO 2. Make use of simplifying techniques in the design of combinational circuits.			
CLO 3. Illustrate combinational and sequential digital circuits			
CLO 4. Demonstrate the use of flipflops and apply for registers			
CLO 5. Design and test counters, Analog-to-Digital and Digital-to-Analog conversion techniques.			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> <li>Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>Show Video/animation films to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Topics will be introduced in a multiple representation.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
BJT Biasing: Fixed bias, Collector to base Bias, voltage divider bias			
Operational Amplifier Application Circuits: Peak Detector, Schmitt trigger, Active Filters, Non-Linear Amplifier, Relaxation Oscillator, Current-to-Voltage and Voltage-to-Current Converter, Regulated Power Supply Parameters, adjustable voltage regulator, D to A and A to D converter.			
<b>Textbook 1: Part A: Chapter 4 (Sections 4.2, 4.3, 4.4), Chapter 7 (Sections 7.4, 7.6 to 7.11), Chapter 8 (Sections 8.1 and 8.5), Chapter 9.</b>			
<b>Laboratory Component:</b>			
<ol style="list-style-type: none"> <li>Simulate BJT CE voltage divider biased voltage amplifier using any suitable circuit simulator.</li> <li>Using ua 741 Opamp, design a 1 kHz Relaxation Oscillator with 50% duty cycle</li> <li>Design an astable multivibrator circuit for three cases of duty cycle (50%, &lt;50% and &gt;50%) using NE 555 timer IC.</li> <li>Using ua 741 opamp, design a window comparator for any given UTP and LTP.</li> </ol>			
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>Demonstration of circuits using simulation.</li> <li>Project work: Design a integrated power supply and function generator operating at audio frequency. Sine, square and triangular functions are to be generated.</li> <li>Chalk and Board for numerical</li> </ol>		
<b>Module-2</b>			

Karnaugh maps: minimum forms of switching functions, two and three variable Karnaugh maps, four variable Karnaugh maps, determination of minimum expressions using essential prime implicants, Quine-McClusky Method: determination of prime implicants, the prime implicant chart, Petricks method, simplification of incompletely specified functions, simplification using map-entered variables

**Textbook 1: Part B: Chapter 5 (Sections 5.1 to 5.4) Chapter 6 (Sections 6.1 to 6.5)**

**Laboratory Component:**

1. Given a 4-variable logic expression, simplify it using appropriate technique and implement the same using basic gates.

**Teaching-Learning Process**

1. Chalk and Board for numerical
2. Laboratory Demonstration

**Module-3**

Combinational circuit design and simulation using gates: Review of Combinational circuit design, design of circuits with limited Gate Fan-in, Gate delays and Timing diagrams, Hazards in combinational Logic, simulation and testing of logic circuits

Multiplexers, Decoders and Programmable Logic Devices: Multiplexers, three state buffers, decoders and encoders, Programmable Logic devices.

**Textbook 1: Part B: Chapter 8, Chapter 9 (Sections 9.1 to 9.6)**

**Laboratory Component:**

1. Given a 4-variable logic expression, simplify it using appropriate technique and realize the simplified logic expression using 8:1 multiplexer IC.
2. Design and implement code converter I) Binary to Gray (II) Gray to Binary Code

**Teaching-Learning Process**

1. Demonstration using simulator
2. Case study: Applications of Programmable Logic device
3. Chalk and Board for numerical

**Module-4**

Introduction to VHDL: VHDL description of combinational circuits, VHDL Models for multiplexers, VHDL Modules.

Latches and Flip-Flops: Set Reset Latch, Gated Latches, Edge-Triggered D Flip Flop 3,SR Flip Flop, J K Flip Flop, T Flip Flop.

**Textbook 1: Part B: Chapter 10(Sections 10.1 to 10.3), Chapter 11 (Sections 11.1 to 11.7)**

**Laboratory Component:**

1. Given a 4-variable logic expression, simplify it using appropriate technique and simulate the same in HDL simulator
2. Realize a J-K Master / Slave Flip-Flop using NAND gates and verify its truth table. And implement the same in HDL.

**Teaching-Learning Process**

1. Demonstration using simulator
2. Case study: Arithmetic and Logic unit in VHDL
3. Chalk and Board for numerical

**Module-5**

Registers and Counters: Registers and Register Transfers, Parallel Adder with accumulator, shift registers, design of Binary counters, counters for other sequences, counter design using SR and J K Flip Flops.

**Textbook 1: Part B: Chapter 12 (Sections 12.1 to 12.5)**

<b>Laboratory Component:</b>	
<ol style="list-style-type: none"> <li>Design and implement a mod-n (<math>n &lt; 8</math>) synchronous up counter using J-K Flip-Flop ICs and demonstrate its working.</li> <li>Design and implement an asynchronous counter using decade counter IC to count up from 0 to n (<math>n \leq 9</math>) and demonstrate on 7-segment display (using IC-7447)</li> </ol>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>Demonstration using simulator</li> <li>Project Work: Designing any counter, use LED / Seven-segment display to display the output</li> <li>Chalk and Board for numerical</li> </ol>
<b>Course outcome (Course Skill Set)</b>	
At the end of the course the student will be able to:	
CO 1. Design and analyze application of analog circuits using photo devices, timer IC, power supply and regulator IC and op-amp.	
CO 2. Explain the basic principles of A/D and D/A conversion circuits and develop the same.	
CO 3. Simplify digital circuits using Karnaugh Map, and Quine-McClusky Methods	
CO 4. Explain Gates and flip flops and make us in designing different data processing circuits, registers and counters and compare the types.	
CO 5. Develop simple HDL programs	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
<ol style="list-style-type: none"> <li>First test at the end of 5<sup>th</sup> week of the semester</li> <li>Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol>	
Two assignments each of <b>10 Marks</b>	
<ol style="list-style-type: none"> <li>First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol>	
Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to <b>20 marks</b> .	
<i>Note: Minimum of 80% of the laboratory components have to be covered.</i>	
<ul style="list-style-type: none"> <li>Rubrics for each Experiment taken average for all Lab components – 15 Marks.</li> <li>Viva-Voce– 5 Marks (more emphasized on demonstration topics)</li> </ul>	
The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.</b>	
<b>Semester End Examination:</b>	
Theory SEE will be conducted by University as per the scheduled timetable, with common question	

papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Charles H Roth and Larry L Kinney, Analog and Digital Electronics, Cengage Learning, 2019

**Reference Books**

1. Anil K Maini, Varsha Agarwal, Electronic Devices and Circuits, Wiley, 2012.
2. Donald P Leach, Albert Paul Malvino & Goutam Saha, Digital Principles and Applications, 8th Edition, Tata McGraw Hill, 2015.
3. M. Morris Mani, Digital Design, 4th Edition, Pearson Prentice Hall, 2008.
4. David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2008

**Weblinks and Video Lectures (e-Resources):**

1. Analog Electronic Circuits: <https://nptel.ac.in/courses/108/102/108102112/>
2. Digital Electronic Circuits: <https://nptel.ac.in/courses/108/105/108105132/>
3. Analog Electronics Lab: <http://vlabs.iitkgp.ac.in/be/>
4. Digital Electronics Lab: <http://vlabs.iitkgp.ac.in/dec>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

1. Real world problem solving - applying the design concepts of oscillator, amplifier, switch, Digital circuits using Opamps, 555 timer, transistor, Digital ICs and design a application like tone generator, temperature sensor, digital clock, dancing lights etc.

### III Semester

<b>COMPUTER ORGANIZATION AND ARCHITECTURE</b>			
Course Code	<b>21CS34</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Understand the organization and architecture of computer systems, their structure and operation</p> <p>CLO 2. Illustrate the concept of machine instructions and programs</p> <p>CLO 3. Demonstrate different ways of communicating with I/O devices</p> <p>CLO 4. Describe different types memory devices and their functions</p> <p>CLO 5. Explain arithmetic and logical operations with different data types</p> <p>CLO 6. Demonstrate processing unit with parallel processing and pipeline architecture</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Basic Structure of Computers:</b> Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.			
<b>Machine Instructions and Programs:</b> Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes			
<b>Textbook 1: Chapter1 – 1.3, 1.4, 1.6 (1.6.1-1.6.4, 1.6.7), Chapter2 – 2.2 to 2.5</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<b>Input/Output Organization:</b> Accessing I/O Devices, Interrupts – Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits			
<b>Textbook 1: Chapter4 – 4.1, 4.2, 4.4, 4.5, 4.6</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<b>Memory System:</b> Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Virtual memories			
<b>Textbook 1: Chapter 5 – 5.1 to 5.4, 5.5 (5.5.1, 5.5.2)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration		

<b>Module-4</b>	
<b>Arithmetic:</b> Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers	
<b>Basic Processing Unit:</b> Fundamental Concepts, Execution of a Complete Instruction, Hardwired control, Microprogrammed control	
<b>Textbook 1: Chapter2-2.1, Chapter6 – 6.1 to 6.3</b>	
<b>Textbook 1: Chapter7 – 7.1, 7.2,7.4, 7.5</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning
<b>Module-5</b>	
<b>Pipeline and Vector Processing:</b> Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Vector Processing, Array Processors	
<b>Textbook 2: Chapter 9 – 9.1, 9.2, 9.3, 9.4, 9.6, 9.7</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Explain the organization and architecture of computer systems with machine instructions and programs	
CO 2. Analyze the input/output devices communicating with computer system	
CO 3. Demonstrate the functions of different types of memory devices	
CO 4. Apply different data types on simple arithmetic and logical unit	
CO 5. Analyze the functions of basic processing unit, Parallel processing and pipelining	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.</b>	
<b>Semester End Examination:</b>	
Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject ( <b>duration 03 hours</b> )	
1. The question paper will have ten questions. Each question is set for 20 marks.	

2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Textbooks**

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5<sup>th</sup> Edition, Tata McGraw Hill
2. M. Morris Mano, Computer System Architecture, PHI, 3<sup>rd</sup> Edition

**Reference:**

1. William Stallings: Computer Organization & Architecture, 9th Edition, Pearson

**Weblinks and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/106/103/106103068/>
2. <https://nptel.ac.in/content/storage2/courses/106103068/pdf/coa.pdf>
3. <https://nptel.ac.in/courses/106/105/106105163/>
4. <https://nptel.ac.in/courses/106/106/106106092/>
5. <https://nptel.ac.in/courses/106/106/106106166/>
6. <http://www.nptelvideos.in/2012/11/computer-organization.html>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Discussion and literature survey on real world use cases
- Quizzes



### III Semester

<b>OBJECT ORIENTED PROGRAMMING WITH JAVA LABORATORY</b>			
Course Code	<b>21CSL35</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	1	Exam Hours	03
<b>Course Objectives:</b>			
CLO 1. Demonstrate the use of Eclipse/Netbeans IDE to create Java Applications.			
CLO 2. Using java programming to develop programs for solving real-world problems.			
CLO 3. Reinforce the understanding of basic object-oriented programming concepts.			
<b>Note: two hours tutorial is suggested for each laboratory sessions.</b>			
<b>Prerequisite</b>			
<ul style="list-style-type: none"> <li>• Students should be familiarized about java installation and setting the java environment.</li> <li>• Usage of IDEs like Eclipse/Netbeans should be introduced.</li> </ul>			
<b>Sl. No.</b>	<b><i>PART A – List of problems for which student should develop program and execute in the Laboratory</i></b>		
1	Aim: Introduce the java fundamentals, data types, operators in java  Program: Write a java program that prints all real solutions to the quadratic equation $ax^2+bx+c=0$ . Read in a, b, c and use the quadratic formula.		
2	Aim: Demonstrating creation of java classes, objects, constructors, declaration and initialization of variables.  Program: Create a Java class called <b>Student</b> with the following details as variables within it. USN Name Branch Phone Write a Java program to create n Student objects and print the USN, Name, Branch, and Phone of these objects with suitable headings.		
3	Aim: Discuss the various Decision-making statements, loop constructs in java  Program: A. Write a program to check prime number B. Write a program for Arithmetic calculator using switch case menu		
4	Aim: Demonstrate the core object-oriented concept of Inheritance, polymorphism  Design a super class called <b>Staff</b> with details as StaffId, Name, Phone, Salary. Extend this class by writing three subclasses namely Teaching (domain, publications), Technical (skills), and Contract (period). Write a Java program to read and display at least 3 staff objects of all three categories.		
5	Aim: Introduce concepts of method overloading, constructor overloading, overriding.  Program: Write a java program demonstrating Method overloading and Constructor overloading.		
6	Aim: Introduce the concept of Abstraction, packages.  Program: Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), time converter (hours to minutes, seconds and vice versa) using packages.		
7	Aim: Introduction to abstract classes, abstract methods, and Interface in java		

	Program: Write a program to generate the resume. Create 2 Java classes Teacher (data: personal information, qualification, experience, achievements) and Student (data: personal information, result, discipline) which implements the java interface Resume with the method biodata().
8	Aim: Demonstrate creation of threads using Thread class and Runnable interface, multi-threaded programming.  Program: Write a Java program that implements a <b>multi-thread</b> application that has three threads. First thread generates a random integer for every 1 second; second thread computes the square of the number and prints; third thread will print the value of cube of the number.
9	Aim: Introduce java Collections.  Program: Write a program to perform string operations using ArrayList. Write functions for the following a. Append - add at end b. Insert – add at particular index c. Search d. List all string starts with given letter.
10	Aim: Exception handling in java, introduction to throwable class, throw, throws, finally.  Program: Write a Java program to read two integers a and b. <b>Compute</b> a/b and print, when b is not zero. Raise an exception when b is equal to zero.
11	Aim: Introduce File operations in java.  Program: Write a java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes
12	Aim: Introduce java Applet, awt, swings.  Programs: Develop an applet that displays a simple message in center of the screen. Develop a simple calculator using Swings.
<b>PART B – Practical Based Learning</b>	
01	A problem statement for each batch is to be generated in consultation with the co-examiner and student should develop an algorithm, program and execute the program for the given problem with appropriate outputs.
<b>Course Outcome (Course Skill Set)</b> At the end of the course the student will be able to:	
CO 1. Use Eclipse/NetBeans IDE to design, develop, debug Java Projects. CO 2. Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP. CO 3. Demonstrate the ability to design and develop java programs, analyze, and interpret object-oriented data and document results. CO 4. Apply the concepts of multiprogramming, exception/event handling, abstraction to develop robust programs. CO 5. Develop user friendly applications using File I/O and GUI concepts.	
<b>Assessment Details (both CIE and SEE)</b>  The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE). <b>Continuous Internal Evaluation (CIE):</b> CIE marks for the practical course is <b>50 Marks</b> . The split-up of CIE marks for record/ journal and test are in the ratio <b>60:40</b> . • Each experiment to be evaluated for conduction with observation sheet and record write-up.	

Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.

- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

#### **Semester End Evaluation (SEE):**

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- *Students can pick one experiment from the questions lot of PART A with equal choice to all the students in a batch. For PART B examiners should frame a question for each batch, student should develop an algorithm, program, execute and demonstrate the results with appropriate output for the given problem.*
- *Weightage of marks for PART A is 80% and for PART B is 20%. General rubrics suggested to be followed for part A and part B.*
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero (Not allowed for Part B).
- The duration of SEE is 03 hours
- Rubrics suggested in Annexure-II of Regulation book

#### **Suggested Learning Resources:**

1. E Balagurusamy, Programming with Java, Graw Hill, 6<sup>th</sup> Edition, 2019.
2. Herbert Schildt, C: Java the Complete Reference, McGraw Hill, 11<sup>th</sup> Edition, 2020

### III Semester

<b>MASTERING OFFICE (Practical based)</b>			
Course Code	<b>21CSL381</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:1:1:0	SEE Marks	50
Total Hours of Pedagogy	12T + 12P	Total Marks	100
Credits	01	Exam Hours	02
<b>Course Objectives:</b>			
<p>CLO 1. Understand the basics of computers and prepare documents and small presentations.</p> <p>CLO 2. Attain the knowledge about spreadsheet/worksheet with various options.</p> <p>CLO 3. Create simple presentations using templates various options available.</p> <p>CLO 4. Demonstrate the ability to apply application software in an office environment.</p> <p>CLO 5. Use MS Office to create projects, applications.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>MS-Word</b> -Working with Files, Text – Formatting, Moving, copying and pasting text, Styles – Lists – Bulleted and numbered lists, Nested lists, Formatting lists. Table Manipulations. Graphics – Adding clip Art, add an image from a file, editing graphics, Page formatting - Header and footers, page numbers, Protect the Document, Mail Merge, Macros – Creating &amp; Saving web pages, Hyperlinks.</p>			
<b>Textbook 1: Chapter 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-2</b>			
<p><b>MS-Excel-</b> Modifying a Worksheet – Moving through cells, adding worksheets, rows and columns, Resizing rows and columns, selecting cells, Moving and copying cells, freezing panes - Macros – recording and running. Linking worksheets - Sorting and Filling, Alternating text and numbers with Auto fill, Auto filling functions. Graphics – Adding clip art, add an image from a file, Charts – Using chart Wizard, Copy a chart to Microsoft Word.</p>			
<b>Textbook 1: Chapter 3</b>			
<b>Teaching-Learning Process</b>	Active Learning, Demonstration, presentation,		
<b>Module-3</b>			
<p><b>MS-Power Point</b> -Create a Presentation from a template- Working with Slides – Insert a new slide, applying a design template, changing slide layouts – Resizing a text box, Text box properties, delete a text box - Video and Audio effects, Color Schemes &amp; Backgrounds Adding clip art, adding an image from a file, Save as a web page.</p>			

<b>Textbook 1: Chapter 5</b>	
<b>Teaching-Learning Process</b>	Demonstration, presentation preparation for case studies
<b>Module-4</b>	
<b>MS-Access</b> - Using Access database wizard, pages and projects. Creating Tables – Create a Table in design view. Datasheet Records – Adding, Editing, deleting records, Adding and deleting columns Resizing rows and columns, finding data in a table & replacing, Print a datasheet. Queries - MS-Access.	
<b>Textbook 1: Chapter 4</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Practical based learning.
<b>Module-5</b>	
<b>Microsoft Outlook-</b> Introduction, Starting Microsoft Outlook, Outlook Today, Different Views In Outlook, Outlook Data Files	
<b>Textbook 1: Chapter 7</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Course Outcomes (Course Skill Set):</b> At the end of the course the student will be able to: CO 1. Know the basics of computers and prepare documents, spreadsheets, make small presentations with audio, video and graphs and would be acquainted with internet. CO 2. Create, edit, save and print documents with list tables, header, footer, graphic, spellchecker, mail merge and grammar checker CO 3. Attain the knowledge about spreadsheet with formula, macros spell checker etc. CO 4. Demonstrate the ability to apply application software in an office environment. CO 5. Use Google Suite for office data management tasks	
<b>Assessment Details (both CIE and SEE)</b>  The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE). <b>Continuous Internal Evaluation (CIE):</b> <b>NOTE: List of experiments to be prepared by the faculty based on the syllabus mentioned above</b> CIE marks for the practical course is <b>50 Marks</b> . The split-up of CIE marks for record/ journal and test are in the ratio <b>60:40</b> . <ul style="list-style-type: none"> <li>• Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.</li> <li>• Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.</li> <li>• Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).</li> <li>• Weightage to be given for neatness and submission of record/write-up on time.</li> <li>• Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.</li> <li>• In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.</li> <li>• The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book</li> <li>• The average of 02 tests is scaled down to <b>20 marks</b> (40% of the maximum marks).</li> </ul> The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.	
<b>Semester End Evaluation (SEE):</b>	

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- The duration of SEE is 02 hours

Rubrics suggested in Annexure-II of Regulation book

**Weblinks and Video Lectures (e-Resources):**

1. <https://youtu.be/9VRmgC2GRFE>
2. <https://youtu.be/rJPWi5x0g3I>
3. <https://youtu.be/tcj2BhhCMN4>
4. <https://youtu.be/ubmwp8kbfPc>
5. <https://youtu.be/i6eNvfQ8fTw>
6. <http://office.microsoft.com/en-us/training/CR010047968.aspx>
7. <https://gsuite.google.com/learning-center>
8. <http://spoken-tutorial.org>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Real world problem solving using group discussion.
- Real world examples of Windows Framework.

### III Semester

<b>PROGRAMMING IN C++</b>			
Course Code	<b>21CS382</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	12	Total Marks	100
Credits	01	Exam Hours	01
<b>Course Objectives:</b>			
CLO 1. Understanding about object oriented programming and Gain knowledge about the capability to store information together in an object. CLO 2. Understand the capability of a class to rely upon another class and functions. CLO 3. Understand about constructors which are special type of functions. CLO 4. Create and process data in files using file I/O functions CLO 5. Use the generic programming features of C++ including Exception handling.			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none"> <li>Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to Object Oriented Programming:</b> Computer programming background- C++ overview- First C++ Program -Basic C++ syntax, Object Oriented Programming: What is an object, Classes, methods and messages, abstraction and encapsulation, inheritance, abstract classes, polymorphism.			
<b>Textbook 1: Chapter 1(1.1 to 1.8)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-2</b>			
<b>Functions in C++:</b> Tokens – Keywords – Identifiers and constants – Operators in C++ – Scope resolution operator – Expressions and their types – Special assignment expressions – Function prototyping – Call by reference – Return by reference – Inline functions -Default arguments – Function overloading.			
<b>Textbook 2: Chapter 3(3.2,3.3,3.4,3.13,3.14,3.19, 3.20) , chapter 4(4.3,4.4,4.5,4.6,4.7,4.9)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration, presentation, problem solving		
<b>Module-3</b>			
<b>Inheritance &amp; Polymorphism:</b> Derived class Constructors, destructors-Types of Inheritance- Defining Derived classes, Single Inheritance, Multiple, Hierarchical Inheritance, Hybrid Inheritance.			
<b>Textbook 2: Chapter 6 (6.2,6.11) chapter 8 (8.1 to,8.8)</b>			

<b>Teaching-Learning Process</b>	Chalk and board, Demonstration, problem solving
<b>Module-4</b>	
<b>I/O Streams:</b> C++ Class Hierarchy- File Stream-Text File Handling- Binary File Handling during file operations.	
<b>Textbook 1: Chapter 12(12.5) , Chapter 13 (13.6,13.7)</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Practical based learning, practical's
<b>Module-5</b>	
<b>Exception Handling:</b> Introduction to Exception - Benefits of Exception handling- Try and catch block- Throw statement- Pre-defined exceptions in C++ .	
<b>Textbook 2: Chapter 13 (13.2 to13.6)</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Course Outcomes (Course Skill Set):</b> At the end of the course the student will be able to: CO 1. Able to understand and design the solution to a problem using object-oriented programming concepts. CO 2. Able to reuse the code with extensible Class types, User-defined operators and function Overloading. CO 3. Achieve code reusability and extensibility by means of Inheritance and Polymorphism CO 4. Identify and explore the Performance analysis of I/O Streams. CO 5. Implement the features of C++ including templates, exceptions and file handling for providing programmed solutions to complex problems.	
<b>Assessment Details (both CIE and SEE)</b> The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together <b>Continuous Internal Evaluation:</b> Three Unit Tests each of <b>20 Marks (duration 01 hour)</b> 1. First test at the end of 5 <sup>th</sup> week of the semester 2. Second test at the end of the 10 <sup>th</sup> week of the semester 3. Third test at the end of the 15 <sup>th</sup> week of the semester Two assignments each of <b>10 Marks</b> 4. First assignment at the end of 4 <sup>th</sup> week of the semester 5. Second assignment at the end of 9 <sup>th</sup> week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b> 6. At the end of the 13 <sup>th</sup> week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b> (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course). <b>CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.</b> <b>Semester End Examination:</b> Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject ( <b>duration 01 hours</b> ) SEE paper will be set for 50 questions of each of 01 marks. The pattern of the question paper is MCQ. The time allotted for SEE is 01 hours	



**Textbooks**

1. Bhushan Trivedi, "Programming with ANSI C++", Oxford Press, Second Edition, 2012.
2. Balagurusamy E, Object Oriented Programming with C++, Tata McGraw Hill Education Pvt.Ltd , Fourth Edition 2010.

**Reference Books**

1. Bhave , " Object Oriented Programming With C++", Pearson Education , 2004.
2. Ray Lischner, "Exploring C++ : The programmer's introduction to C++" , apress, 2010
3. Bhave , " Object Oriented Programming With C++", Pearson Education , 2004

**Weblinks and Video Lectures (e-Resources):**

1. Basics of C++ - <https://www.youtube.com/watch?v=BCIS40yzssA>
2. Functions of C++ - <https://www.youtube.com/watch?v=p8ehAjZWjPw>

**Tutorial Link:**

1. [https://www.w3schools.com/cpp/cpp\\_intro.asp](https://www.w3schools.com/cpp/cpp_intro.asp)
2. <https://www.edx.org/course/introduction-to-c-3>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- **Demonstration of simple projects**

## IV Semester

<b>MATHEMATICAL FOUNDATIONS FOR COMPUTING</b>			
Course Code:	<b>21CS41</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Objectives:</b>			
<p>CLO 1. Understand an intense foundational introduction to fundamental concepts in discrete mathematics.</p> <p>CLO 2. Interpret, identify, and solve the language associated with logical structure, sets, relations and functions, modular arithmetic.</p> <p>CLO 3. To develop probability distribution of discrete and continuous random variables. Joint probability distribution occurs in digital signal processing, design engineering and microwave engineering.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>Show Video/animation films to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Topics will be introduced in a multiple representation.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> </ol> <p>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</p>			
<b>Module-1</b>			
<b>Fundamentals of Logic:</b> Basic Connectives and Truth Tables, Logical Equivalence – The Laws of Logic, Logical Implication – Rules of Inference. Fundamentals of Logic contd.: The Use of Quantifiers, Quantifiers, Definitions, and the Proofs of Theorems.			
<b>Self-study:</b> Problems on Logical equivalence.			
<b>Teaching-Learning Process</b>	Chalk and Board, Problem based learning		
<b>Module-2</b>			
<b>Relations and Functions:</b> Cartesian Products and Relations, Functions – Plain and One-to-One, Onto Functions. Function Composition, and Inverse Functions.			
<b>Relations:</b> Properties of Relations, Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders – Hasse Diagrams, Equivalence Relations and Partitions.			
<b>Introduction to Graph Theory:</b> Definitions and Examples, Subgraphs, Complements, and Graph Isomorphism, Vertex Degree, Euler Trails and Circuits.			
<b>Self-study:</b> The Pigeon-hole Principle, problems and its applications			
<b>Teaching-Learning Process</b>	Chalk and Board, Problem based learning		
<b>Module-3</b>			
<b>Statistical Methods:</b> Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression –problems.			

**Curve Fitting:** Curve fitting by the method of least squares- fitting the curves of the form-  
 $y = ax + b$ ,  $y = ax^b$  and  $y = ax^2 + bx + c$

**Self-study:** Angle between two regression lines, problems. Fitting of the curve  $y = a b^x$

<b>Teaching-Learning Process</b>	Chalk and Board, Problem based learning
----------------------------------	---

**Module-4**

**Probability Distributions:** Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)- Illustrative examples.

**Self-study:** exponential distribution.

<b>Teaching-Learning Process</b>	Chalk and Board, Problem based learning
----------------------------------	---

**Module-5**

**Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.

**Sampling Theory:** Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.

**Self-Study:** Point estimation and interval estimation.

<b>Teaching-Learning Process</b>	Chalk and Board, Problem based learning
----------------------------------	---

**Course Outcomes (Course Skill Set)**

At the end of the course the student will be able to:

- CO 1. Apply the concepts of logic for effective computation and relating problems in the Engineering domain.
- CO 2. Analyze the concepts of functions and relations to various fields of Engineering. Comprehend the concepts of Graph Theory for various applications of Computational sciences.
- CO 3. Apply discrete and continuous probability distributions in analysing the probability models arising in the engineering field.
- CO 4. Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
- CO 5. Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20**

**Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:****Books**

1. Ralph P. Grimaldi and B V Ramana, Discrete and Combinatorial Mathematics- An Applied Introduction, Pearson Education, Asia, Fifth edition – 2007. ISBN 978-81-7758-424-0.
2. Higher Engineering Mathematics B. S. Grewal Khanna Publishers 44th Edition, 2017

**Reference Books:**

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata – McGraw Hill, Sixth Edition, Sixth reprint 2008. ISBN-(13):978-0-07-064824-1.
2. C. L. Liu and D P Mohapatra, Elementary Discrete Mathematics, Tata- McGraw Hill, Sixth Edition, ISBN:10:0-07-066913-9.
3. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata – McGraw Hill, 35TH reprint 2008. ISBN 13:978-0-07-463113-3.
4. Advanced Engineering Mathematics C. Ray Wylie, Louis C.Barrett McGraw-Hill 6th Edition 1995
5. Higher Engineering Mathematics B. V. Ramana McGraw-Hill 11th Edition,2010
6. A Text-Book of Engineering Mathematics N. P. Bali and Manish Goyal Laxmi Publications 2014
7. Advanced Engineering Mathematics Chandrika Prasad and Reena Garg Khanna Publishing, 2018

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.youtube.com/watch?v=9AUCdsmBGmA&list=PL0862D1A947252D20&index=10>
2. <https://www.youtube.com/watch?v=oU60TuGHxe0&list=PL0862D1A947252D20&index=11>
3. [https://www.youtube.com/watch?v=\\_BIKq9Xo\\_5A&list=PL0862D1A947252D20&index=13](https://www.youtube.com/watch?v=_BIKq9Xo_5A&list=PL0862D1A947252D20&index=13)
4. <https://www.youtube.com/watch?v=RMLR2JHHeWo&list=PL0862D1A947252D20&index=14>
5. [https://www.youtube.com/watch?v=nf9e0\\_ylGdc&list=PL0862D1A947252D20&index=15](https://www.youtube.com/watch?v=nf9e0_ylGdc&list=PL0862D1A947252D20&index=15)
6. <https://www.youtube.com/watch?v=7cTWea9YAJE&list=PL0862D1A947252D20&index=24>
7. <https://www.youtube.com/watch?v=695iAm935cY&list=PL0862D1A947252D20&index=25>
8. <https://www.youtube.com/watch?v=ZECJHfsf4Vs&list=PL0862D1A947252D20&index=26>
9. <https://www.youtube.com/watch?v=Dsi7x-A89Mw&list=PL0862D1A947252D20&index=28>
10. <https://www.youtube.com/watch?v=xlUFkMKS3Y&list=PL0862D1A947252D20>
11. <https://www.youtube.com/watch?v=0uTE24o3q-o&list=PL0862D1A947252D20&index=2>
12. <https://www.youtube.com/watch?v=DmClft8ypks&list=PL0862D1A947252D20&index=3>
13. <https://www.youtube.com/watch?v=jNeISigUCo0&list=PL0862D1A947252D20&index=4>
14. <http://nptel.ac.in/courses.php?disciplineID=111>
15. [http://www.class-central.com/subject/math\(MOOCs\)](http://www.class-central.com/subject/math(MOOCs))
16. <http://academicearth.org/>
17. VTU EDUSAT PROGRAMME - 20

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**



## IV Semester

<b>DESIGN AND ANALYSIS OF ALGORITHMS</b>			
Course Code	<b>21CS42</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03
<b>Course Learning Objectives:</b>			
<p>CLO 1. Explain the methods of analysing the algorithms and to analyze performance of algorithms.</p> <p>CLO 2. State algorithm's efficiencies using asymptotic notations.</p> <p>CLO 3. Solve problems using algorithm design methods such as the brute force method, greedy method, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking and branch and bound.</p> <p>CLO 4. Choose the appropriate data structure and algorithm design method for a specified application.</p> <p>CLO 5. Introduce P and NP classes.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>2. Show Video/animation films to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Topics will be introduced in a multiple representation.</li> <li>7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Introduction:</b> What is an Algorithm? It's Properties. Algorithm Specification-using natural language, using Pseudo code convention, Fundamentals of Algorithmic Problem solving, Analysis Framework-Time efficiency and space efficiency, Worst-case, Best-case and Average case efficiency.</p> <p><b>Performance Analysis:</b> Estimating Space complexity and Time complexity of algorithms.</p> <p><b>Asymptotic Notations:</b> Big-Oh notation (<math>O</math>), Omega notation (<math>\Omega</math>), Theta notation (<math>\Theta</math>) with examples, Basic efficiency classes, Mathematical analysis of Non-Recursive and Recursive Algorithms with Examples.</p> <p><b>Brute force design technique:</b> Selection sort, sequential search, string matching algorithm with complexity Analysis.</p> <p><b>Textbook 1:</b> Chapter 1 (Sections 1.1,1.2), Chapter 2(Sections 2.1,2.2,2.3,2.4), Chapter 3(Section 3.1,3.2)</p> <p><b>Textbook 2:</b> Chapter 1(section 1.1,1.2,1.3)</p>			
<b>Laboratory Component:</b>			

<p>1. Sort a given set of n integer elements using Selection Sort method and compute its time complexity. Run the program for varied values of n&gt; 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C++/Java how the brute force method works along with its time complexity analysis: worst case, average case and best case.</p>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Problem based Learning.</li> <li>2. Chalk &amp; board, Active Learning.</li> <li>3. Laboratory Demonstration.</li> </ol>
<b>Module-2</b>	
<p><b>Divide and Conquer:</b> General method, Recurrence equation for divide and conquer, solving it using Master's theorem. , Divide and Conquer algorithms and complexity Analysis of Finding the maximum &amp; minimum, Binary search, Merge sort, Quick sort.</p> <p><b>Decrease and Conquer Approach:</b> Introduction, Insertion sort, Graph searching algorithms, Topological Sorting. It's efficiency analysis.</p> <p><b>Textbook 2: Chapter 3(Sections 3.1,3.3,3.4,3.5,3.6)</b></p> <p><b>Textbook 1: Chapter 4 (Sections 4.1,4.2,4.3), Chapter 5(Section 5.1,5.2,5.3)</b></p>	
<b>Laboratory Component:</b>	
<ol style="list-style-type: none"> <li>1. Sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n&gt; 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C++/Java how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.</li> <li>2. Sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n&gt; 5000, and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C++/Java how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.</li> </ol>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Chalk &amp; board, Active Learning, MOOC, Problem based Learning.</li> <li>2. Laboratory Demonstration.</li> </ol>
<b>Module-3</b>	
<p><b>Greedy Method:</b> General method, Coin Change Problem, Knapsack Problem, solving Job sequencing with deadlines Problems.</p> <p><b>Minimum cost spanning trees:</b> Prim's Algorithm, Kruskal's Algorithm with performance analysis.</p> <p><b>Single source shortest paths:</b> Dijkstra's Algorithm.</p> <p><b>Optimal Tree problem:</b> Huffman Trees and Codes.</p> <p><b>Transform and Conquer Approach:</b> Introduction, Heaps and Heap Sort.</p> <p><b>Textbook 2: Chapter 4(Sections 4.1,4.3,4.5)</b></p> <p><b>Textbook 1: Chapter 9(Section 9.1,9.2,9.3,9.4), Chapter 6( section 6.4)</b></p>	
<b>Laboratory Component:</b>	

Write & Execute C++/Java Program

1. To solve Knapsack problem using Greedy method.
2. To find shortest paths to other vertices from a given vertex in a weighted connected graph, using Dijkstra's algorithm.
3. To find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm. Use Union-Find algorithms in your program.
4. To find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.

**Teaching-Learning Process**

1. Chalk & board, Active Learning, MOOC, Problem based Learning.
2. Laboratory Demonstration.

#### **Module-4**

**Dynamic Programming:** General method with Examples, Multistage Graphs.

**Transitive Closure:** Warshall's Algorithm. **All Pairs Shortest Paths:** Floyd's Algorithm, Knapsack problem, Bellman-Ford Algorithm, Travelling Sales Person problem.

**Space-Time Tradeoffs:** Introduction, Sorting by Counting, Input Enhancement in String Matching-Harspool's algorithm.

**Textbook 2: Chapter 5 (Sections 5.1,5.2,5.4,5.9)**

**Textbook 1: Chapter 8(Sections 8.2,8.4), Chapter 7 (Sections 7.1,7.2)**

**Laboratory Component:**

Write C++/ Java programs to

1. Solve All-Pairs Shortest Paths problem using Floyd's algorithm.
2. Solve Travelling Sales Person problem using Dynamic programming.
3. Solve 0/1 Knapsack problem using Dynamic Programming method.

**Teaching-Learning Process**

1. Chalk & board, Active Learning, MOOC, Problem based Learning.
2. Laboratory Demonstration.

#### **Module-5**

**Backtracking:** General method, solution using back tracking to N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles Problems.

**Branch and Bound:** Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem

**NP-Complete and NP-Hard problems:** Basic concepts, non- deterministic algorithms, P, NP, NP-Complete, and NP-Hard classes.

**Textbook 1: Chapter 12 (Sections 12.1,12.2) Chapter 11(11.3)**

**Textbook 2: Chapter 7 (Sections 7.1,7.2,7.3,7.4,7.5) Chapter 11 (Section 11.1)**

**Laboratory Component:**

1. Design and implement C++/Java Program to find a subset of a given set  $S = \{S_1, S_2, \dots, S_n\}$  of  $n$  positive integers whose SUM is equal to a given positive integer  $d$ . For example, if  $S = \{1, 2, 5, 6, 8\}$  and  $d = 9$ , there are two solutions  $\{1, 2, 6\}$  and  $\{1, 8\}$ . Display a suitable message, if the given problem instance doesn't have a solution.



- Design and implement C++/Java Program to find all Hamiltonian Cycles in a connected undirected Graph G of n vertices using backtracking principle.

#### Teaching-Learning Process

- Chalk & board, Active Learning, MOOC, Problem based learning.
- Laboratory Demonstration.

#### Course outcome (Course Skill Set)

At the end of the course the student will be able to:

- CO 1. Analyze the performance of the algorithms, state the efficiency using asymptotic notations and analyze mathematically the complexity of the algorithm.
- CO 2. Apply divide and conquer approaches and decrease and conquer approaches in solving the problems analyze the same
- CO 3. Apply the appropriate algorithmic design technique like greedy method, transform and conquer approaches and compare the efficiency of algorithms to solve the given problem.
- CO 4. Apply and analyze dynamic programming approaches to solve some problems. and improve an algorithm time efficiency by sacrificing space.
- CO 5. Apply and analyze backtracking, branch and bound methods and to describe P, NP and NP-Complete problems.

#### Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

#### Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

- First test at the end of 5<sup>th</sup> week of the semester
- Second test at the end of the 10<sup>th</sup> week of the semester
- Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4<sup>th</sup> week of the semester
- Second assignment at the end of 9<sup>th</sup> week of the semester

Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to **20 marks**.

*Note: Minimum of 80% of the laboratory components have to be covered.*

- Rubrics for each Experiment taken average for all Lab components – 15 Marks.
- Viva-Voce– 5 Marks (more emphasized on demonstration topics)

The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

#### **Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

#### **Suggested Learning Resources:**

##### **Textbooks**

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin: 2nd Edition, 2009. Pearson.
2. Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Press.

##### **Reference Books**

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
2. Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

#### **Weblinks and Video Lectures (e-Resources):**

1. <http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS43.html>
2. <https://nptel.ac.in/courses/106/101/106101060/>
3. <http://elearning.vtu.ac.in/econtent/courses/video/FEP/ADA.html>
4. <http://cse01-iiith.vlabs.ac.in/>
5. <http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms>

#### **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

1. Real world problem solving and puzzles using group discussion. E.g., Fake coin identification, Peasant, wolf, goat, cabbage puzzle, Konigsberg bridge puzzle etc.,
2. Demonstration of solution to a problem through programming.

## IV Semester

<b>MICROCONTROLLER AND EMBEDDED SYSTEMS</b>			
Course Code	<b>21CS43</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03
<b>Course Learning Objectives:</b>			
CLO 1: Understand the fundamentals of ARM-based systems, including programming modules with registers and the CPSR.			
CLO 2: Use the various instructions to program the ARM controller.			
CLO 3: Program various embedded components using the embedded C program.			
CLO 4: Identify various components, their purpose, and their application to the embedded system's applicability.			
CLO 5: Understand the embedded system's real-time operating system and its application in IoT.			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> <li>1. The lecturer method (L) does not mean only the traditional lecture method, but different types of teaching methods may be adopted to develop the outcomes.</li> <li>2. Show video/animation films to explain the functioning of various concepts.</li> <li>3. Encourage collaborative (group learning) learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Topics will be introduced in multiple representations.</li> <li>7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world, and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
Microprocessors versus Microcontrollers, ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software.			
<b>ARM Processor Fundamentals:</b> Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions			
<b>Textbook 1: Chapter 1 - 1.1 to 1.4, Chapter 2 - 2.1 to 2.5</b>			
<b>Laboratory Component:</b>			
<ol style="list-style-type: none"> <li>1. Using Keil software, observe the various registers, dump, CPSR, with a simple ALP programme.</li> </ol>			
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Demonstration of registers, memory access, and CPSR in a programme module.</li> <li>2. For concepts, numerical, and discussion, use chalk and a whiteboard, as well as a PowerPoint presentation.</li> </ol>		
<b>Module-2</b>			
<b>Introduction to the ARM Instruction Set:</b> Data Processing Instructions , Branch Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants			
<b>C Compilers and Optimization :</b> Basic C Data Types, C Looping Structures, Register Allocation, Function			

Calls, Pointer Aliasing,

**Textbook 1: Chapter 3: Sections 3.1 to 3.6 (Excluding 3.5.2), Chapter 5**

**Laboratory Component:**

2. Write a program to find the sum of the first 10 integer numbers.
3. Write a program to find the factorial of a number.
4. Write a program to add an array of 16 bit numbers and store the 32 bit result in internal RAM.
5. Write a program to find the square of a number (1 to 10) using a look-up table.
6. Write a program to find the largest or smallest number in an array of 32 numbers.

**Teaching-Learning Process**

1. Demonstration of sample code using Keil software.
2. Laboratory Demonstration

**Module-3**

**C Compilers and Optimization :**Structure Arrangement, Bit-fields, Unaligned Data and Endianness, Division, Floating Point, Inline Functions and Inline Assembly, Portability Issues.

**ARM programming using Assembly language:** Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs

**Textbook 1: Chapter-5,6**

**Laboratory Component:**

1. Write a program to arrange a series of 32 bit numbers in ascending/descending order.
2. Write a program to count the number of ones and zeros in two consecutive memory locations.
3. Display "Hello World" message using Internal UART.

**Teaching-Learning Process**

1. Demonstration of sample code using Keil software.
2. Chalk and Board for numerical

**Module-4**

**Embedded System Components:** Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems, purpose of embedded systems.

Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators, LED, 7 segment LED display, stepper motor, Keyboard, Push button switch, Communication Interface (onboard and external types), Embedded firmware, Other system components.

**Textbook 2: Chapter 1 (Sections 1.2 to 1.6), Chapter 2 (Sections 2.1 to 2.6)**

**Laboratory Component:**

1. Interface and Control a DC Motor.
2. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
3. Determine Digital output for a given Analog input using Internal ADC of ARM controller.
4. Interface a DAC and generate Triangular and Square waveforms.
5. Interface a 4x4 keyboard and display the key code on an LCD.
6. Demonstrate the use of an external interrupt to toggle an LED On/Off.
7. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.

**Teaching-Learning Process**

1. Demonstration of sample code for various embedded components using keil.
2. Chalk and Board for numerical and discussion

**Module-5**

**RTOS and IDE for Embedded System Design:** Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Multiprocessing and Multitasking, Task Communication (without any program), Task synchronization

issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment – Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques, target hardware debugging, boundary scan.

**Textbook 2: Chapter-10 (Sections 10.1, 10.2, 10.3, 10.4 , 10.7, 10.8.1.1, 10.8.1.2, 10.8.2.2, 10.10 only), Chapter 12, Chapter-13 ( block diagram before 13.1, 13.3, 13.4, 13.5, 13.6 only)**

**Laboratory Component:**

1. Demonstration of IoT applications by using Arduino and Raspberry Pi

**Teaching-Learning Process**

1. Chalk and Board for numerical and discussion
2. Significance of real time operating system[RTOS] using raspberry pi

**Course outcome (Course Skill Set)**

At the end of the course, the student will be able to:

- CO 1. Explain C-Compilers and optimization
- CO 2. Describe the ARM microcontroller's architectural features and program module.
- CO 3. Apply the knowledge gained from programming on ARM to different applications.
- CO 4. Program the basic hardware components and their application selection method.
- CO 5. Demonstrate the need for a real-time operating system for embedded system applications.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to **20 marks**.

*Note: Minimum of 80% of the laboratory components have to be covered.*

- Rubrics for each Experiment taken average for all Lab components – 15 Marks.
- Viva-Voce– 5 Marks (more emphasized on demonstration topics)

The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:****Textbooks**

1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.
2. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2<sup>nd</sup> Edition.

**Reference Books**

1. Raghunandan. G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication,2019
2. The Insider's Guide to the ARM7 Based Microcontrollers, Hitex Ltd.,1st edition, 2005.
3. Steve Furber, ARM System-on-Chip Architecture, Second Edition, Pearson, 2015.
4. Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2nd Edition, 2008.

**Weblinks and Video Lectures (e-Resources):****Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## IV Semester

<b>OPERATING SYSTEMS</b>			
Course Code:	<b>21CS44</b>	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Objectives:</b>			
<p>CLO 1. Demonstrate the need for OS and different types of OS</p> <p>CLO 2. Apply suitable techniques for management of different resources</p> <p>CLO 3. Use processor, memory, storage and file system commands</p> <p>CLO 4. Realize the different concepts of OS in platform of usage through case studies</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Introduction to operating systems, System structures:</b> What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Special-purpose systems; Computing environments.</p> <p><b>Operating System Services:</b> User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines; Operating System generation; System boot.</p> <p><b>Process Management:</b> Process concept; Process scheduling; Operations on processes; Inter process communication</p>			
<b>Textbook 1: Chapter - 1,2,3</b>			
<b>Teaching-Learning Process</b>	<p>Active learning and problem solving</p> <ol style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=vBURTt97EkA&amp;list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2Q">https://www.youtube.com/watch?v=vBURTt97EkA&amp;list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2Q</a></li> <li><a href="https://www.youtube.com/watch?v=a2B69vCtjOU&amp;list=PL3-wYxht4yCjpcfUDz-TgD_ainZ2K3MUZ&amp;index=2">https://www.youtube.com/watch?v=a2B69vCtjOU&amp;list=PL3-wYxht4yCjpcfUDz-TgD_ainZ2K3MUZ&amp;index=2</a></li> </ol>		
<b>Module-2</b>			
<p><b>Multi-threaded Programming:</b> Overview; Multithreading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Multiple-processor</p>			

scheduling; Thread scheduling.	
<b>Process Synchronization:</b> Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors.	
<b>Textbook 1: Chapter - 4,5</b>	
<b>Teaching-Learning Process</b>	Active Learning and problem solving 1. <a href="https://www.youtube.com/watch?v=HW2Wcx-ktsc">https://www.youtube.com/watch?v=HW2Wcx-ktsc</a> 2. <a href="https://www.youtube.com/watch?v=9YRxlvt9Zo">https://www.youtube.com/watch?v=9YRxlvt9Zo</a>
<b>Module-3</b>	
<b>Deadlocks:</b> Deadlocks; System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.	
<b>Memory Management:</b> Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.	
<b>Textbook 1: Chapter - 7,8</b>	
<b>Teaching-Learning Process</b>	Active Learning, Problem solving based on deadlock with animation 1. <a href="https://www.youtube.com/watch?v=MYgmmJjfdBg">https://www.youtube.com/watch?v=MYgmmJjfdBg</a> 2. <a href="https://www.youtube.com/watch?v=Y14b7_T3AEw&amp;list=PLEJxKK7AcSEGPOCFtQTJhOEIU44J_JAun&amp;index=30">https://www.youtube.com/watch?v=Y14b7_T3AEw&amp;list=PLEJxKK7AcSEGPOCFtQTJhOEIU44J_JAun&amp;index=30</a>
<b>Module-4</b>	
<b>Virtual Memory Management:</b> Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.	
<b>File System, Implementation of File System:</b> File system: File concept; Access methods; Directory structure; File system mounting; File sharing; Protection: Implementing File system: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management.	
<b>Textbook 1: Chapter - 9,10,11</b>	
<b>Teaching-Learning Process</b>	Active learning about memory management and File system 1. <a href="https://www.youtube.com/watch?v=pl6qrCB8pDw&amp;list=PLIY8eNdw5tW-BxRY0yK3fTYVqytw8qhp">https://www.youtube.com/watch?v=pl6qrCB8pDw&amp;list=PLIY8eNdw5tW-BxRY0yK3fTYVqytw8qhp</a> 2. <a href="https://www.youtube.com/watch?v=-orfHvNBzY">https://www.youtube.com/watch?v=-orfHvNBzY</a>
<b>Module-5</b>	
<b>Secondary Storage Structures, Protection:</b> Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management. Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix, Implementation of access matrix, Access control, Revocation of access rights, Capability- Based systems.	
<b>Case Study: The Linux Operating System:</b> Linux history; Design principles; Kernel modules; Process management; Scheduling; Memory Management; File systems, Input and output; Inter-process communication.	
<b>Textbook 1: Chapter - 2,21</b>	
<b>Teaching-Learning Process</b>	Active learning about case studies 1. <a href="https://www.youtube.com/watch?v=TTBkc5eiju4">https://www.youtube.com/watch?v=TTBkc5eiju4</a> 2. <a href="https://www.youtube.com/watch?v=8hkvMRGTzCM&amp;list=PLEAYkSg4uSQ2PAch478muxnoeTNz_QeUJ&amp;index=36">https://www.youtube.com/watch?v=8hkvMRGTzCM&amp;list=PLEAYkSg4uSQ2PAch478muxnoeTNz_QeUJ&amp;index=36</a> 3. <a href="https://www.youtube.com/watch?v=mX1FEur4VCw">https://www.youtube.com/watch?v=mX1FEur4VCw</a>
<b>Course Outcomes (Course Skill Set)</b>	
At the end of the course the student will be able to:	
CO 1. Identify the structure of an operating system and its scheduling mechanism.	



- CO 2. Demonstrate the allocation of resources for a process using scheduling algorithm.
- CO 3. Identify root causes of deadlock and provide the solution for deadlock elimination
- CO 4. Explore about the storage structures and learn about the Linux Operating system.
- CO 5. Analyze Storage Structures and Implement Customized Case study

### Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

#### Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

#### Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

### Suggested Learning Resources:

#### Textbooks

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 7th edition, Wiley-India, 2006

#### Reference Books

1. Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition
2. D.M Dhamdhare, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.
3. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE), 2014.
4. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.

#### Weblinks and Video Lectures (e-Resources):

1. [https://www.youtube.com/watch?v=vBURTt97EkA&list=PLBlnK6fEygRiVhbXDGLXDk\\_OQAeuVcp2O](https://www.youtube.com/watch?v=vBURTt97EkA&list=PLBlnK6fEygRiVhbXDGLXDk_OQAeuVcp2O)
2. <https://www.youtube.com/watch?v=783KAB->

- tuE4&list=PLIemF3uozcAKTgsCIj82voMK3TMROYE\_f
3. <https://www.youtube.com/watch?v=3-ITLMMeeXY&list=PL3pGy4HtqwD0n7bQfHjPnsWzkeR-n6mk0>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Real world problem solving using group discussion.
- Role play for process scheduling.
- Present animation for Deadlock.
- Real world examples of memory management concepts

#### IV Semester

<b>PYTHON PROGRAMMING LABORATORY</b>			
Course Code	<b>21CSL46</b>	CIE Marks	50
Teaching Hours/Weeks (L: T: P: S)	0: 0: 2: 0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	01	Exam Hours	03
<b>Course Objectives:</b>			
CLO 1. Demonstrate the use of IDLE or PyCharm IDE to create Python Applications			
CLO 2. Using Python programming language to develop programs for solving real-world problems			
CLO 3. Implement the Object-Oriented Programming concepts in Python.			
CLO 4. Appraise the need for working with various documents like Excel, PDF, Word and Others			
CLO 5. Demonstrate regular expression using python programming			
<b>Note: two hours tutorial is suggested for each laboratory sessions.</b>			
<b>Prerequisite</b>			
<ul style="list-style-type: none"> <li>• Students should be familiarized about Python installation and setting Python environment</li> <li>• Usage of IDLE or IDE like PyCharm should be introduced            Python Installation: <a href="https://www.youtube.com/watch?v=Kn1HF3oD19c">https://www.youtube.com/watch?v=Kn1HF3oD19c</a>            PyCharm Installation: <a href="https://www.youtube.com/watch?v=SZUNUB6nz3g">https://www.youtube.com/watch?v=SZUNUB6nz3g</a></li> </ul>			
<b>Sl. No.</b>	<b><i>PART A – List of problems for which student should develop program and execute in the Laboratory</i></b>		
1	<p><b>Aim:</b> Introduce the Python fundamentals, data types, operators, flow control and exception handling in Python</p> <p>a) Write a python program to find the best of two test average marks out of three test's marks accepted from the user.</p> <p>b) Develop a Python program to check whether a given number is palindrome or not and also count the number of occurrences of each digit in the input number.</p> <p>Datatypes: <a href="https://www.youtube.com/watch?v=gCCVsvgR2KU">https://www.youtube.com/watch?v=gCCVsvgR2KU</a>            Operators: <a href="https://www.youtube.com/watch?v=v5MR5JnKcZI">https://www.youtube.com/watch?v=v5MR5JnKcZI</a>            Flow Control: <a href="https://www.youtube.com/watch?v=PqFKRqpHrjw">https://www.youtube.com/watch?v=PqFKRqpHrjw</a>            For loop: <a href="https://www.youtube.com/watch?v=0ZvaDa8eT5s">https://www.youtube.com/watch?v=0ZvaDa8eT5s</a>            While loop: <a href="https://www.youtube.com/watch?v=HZARlmviDxg">https://www.youtube.com/watch?v=HZARlmviDxg</a>            Exceptions: <a href="https://www.youtube.com/watch?v=6SPDvPK38tw">https://www.youtube.com/watch?v=6SPDvPK38tw</a></p>		
2	<p><b>Aim:</b> Demonstrating creation of functions, passing parameters and return values</p> <p>a) Defined as a function F as <math>F_n = F_{n-1} + F_{n-2}</math>. Write a Python program which accepts a value for N (where <math>N &gt; 0</math>) as input and pass this value to the function. Display suitable error message if the condition for input value is not followed.</p> <p>b) Develop a python program to convert binary to decimal, octal to hexadecimal using functions.</p> <p>Functions: <a href="https://www.youtube.com/watch?v=BVfCWuca9nw">https://www.youtube.com/watch?v=BVfCWuca9nw</a>            Arguments: <a href="https://www.youtube.com/watch?v=ijXMGpoMkhQ">https://www.youtube.com/watch?v=ijXMGpoMkhQ</a>            Return value: <a href="https://www.youtube.com/watch?v=nuNXiEDnM44">https://www.youtube.com/watch?v=nuNXiEDnM44</a></p>		
3	<p><b>Aim:</b> Demonstration of manipulation of strings using string methods</p> <p>a) Write a Python program that accepts a sentence and find the number of words, digits, uppercase letters and lowercase letters.</p>		

	<p>b) Write a Python program to find the string similarity between two given strings</p> <p><b>Sample Output:</b>  Original string:  Python Exercises  Python Exercises  Similarity between two said strings:  1.0</p> <p><b>Sample Output:</b>  Original string:  Python Exercises  Python Exercise  Similarity between two said strings:  0.967741935483871</p> <p>Strings: <a href="https://www.youtube.com/watch?v=ISItwlnF0eU">https://www.youtube.com/watch?v=ISItwlnF0eU</a>  String functions: <a href="https://www.youtube.com/watch?v=9a3CxJyTq00">https://www.youtube.com/watch?v=9a3CxJyTq00</a></p>
4	<p><b>Aim:</b> Discuss different collections like list, tuple and dictionary</p> <p>a) Write a python program to implement insertion sort and merge sort using lists  b) Write a program to convert roman numbers in to integer values using dictionaries.</p> <p>Lists: <a href="https://www.youtube.com/watch?v=Eaz5e6M8tL4">https://www.youtube.com/watch?v=Eaz5e6M8tL4</a>  List methods: <a href="https://www.youtube.com/watch?v=8-RDVWGktuI">https://www.youtube.com/watch?v=8-RDVWGktuI</a>  Tuples: <a href="https://www.youtube.com/watch?v=bdS4dHIJGbc">https://www.youtube.com/watch?v=bdS4dHIJGbc</a>  Tuple operations: <a href="https://www.youtube.com/watch?v=TItKabcTTQ4">https://www.youtube.com/watch?v=TItKabcTTQ4</a>  Dictionary: <a href="https://www.youtube.com/watch?v=4Q0pW8XB0kc">https://www.youtube.com/watch?v=4Q0pW8XB0kc</a>  Dictionary methods: <a href="https://www.youtube.com/watch?v=oLeNHuORpNY">https://www.youtube.com/watch?v=oLeNHuORpNY</a></p>
5	<p><b>Aim:</b> Demonstration of pattern recognition with and without using regular expressions</p> <p>a) Write a function called isphonenumber () to recognize a pattern 415-555-4242 without using regular expression and also write the code to recognize the same pattern using regular expression.  b) Develop a python program that could search the text in a file for phone numbers (+919900889977) and email addresses (<a href="mailto:sample@gmail.com">sample@gmail.com</a>)</p> <p>Regular expressions: <a href="https://www.youtube.com/watch?v=LnzFnZfHLS4">https://www.youtube.com/watch?v=LnzFnZfHLS4</a></p>
6	<p><b>Aim:</b> Demonstration of reading, writing and organizing files.</p> <p>a) Write a python program to accept a file name from the user and perform the following operations</p> <ol style="list-style-type: none"> <li>1. Display the first N line of the file</li> <li>2. Find the frequency of occurrence of the word accepted from the user in the file</li> </ol> <p>b) Write a python program to create a ZIP file of a particular folder which contains several files inside it.</p> <p>Files: <a href="https://www.youtube.com/watch?v=vuyb7CxZgbU">https://www.youtube.com/watch?v=vuyb7CxZgbU</a>  <a href="https://www.youtube.com/watch?v=FqcjKewJTQ0">https://www.youtube.com/watch?v=FqcjKewJTQ0</a></p> <p>File organization: <a href="https://www.youtube.com/watch?v=MRuq3SRXses">https://www.youtube.com/watch?v=MRuq3SRXses</a></p>
7	<p><b>Aim:</b> Demonstration of the concepts of classes, methods, objects and inheritance</p>

	<p>a) By using the concept of inheritance write a python program to find the area of triangle, circle and rectangle.</p> <p>b) Write a python program by creating a class called Employee to store the details of Name, Employee_ID, Department and Salary, and implement a method to update salary of employees belonging to a given department.</p> <p>OOP's concepts: <a href="https://www.youtube.com/watch?v=qiSCMNBIP2g">https://www.youtube.com/watch?v=qiSCMNBIP2g</a>  Inheritance: <a href="https://www.youtube.com/watch?v=Cn7AkDb4pIU">https://www.youtube.com/watch?v=Cn7AkDb4pIU</a></p>
8	<p><b>Aim:</b> Demonstration of classes and methods with polymorphism and overriding</p> <p>a) Write a python program to find the whether the given input is palindrome or not (for both string and integer) using the concept of polymorphism and inheritance.</p> <p>Overriding: <a href="https://www.youtube.com/watch?v=CcTzTuIsoFk">https://www.youtube.com/watch?v=CcTzTuIsoFk</a></p>
9	<p><b>Aim:</b> Demonstration of working with excel spreadsheets and web scraping</p> <p>a) Write a python program to download the all XKCD comics</p> <p>b) Demonstrate python program to read the data from the spreadsheet and write the data in to the spreadsheet</p> <p>Web scraping: <a href="https://www.youtube.com/watch?v=ng2o98k983k">https://www.youtube.com/watch?v=ng2o98k983k</a></p> <p>Excel: <a href="https://www.youtube.com/watch?v=nsKNPHJ9iPc">https://www.youtube.com/watch?v=nsKNPHJ9iPc</a></p>
10	<p><b>Aim:</b> Demonstration of working with PDF, word and JSON files</p> <p>a) Write a python program to combine select pages from many PDFs</p> <p>b) Write a python program to fetch current weather data from the JSON file</p> <p>PDFs: <a href="https://www.youtube.com/watch?v=q70xzDG6nls">https://www.youtube.com/watch?v=q70xzDG6nls</a>  <a href="https://www.youtube.com/watch?v=JhQVD7Y1bsA">https://www.youtube.com/watch?v=JhQVD7Y1bsA</a>  <a href="https://www.youtube.com/watch?v=FcrW-ESdY-A">https://www.youtube.com/watch?v=FcrW-ESdY-A</a></p> <p>Word files: <a href="https://www.youtube.com/watch?v=ZU3cSl51jWE">https://www.youtube.com/watch?v=ZU3cSl51jWE</a></p> <p>JSON files: <a href="https://www.youtube.com/watch?v=9N6a-VLBa2I">https://www.youtube.com/watch?v=9N6a-VLBa2I</a></p>
<b>Python (Full Course):</b> <a href="https://www.youtube.com/watch?v=_uQrJ0TkZlc">https://www.youtube.com/watch?v=_uQrJ0TkZlc</a>	
<b>Pedagogy</b>	For the above experiments the following pedagogy can be considered. Problem based learning, Active learning, MOOC, Chalk &Talk
<b>PART B – Practical Based Learning</b>	
A problem statement for each batch is to be generated in consultation with the co-examiner and student should develop an algorithm, program and execute the program for the given problem with appropriate outputs.	
<b>Course Outcomes:</b>	
CO 1. Demonstrate proficiency in handling of loops and creation of functions. CO 2. Identify the methods to create and manipulate lists, tuples and dictionaries. CO 3. Discover the commonly used operations involving regular expressions and file system. CO 4. Interpret the concepts of Object-Oriented Programming as used in Python. CO 5. Determine the need for scraping websites and working with PDF, JSON and other file formats.	

### **Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

#### **Continuous Internal Evaluation (CIE):**

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

#### **Semester End Evaluation (SEE):**

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- *Students can pick one experiment from the questions lot of PART A with equal choice to all the students in a batch. For PART B examiners should frame a question for each batch, student should develop an algorithm, program, execute and demonstrate the results with appropriate output for the given problem.*

- *Weightage of marks for PART A is 80% and for PART B is 20%. General rubrics suggested to be followed for part A and part B.*
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero (Not allowed for Part B).
- The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

**Textbooks:**

1. Al Sweigart, "**Automate the Boring Stuff with Python**", 1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at <https://automatetheboringstuff.com/>)
2. Reema Thareja "**Python Programming Using Problem Solving Approach**" Oxford University Press.
3. Allen B. Downey, "**Think Python: How to Think Like a Computer Scientist**", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at <http://greenteapress.com/thinkpython2/thinkpython2.pdf>)

## IV Semester

<b>WEB PROGRAMMING (Practical based)</b>			
Course Code	<b>21CSL481</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:1:1:0	SEE Marks	50
Total Hours of Pedagogy	12T + 12P	Total Marks	100
Credits	01	Exam Hours	02
<b>Course Objectives:</b>			
CLO 1. Learn Web tool box and history of web browsers.			
CLO 2. Learn HTML, XHTML tags with utilizations.			
CLO 3. Know CSS with dynamic document utilizations.			
CLO 4. Learn JavaScript with Element access in JavaScript.			
CLO 5. Logically plan and develop web pages..			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to WEB Programming:</b> Internet, WWW, Web Browsers, and Web Servers, URLs, MIME, HTTP, Security, The Web Programmers Toolbox.			
<b>Textbook 1: Chapter 1(1.1 to 1.9)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-2</b>			
<b>HTML and XHTML:</b> Origins of HTML and XHTML, Basic syntax, Standard XHTML document structure, Basic text markup, Images, Hypertext Links, Lists, Tables. Forms, Frames in HTML and XHTML, Syntactic differences between HTML and XHTML.			
<b>Textbook 1: Chapter 2(2.1 to 2.10)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration, presentation, problem solving		
<b>Module-3</b>			
<b>CSS:</b> Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, Background images, tags.			
<b>Textbook 1: Chapter 3(3.1 to 3.12)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Demonstration, problem solving		
<b>Module-4</b>			
<b>Java Script - I:</b> Object orientation and JavaScript; General syntactic characteristics; Primitives,			



Operations, and expressions; Screen output and keyboard input.

**Textbook 1: Chapter 4(4.1 to 4.5)**

<b>Teaching-Learning Process</b>	Chalk and board, Practical based learning, practical's
----------------------------------	--

**Module-5**

**Java Script – II:** Control statements, Object creation and Modification; Arrays; Functions; Constructor; Pattern matching using expressions; Errors, Element access in JavaScript.

**Textbook 1: Chapter 4(4.6 to 4.14)**

<b>Teaching-Learning Process</b>	Chalk and board, MOOC
----------------------------------	-----------------------

**Course Outcomes (Course Skill Set):**

At the end of the course the student will be able to:

- CO 1. Describe the fundamentals of web and concept of HTML.
- CO 2. Use the concepts of HTML, XHTML to construct the web pages.
- CO 3. Interpret CSS for dynamic documents.
- CO 4. Evaluate different concepts of JavaScript & Construct dynamic documents.
- CO 5. Design a small project with JavaScript and XHTML.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

**Continuous Internal Evaluation (CIE):**

**NOTE: List of experiments to be prepared by the faculty based on the syllabus mentioned above**

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- The duration of SEE is 02 hours

Rubrics suggested in Annexure-II of Regulation book

#### **Textbooks**

1. Robert W Sebesta, "Programming the World Wide Web", 6th Edition, Pearson Education, 2008.

#### **Reference Books**

1. M.Deitel, P.J.Deitel, A.B.Goldberg, "Internet & World Wide Web How to program", 3rd Edition, Pearson Education / PHI, 2004.
2. Chris Bates, "Web Programming Building Internet Applications", 3rd Edition, Wiley India, 2006.
3. Xue Bai et al, "The Web Warrior Guide to Web Programming", Thomson, 2003.
4. Sklar, "The Web Warrior Guide to Web Design Technologies", 1st Edition, Cengage Learning India

#### **Weblinks and Video Lectures (e-Resources):**

1. Fundamentals of WEB Programming: <https://www.youtube.com/watch?v=DR9dr6gxdM>
2. HTML and XHTML: <https://www.youtube.com/watch?v=A1XIIDDXgwg>
3. CSS: <https://www.youtube.com/watch?v=J35jug1uHzE>
4. Java Script and HTML Documents: <https://www.youtube.com/watch?v=Gd0RBdFRvF0>
5. Dynamic Documents with JavaScript: <https://www.youtube.com/watch?v=HTFSIJALNKc>

#### **Tutorial Link:**

1. <http://www.tutorialspoint.com>
2. <http://www.w3schools.com>

#### **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Demonstration of simple projects

## IV Semester

<b>UNIX SHELL PROGRAMMING</b>			
Course Code	<b>21CS482</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	12	Total Marks	100
Credits	01	Exam Hours	01
<b>Course Objectives:</b>			
CLO 1. To help the students to understand effective use of Unix concepts, commands and terminology.			
CLO 2. Identify, access, and evaluate UNIX file system.			
CLO 3. Understand UNIX command syntax and semantics.			
CLO 4. Ability to read and understand specifications, scripts and programs.			
CLO 5. Analyze Facility with UNIX Process.			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction of UNIX</b> - Introduction, History, Architecture, Experience the Unix environment, Basic commands ls, cat, cal, date, calendar, who, printf, tty, sty, uname, passwd, echo, tput, and bc.			
<b>Textbook 1: Chapter 1(1.1 to 1.4) , Chapter 2- 2.1</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-2</b>			
<b>UNIX File System-</b> The file, what's in a filename? The parent-child relationship, pwd, the Home directory, absolute pathnames, using absolute pathnames for a command, cd, mkdir, rmdir, Relative pathnames, The UNIX file system.			
<b>Textbook 1: Chapter 4</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration, presentation, problem solving		
<b>Module-3</b>			
<b>Basic File Attributes - Is - l, the -d option, File Permissions, chmod, Security and File Permission, users and groups, security level, changing permission, user masks, changing ownership and group, File Attributes, More file attributes: hard link, symbolic link, umask, find.</b>			
<b>Textbook 1: Chapter 6</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Demonstration, problem solving		
<b>Module-4</b>			
<b>Introduction to the Shell Scripting</b> - Introduction to Shell Scripting, Shell Scripts, read, Command Line			

Arguments, Exit Status of a Command, The Logical Operators && and ||, exit, if, and case conditions, expr, sleep and wait, while, until, for, \$, @, redirection. The here document, set, trap, Sample Validation and Data Entry Scripts.

**Textbook 1: Chapter 11,12,14**

<b>Teaching-Learning Process</b>	Chalk and board, Practical based learning, practical's
----------------------------------	--

**Module-5**

**Introduction to UNIX System process:** Mechanism of process creation. Parent and child process. The ps command with its options. Executing a command at a specified point of time: at command. Executing a command periodically: cron command and the crontab file.. Signals.

**Textbook 1: Chapter 9,19**

<b>Teaching-Learning Process</b>	Chalk and board, MOOC
----------------------------------	-----------------------

**Course Outcomes (Course Skill Set):**

- At the end of the course the student will be able to:
- CO 1. Know the basics of Unix concepts and commands.
  - CO 2. Evaluate the UNIX file system.
  - CO 3. Apply Changes in file system.
  - CO 4. Understand scripts and programs.
  - CO 5. Analyze Facility with UNIX system process

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

**Theory SEE** will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 01 hours**)

SEE paper will be set for 50 questions of each of 01 marks. The pattern of the question paper is MCQ. The time allotted for SEE is 01 hours

**Textbooks**

1. Unix Concepts & Applications 4rth Edition, Sumitabha Das, Tata McGraw Hill

References:

2. Unix Shell Programming, Yashwant Kanetkar
3. Introduction to UNIX by M G Venkatesh Murthy.

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.youtube.com/watch?v=ffYUfAqEamY>
2. <https://www.youtube.com/watch?v=Q05NZiYFcD0>
3. <https://www.youtube.com/watch?v=8GdT53KDIyY>
4. <https://www.youtube.com/watch?app=desktop&v=3Pga3y7rCgo>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Real world problem solving using group discussion.
- Real world examples of Linux operating system Utilizations.

## IV Semester

<b>R PROGRAMMING (Practical based)</b>			
Course Code	<b>21CSL483</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:1:1:0	SEE Marks	50
Total Hours of Pedagogy	12T + 12P	Total Marks	100
Credits	01	Exam Hours	02
<b>Course Objectives:</b>			
CLO 1. Explore and understand how R and R Studio interactive environment.			
CLO 2. To learn and practice programming techniques using R programming.			
CLO 3. Read Structured Data into R from various sources.			
CLO 4. Understand the different data Structures, data types in R.			
CLO 5. To develop small applications using R Programming			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Numeric, Arithmetic, Assignment, and Vectors:</b> R for Basic Math, Arithmetic, Variables, Functions, Vectors, Expressions and assignments Logical expressions.			
<b>Textbook 1: Chapter 2(2.1 to 2.7)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-2</b>			
<b>Matrices and Arrays:</b> Defining a Matrix, Sub-setting, Matrix Operations, <b>Conditions and Looping:</b> if statements, looping with for, looping with while, vector based programming.			
<b>Textbook 1: Chapter 2- 2.8, chapter 3- 3.2 to 3.5</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration, presentation, problem solving		
<b>Module-3</b>			
<b>Lists and Data Frames:</b> Data Frames, <b>Lists</b> , Special values, The apply family.			
<b>Textbook 1: Chapter 6- 6.2 to 6.4</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Demonstration, problem solving		
<b>Module-4</b>			
<b>Functions:</b> Calling functions, scoping, Arguments matching, writing functions: The function command, Arguments, specialized function.			
<b>Textbook 1: Chapter 5- 5.1 to 5.6</b>			

<b>Teaching-Learning Process</b>	Chalk and board, Practical based learning, practical's
<b>Module-5</b>	
Pointers: packages, frames, de bugging, manipulation of code, compilation of the code.	
<b>Textbook 1: Chapter 8- 8.1 to 8.8</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Course Outcomes (Course Skill Set):</b> At the end of the course the student will be able to: CO 1. To understand the fundamental syntax of R through readings, practice exercises, CO 2. To demonstrations, and writing R code. CO 3. To apply critical programming language concepts such as data types, iteration, CO 4. To understand control structures, functions, and Boolean operators by writing R programs and through examples CO 5. To import a variety of data formats into R using R-Studio CO 6. To prepare or tidy data for in preparation for analyze.	
<b>Assessment Details (both CIE and SEE)</b>  The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE). <b>Continuous Internal Evaluation (CIE):</b> <i><b>NOTE: List of experiments to be prepared by the faculty based on the syllabus mentioned above</b></i> CIE marks for the practical course is <b>50 Marks</b> . The split-up of CIE marks for record/ journal and test are in the ratio <b>60:40</b> . <ul style="list-style-type: none"> <li>• Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.</li> <li>• Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.</li> <li>• Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).</li> <li>• Weightage to be given for neatness and submission of record/write-up on time.</li> <li>• Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.</li> <li>• In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.</li> <li>• The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book</li> <li>• The average of 02 tests is scaled down to <b>20 marks</b> (40% of the maximum marks).</li> </ul> The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.	
<b>Semester End Evaluation (SEE):</b> <ul style="list-style-type: none"> <li>• SEE marks for the practical course is 50 Marks.</li> <li>• SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University</li> <li>• All laboratory experiments are to be included for practical examination.</li> <li>• (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. <b>OR</b> based on the course requirement evaluation rubrics shall be decided jointly by examiners.</li> <li>• Students can pick one question (experiment) from the questions lot prepared by the internal</li> </ul>	

/external examiners jointly.

- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- The duration of SEE is 02 hours

Rubrics suggested in Annexure-II of Regulation book

**Textbooks**

1. Jones, O., Maillardet. R. and Robinson, A. (2014). Introduction to Scientific Programming and Simulation Using R. Chapman & Hall/CRC, The R Series.

**References:**

1. Michael J. Crawley, "Statistics: An Introduction using R", Second edition, Wiley,2015

**Weblinks and Video Lectures (e-Resources):**

1. Wickham, H. & Grolemund, G. (2018). for Data Science. O'Reilly: New York. Available for free at <http://r4ds.had.co.nz>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Demonstration of simple projects



## V Semester

<b>OBJECT ORIENTED MODELLING AND DESIGN</b>			
Course Code	<b>21CD51</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Describe the concepts involved in Object-Oriented modelling and their benefits.</p> <p>CLO 2. Demonstrate concept of use-case model, sequence model and state chart model for a given problem.</p> <p>CLO 3. Explain the facets of the unified process approach to design and build a Software system.</p> <p>CLO 4. Translate the requirements into implementation for Object Oriented design.</p> <p>CLO 5. Choose an appropriate design pattern to facilitate development procedure.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem with different approaches and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived Data; Packages. State Modeling; Events, States, Transitions and Conditions, State Diagrams, State diagram behaviour.			
<b>Text Book-1: 4, 5</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
UseCase Modelling and Detailed Requirements: Overview; Detailed object-oriented Requirements definitions; System Processes-A use case/Scenario view; Identifying Input and outputs-The System sequence diagram; Identifying Object Behaviour-The state chart Diagram; Integrated Object-oriented Models.			
<b>Text Book-2:Chapter- 6:Page 210 to 250</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
Process Overview, System Conception and Domain Analysis: Process Overview: Development stages; Development life Cycle; System Conception: Devising a system concept; elaborating a concept; preparing			

a problem statement. Domain Analysis: Overview of analysis; Domain Class model: Domain state model; Domain interaction model; Iterating the analysis.

**Text Book-1:Chapter- 10,11,and 12**

<b>Teaching-Learning Process</b>	<b>Chalk and board, Problem based learning, Demonstration</b>
----------------------------------	---

**Module-4**

Use case Realization :The Design Discipline within up iterations: Object Oriented Design-The Bridge between Requirements and Implementation; Design Classes and Design within Class Diagrams; Interaction Diagrams-Realizing Use Case and defining methods; Designing with Communication Diagrams; Updating the Design Class Diagram; Package Diagrams-Structuring the Major Components; Implementation Issues for Three-Layer Design.

**Text Book-2: Chapter 8: page 292 to 346**

<b>Teaching-Learning Process</b>	Chalk & board, Problem based learning
----------------------------------	---------------------------------------

**Module-5**

Design Patterns: Introduction; what is a design pattern?, Describing design patterns, the catalogue of design patterns, Organizing the catalogue, How design patterns solve design problems, how to select a design patterns, how to use a design pattern; Creational patterns: prototype and singleton (only); structural patterns adaptor and proxy (only).

**Text Book-3: Ch-1: 1.1, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8,Ch-3,Ch-4.**

<b>Teaching-Learning Process</b>	<b>Chalk and board, MOOC</b>
----------------------------------	------------------------------

**Course Outcomes**

At the end of the course the student will be able to:

- CO 1. Describe the concepts of object-oriented and basic class modelling.
- CO 2. Draw class diagrams, sequence diagrams and interaction diagrams to solve problems.
- CO 3. Choose and apply a befitting design pattern for the given problem
- CO 4. Translate the requirements into implementation for Object Oriented design
- CO 5. Choose an appropriate design pattern to facilitate development procedure

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4<sup>th</sup> week of the semester
2. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

1. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks

and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML,2nd Edition, Pearson Education,2005
2. Satzinger, Jackson and Burd: Object-Oriented Analysis & Design with the Unified Process, Cengage Learning, 2005.
3. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides: Design Patterns -Elements of Reusable Object-Oriented Software, Pearson Education,2007.

**Reference:**

1. Grady Booch et. al.: Object-Oriented Analysis and Design with Applications,3rd Edition,Pearson Education,2007.
2. Frank Buschmann, RegineMeunier, Hans Rohnert, Peter Sommerlad, Michel Stal: Pattern – Oriented Software Architecture. A system of patterns , Volume 1, John Wiley and Sons.2007.
3. Booch, Jacobson, Rumbaugh : Object-Oriented Analysis and Design with Applications, 3rd edition, pearson, Reprint 2013

**Weblinks and Video Lectures (e-Resources):**

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Group Activities, quizzes, Puzzles and presentations

## V Semester

<b>COMPUTER NETWORKS</b>			
Course Code:	21CS52	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40T + 20P	Total Marks	100
Credits	04	Exam Hours	03
<b>Course Objectives:</b>			
<p>CLO 1. Fundamentals of data communication networks.            CLO 2. Software and hardware interfaces            CLO 3. Application of various physical components and protocols            CLO 4. Communication challenges and remedies in the networks.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to networks:</b> Network hardware, Network software, Reference models,			
<b>Physical Layer:</b> Guided transmission media, Wireless transmission			
<b>Textbook 1: Ch.1.2 to 1.4, Ch.2.2 to 2.3</b>			
<b>Laboratory Component:</b>			
<ol style="list-style-type: none"> <li>1. Implement Three nodes point - to - point network with duplex links between them for different topologies. 1Set the queue size, vary the bandwidth, and find the number of packets dropped for various iterations.</li> </ol>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration		
<b>Module-2</b>			
<b>The Data link layer:</b> Design issues of DLL, Error detection and correction, Elementary data link protocols, Sliding window protocols.			
<b>The medium access control sublayer:</b> The channel allocation problem, Multiple access protocols.			
<b>Textbook 1: Ch.3.1 to 3.4, Ch.4.1 and 4.2</b>			
<b>Laboratory Component:</b>			
<ol style="list-style-type: none"> <li>1. Implement simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the throughput with respect to transmission of packets</li> <li>2. Write a program for error detecting code using CRC-CCITT (16- bits).</li> </ol>			

<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-3</b>	
<b>The Network Layer:</b> Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, QoS.	
<b>Textbook 1: Ch 5.1 to 5.4</b>	
<b>Laboratory Component:</b>	
<ol style="list-style-type: none"> <li>1. Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion in the network.</li> <li>2. Write a program to find the shortest path between vertices using bellman-ford algorithm.</li> </ol>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-4</b>	
<b>The Transport Layer:</b> The Transport Service, Elements of transport protocols, Congestion control, The internet transport protocols.	
<b>Textbook 1: Ch 6.1 to 6.4 and 6.5.1 to 6.5.7</b>	
<b>Laboratory Component:</b>	
<ol style="list-style-type: none"> <li>1. Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.</li> <li>2. Write a program for congestion control using leaky bucket algorithm.</li> </ol>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-5</b>	
<b>Application Layer:</b> Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS—The Internet's Directory Service.	
<b>Textbook 2: Ch 2.1 to 2.4</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Course Outcomes (Course Skill Set)</b>	
At the end of the course the student will be able to:	
<ol style="list-style-type: none"> <li>CO 1. Learn the basic needs of communication system.</li> <li>CO 2. Interpret the communication challenges and its solution.</li> <li>CO 3. Identify and organize the communication system network components</li> <li>CO 4. Design communication networks for user requirements.</li> </ol>	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
<ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol>	
Two assignments each of <b>10 Marks</b>	
<ol style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol>	
Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will contribute to <b>20 marks</b> .	
<i>Note: Minimum of 80% of the laboratory components have to be covered.</i>	

- Rubrics for each Experiment taken average for all Lab components – 15 Marks.
- Viva-Voce– 5 Marks (more emphasized on demonstration topics)

The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks:**

1. Computer-Networks- Andrew S. Tanenbaum and David J. Wetherall, Pearson Education, 5th-Edition. (www.pearsonhighered.com/tanenbaum)
2. Computer Networking A Top-Down Approach -James F. Kurose and Keith W. RossPearson Education 7<sup>th</sup> Edition.

**Reference Books:**

1. Behrouz A Forouzan, Data and Communications and Networking, Fifth Edition, McGraw Hill,Indian Edition
2. Larry L Peterson and Brusce S Davie, Computer Networks, fifth edition, ELSEVIER

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.digimat.in/nptel/courses/video/106105183/L01.html>
2. <http://www.digimat.in/nptel/courses/video/106105081/L25.html>
3. <https://nptel.ac.in/courses/106105081>
4. VTU e-Shikshana Program

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Simulation of Personal area network, Home area network, achieve QoS etc.

**Note:** For the Simulation experiments modify the topology and parameters set for the experiment and take multiple rounds of reading and analyze the results available in log files. Plot necessary graphs and conclude using NS2. Installation procedure of the required software must be demonstrated, carried out in groups, and documented in the report. Non simulation programs can be implemented using Java

**V Semester**

<b>DATA BASE MANAGEMENT SYSTEMS</b>			
Course Code	21CS53	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
CLO 1. Provide a strong foundation in database concepts, technology, and practice.			
CLO 2. Practice SQL programming through a variety of database problems.			
CLO 3. Demonstrate the use of concurrency and transactions in database			
CLO 4. Design and build database applications for real world problems.			

### Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

### Module-1

**Introduction to Databases:** Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.

**Overview of Database Languages and Architectures:** Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.

**Conceptual Data Modelling using Entities and Relationships:** Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, Examples

**Textbook 1: Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.7**

<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning
----------------------------------	--

### Module-2

**Relational Model:** Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.

**Relational Algebra:** Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra.

**Mapping Conceptual Design into a Logical Design:** Relational Database Design using ER-to-Relational mapping.

**Textbook 1:, Ch 5.1 to 5.3, 8.1 to 8.5, 9.1;**

<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
----------------------------------	---

### Module-3

**SQL:** SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL.

**Advances Queries:** More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.  
Database

**Application Development:** Accessing databases from applications, An introduction to JDBC, JDBC classes and interfaces, SQLJ, Stored procedures, Case study: The internet Bookshop.

**Textbook 1: Ch 6.1 to 6.5, 7.1 to 7.4; Textbook 2: 6.1 to 6.6;**

<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
----------------------------------	--

**Module-4**

**Normalization: Database Design Theory** – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Examples on normal forms.

**Normalization Algorithms:** Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design, Nulls, Dangling tuples, and alternate Relational Designs, Further discussion of Multivalued dependencies and 4NF, Other dependencies and Normal Forms

**Textbook 1: Ch 14.1 to -14.7, 15.1 to 15.6**

<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning
----------------------------------	--------------------------------------

**Module-5**

**Transaction Processing:** Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.

**Concurrency Control in Databases:** Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking.

**Textbook 1: Ch 20.1 to 20.6, 21.1 to 21.7;**

<b>Teaching-Learning Process</b>	Chalk and board, MOOC
----------------------------------	-----------------------

**Course Outcomes**

At the end of the course the student will be able to:

- CO 1. Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS
- CO 2. Use Structured Query Language (SQL) for database manipulation and also demonstrate the basic of query evaluation.
- CO 3. Design and build simple database systems and *relate* the concept of transaction, concurrency control and recovery in database
- CO 4. Develop application to interact with databases, relational algebra expression.
- CO 5. Develop applications using tuple and domain relation expression from queries.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

- 1. First test at the end of 5<sup>th</sup> week of the semester
- 2. Second test at the end of the 10<sup>th</sup> week of the semester
- 3. Third test at the end of the 15<sup>th</sup> week of the semester



Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

**Reference Books:**

**NIL**

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.youtube.com/watch?v=3EJlovevfcA>
2. <https://www.youtube.com/watch?v=9TwMRs3qTcU>
3. <https://www.youtube.com/watch?v=ZWl0Xow304I>
4. <https://www.youtube.com/watch?v=4YilEjkNPrQ>
5. <https://www.youtube.com/watch?v=CZTkgMoqVss>
6. <https://www.youtube.com/watch?v=HI4NZB1XR9c>
7. [https://www.youtube.com/watch?v=EGEwkad\\_IIA](https://www.youtube.com/watch?v=EGEwkad_IIA)
8. <https://www.youtube.com/watch?v=t5hsV9lC1rU>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**Demonstration of real time Database projects - E-commerce Platform, Inventory Management, Railway System, College Data Management, Library Data Management, Solution for Saving Student Records, Hospital Data Management, Blood Donation Management.**

## V Semester

<b>ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING</b>			
Course Code	21CS54	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
CLO 1. Gain a historical perspective of AI and its foundations			
CLO 2. Become familiar with basic principles of AI toward problem solving			
CLO 3. Familiarize with the basics of Machine Learning & Machine Learning process, basics of Decision Tree, and probability learning			
CLO 4. Understand the working of Artificial Neural Networks and basic concepts of clustering algorithms			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction:</b> What is AI? Foundations and History of AI			
<b>Problem-solving:</b> Problem-solving agents, Example problems, Searching for Solutions, Uninformed Search Strategies: Breadth First search, Depth First Search,			
<b>Textbook 1: Chapter 1- 1.1, 1.2, 1.3</b>			
<b>Textbook 1: Chapter 3- 3.1, 3.2, 3.3, 3.4.1, 3.4.3</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning. Problem based learning		
<b>Module-2</b>			
<b>Informed Search Strategies:</b> Greedy best-first search, A*search, Heuristic functions.			
Introduction to Machine Learning , Understanding Data			
<b>Textbook 1: Chapter 3 - 3.5, 3.5.1, 3.5.2, 3.6</b>			
<b>Textbook 2: Chapter 1 and 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
Basics of Learning theory			
Similarity Based Learning			
Regression Analysis			

<b>Textbook 2: Chapter 3 - 3.1 to 3.4, Chapter 4, chapter 5.1 to 5.4</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-4</b>	
Decision Tree learning Bayesian Learning	
<b>Textbook 2: Chapter 6 and 8</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-5</b>	
Artificial neural Network Clustering Algorithms	
<b>Textbook 2: Chapter 10 and 13</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning.
<b>Course Outcomes Course Skill Set)</b>	
At the end of the course the student will be able to:	
CO 1. Apply the knowledge of searching and reasoning techniques for different applications.	
CO 2. Have a good understanding of machine learning in relation to other fields and fundamental issues and challenges of machine learning.	
CO 3. Apply the knowledge of classification algorithms on various dataset and compare results	
CO 4. Model the neuron and Neural Network, and to analyze ANN learning and its applications.	
CO 5. Identifying the suitable clustering algorithm for different pattern	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
<ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol>	
Two assignments each of <b>10 Marks</b>	
<ol style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol>	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours) OR</b> Suitable Programming experiments based on the syllabus contents can be given to the students to submit the same as laboratory work( for example; Implementation of concept learning, implementation of decision tree learning algorithm for suitable data set, etc...)	
<ol style="list-style-type: none"> <li>6. At the end of the 13<sup>th</sup> week of the semester</li> </ol>	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the	

methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Stuart J. Russell and Peter Norvig, Artificial Intelligence, 3<sup>rd</sup> Edition, Pearson,2015
2. S. Sridhar, M Vijayalakshmi "Machine Learning". Oxford ,2021

**Reference:**

1. Elaine Rich, Kevin Knight, Artificial Intelligence, 3<sup>rd</sup>edition, Tata McGraw Hill,2013
2. George F Luger, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011
3. Tom Michel, Machine Learning, McGrawHill Publication.

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.kdnuggets.com/2019/11/10-free-must-read-books-ai.html>
2. <https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409>
3. <https://nptel.ac.in/courses/106/105/106105077/>
4. <https://www.javatpoint.com/history-of-artificial-intelligence>
5. <https://www.tutorialandexample.com/problem-solving-in-artificial-intelligence>
6. <https://techvidvan.com/tutorials/ai-heuristic-search/>
7. <https://www.analyticsvidhya.com/machine-learning/>
8. <https://www.javatpoint.com/decision-tree-induction>
9. <https://www.hackerearth.com/practice/machine-learning/machine-learning-algorithms/ml-decision-tree/tutorial/>
10. <https://www.javatpoint.com/unsupervised-artificial-neural-networks>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Role play for strategies– DFS & BFS, Outlier detection in Banking and insurance transaction for identifying fraudulent behaviour etc. Uncertainty and reasoning Problem- reliability of sensor used to detect pedestrians using Bayes Rule

## V Semester

<b>DATABASE MANAGEMENT SYSTEM LABORATORY WITH MINI PROJECT</b>			
Course Code	<b>21CSL55</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	01	Exam Hours	03
<b>Course Learning Objectives:</b>			
CLO 1. Foundation knowledge in database concepts, technology and practice to groom students into well-informed database application developers.			
CLO 2. Strong practice in SQL programming through a variety of database problems.			
CLO 3. Develop database applications using front-end tools and back-end DBMS..			
<b>Sl. No.</b>	<b>PART-A: SQL Programming (Max. Exam Marks. 50)</b>		
	Design, develop, and implement the specified queries for the following problems using Oracle, MySQL, MS SQL Server, or any other DBMS under LINUX/Windows environment. Create Schema and insert at least 5 records for each table. Add appropriate database constraints.		
1	<p>Aim: Demonstrating creation of tables, applying the view concepts on the tables.</p> <p>Program Consider the following schema for a Library Database:  <b>BOOK(Book_id, Title, Publisher_Name, Pub_Year)</b>  <b>BOOK_AUTHORS(Book_id, Author_Name)</b>  <b>PUBLISHER(Name, Address, Phone)</b>  <b>BOOK_COPIES(Book_id, Programme_id, No-of_Copies)</b>  <b>BOOK_LENDING(Book_id, Programme_id, Card_No, Date_Out, Due_Date)</b>  <b>LIBRARY_PROGRAMME(Programme_id, Programme_Name, Address)</b></p> <p>Write SQL queries to</p> <ol style="list-style-type: none"> <li>1. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each Programme, etc.</li> <li>2. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2017 to Jun 2017.</li> <li>3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation.</li> <li>4. Partition the BOOK table based on year of publication. Demonstrate its working with a simple query.</li> <li>5. Create a view of all books and its number of copies that are currently available in the Library.</li> </ol> <p>Reference:  <a href="https://www.youtube.com/watch?v=AaSU-AOguls">https://www.youtube.com/watch?v=AaSU-AOguls</a>  <a href="https://www.youtube.com/watch?v=-EwEvJxS-Fw">https://www.youtube.com/watch?v=-EwEvJxS-Fw</a></p>		
2	<p>Aim: Discuss the various concepts on constraints and update operations.</p> <p>Program: Consider the following schema for Order Database:  <b>SALESMAN(Salesman_id, Name, City, Commission)</b>  <b>CUSTOMER(Customer_id, Cust_Name, City, Grade, Salesman_id)</b>  <b>ORDERS(Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id)</b></p> <p>Write SQL queries to</p> <p>Count the customers with grades above Bangalore’s average.</p> <ol style="list-style-type: none"> <li>2. Find the name and numbers of all salesman who had more than one customer.</li> <li>3. List all the salesman and indicate those who have and don’t have customers in their cities (Use UNION operation.)</li> <li>4. Create a view that finds the salesman who has the customer with the highest order of a day.</li> <li>5. Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.</li> </ol> <p>Reference:  <a href="https://www.youtube.com/watch?v=AA-KL1jbMeY">https://www.youtube.com/watch?v=AA-KL1jbMeY</a></p>		

	<p><a href="https://www.youtube.com/watch?v=7S_tz1z_5bA">https://www.youtube.com/watch?v=7S_tz1z_5bA</a></p>
3	<p>Aim: Demonstrate the concepts of JOIN operations.</p> <p>Program: Consider the schema for Movie Database:  <b>ACTOR(Act_id, Act_Name, Act_Gender)</b>  <b>DIRECTOR(Dir_id, Dir_Name, Dir_Phone)</b>  <b>MOVIES(Mov_id, Mov_Title, Mov_Year, Mov_Lang, Dir_id)</b>  <b>MOVIE_CAST(Act_id, Mov_id, Role)</b>  <b>RATING(Mov_id, Rev_Stars)</b></p> <p>Write SQL queries to</p> <ol style="list-style-type: none"> <li>List the titles of all movies directed by 'Hitchcock'.</li> <li>Find the movie names where one or more actors acted in two or more movies.</li> <li>List all actors who acted in a movie before 2000 and also in a movie after 2015(use JOIN operation).</li> <li>Find the title of movies and number of stars for each movie that has at least one rating and find the highest number of stars that movie received. Sort the result by movie title.</li> <li>Update rating of all movies directed by 'Steven Spielberg' to 5.</li> </ol> <p>Reference:  <a href="https://www.youtube.com/watch?v=hSiCUNVKIAo">https://www.youtube.com/watch?v=hSiCUNVKIAo</a>  <a href="https://www.youtube.com/watch?v=Eod3aQkFz84">https://www.youtube.com/watch?v=Eod3aQkFz84</a></p>
4	<p>Aim: Introduce concepts of PLSQL and usage on the table.</p> <p>Program: Consider the schema for College Database:  <b>STUDENT(USN, SName, Address, Phone, Gender)</b>  <b>SEMSEC(SSID, Sem, Sec)</b>  <b>CLASS(USN, SSID)</b>  <b>COURSE(Subcode, Title, Sem, Credits)</b>  <b>IAMARKS(USN, Subcode, SSID, Test1, Test2, Test3, FinalIA)</b></p> <p>Write SQL queries to</p> <ol style="list-style-type: none"> <li>List all the student details studying in fourth semester 'C' section.</li> <li>Compute the total number of male and female students in each semester and in each section.</li> <li>Create a view of Test1 marks of student USN '1BI15CS101' in all Courses.</li> <li>Calculate the FinalIA (average of best two test marks) and update the corresponding table for all students.</li> <li>Categorize students based on the following criterion:  If FinalIA = 17 to 20 then CAT = 'Outstanding'  If FinalIA = 12 to 16 then CAT = 'Average'  If FinalIA &lt; 12 then CAT = 'Weak'</li> </ol> <p>Give these details only for 8th semester A, B, and C section students.</p> <p>Reference:  <a href="https://www.youtube.com/watch?v=horURQewW9c">https://www.youtube.com/watch?v=horURQewW9c</a>  <a href="https://www.youtube.com/watch?v=P7-wKbKrAhk">https://www.youtube.com/watch?v=P7-wKbKrAhk</a></p>
5	<p>Aim: Demonstrate the core concepts on table like nested and correlated nesting queries and also EXISTS and NOT EXISTS keywords.</p> <p>Program: Consider the schema for Company Database:  <b>EMPLOYEE(SSN, Name, Address, Sex, Salary, SuperSSN, DNo)</b>  <b>DEPARTMENT(DNo, DName, MgrSSN, MgrStartDate)</b>  <b>DLOCATION(DNo,DLoc)</b>  <b>PROJECT(PNo, PName, PLocation, DNo)</b>  <b>WORKS_ON(SSN, PNo, Hours)</b></p> <p>Write SQL queries to</p> <p>Make a list of all project numbers for projects that involve an employee whose last name is 'Scott', either as a worker or as a manager of the department that controls the project.</p>

	<p>Show the resulting salaries if every employee working on the 'IoT' project is given a 10 percent raise.</p> <p>Find the sum of the salaries of all employees of the 'Accounts' department, as well as the maximum salary, the minimum salary, and the average salary in this department</p> <p>Retrieve the name of each employee who works on all the projects controlled by department number 5 (use NOT EXISTS operator).</p> <p>For each department that has more than five employees, retrieve the department number and the number of its employees who are making more than Rs.6,00,000.</p> <p><b>Reference:</b>  <a href="https://www.youtube.com/watch?v=Dk8f3ejqKts">https://www.youtube.com/watch?v=Dk8f3ejqKts</a></p>
<b>Pedagogy</b>	For the above experiments the following pedagogy can be considered. Problem based learning, Active learning, MOOC, Chalk &Talk
<b>PART B</b>	
	<b>Mini project:</b> For any problem selected, make sure that the application should have five or more tables. Indicative areas include: Organization, health care, Ecommerce etc.
<p><b>Course Outcomes:</b>  At the end of the course the student will be able to:  CO 1. Create, Update and query on the database.  CO 2. Demonstrate the working of different concepts of DBMS  CO 3. Implement, analyze and evaluate the project developed for an application.</p>	
<p><b>Assessment Details (both CIE and SEE)</b></p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).</p> <p><b>Continuous Internal Evaluation (CIE):</b></p> <p>CIE marks for the practical course is <b>50 Marks</b>.</p> <p>The split-up of CIE marks for record/ journal and test are in the ratio <b>60:40</b>.</p> <p>Each experiment to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.</p> <p>Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.</p> <p>Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).</p> <p>Weightage to be given for neatness and submission of record/write-up on time.</p> <p>Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.</p> <p>In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.</p> <p>The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book</p> <p>The average of 02 tests is scaled down to 20 marks (40% of the maximum marks).</p> <p>The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.</p>	
<b>Semester End Evaluation (SEE):</b>	

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- *Students can pick one experiment from the questions lot of PART A with an equal choice to all the students in a batch. For PART B, the project group (Maximum of 4 students per batch) should demonstrate the mini-project.*
- *Weightage of marks for PART A is 60% and for PART B is 40%. General rubrics suggested to be followed for part A and part B.*
- Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero (Not allowed for Part B).
- The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

**Textbooks:**

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

**Suggested Weblinks/ E Resource**

<https://www.tutorialspoint.com/sql/index.htm>



## V Semester

<b>ANGULAR JS AND NODE JS (Practical based)</b>			
Course Code:	<b>21CSL581</b>	CIE Marks	50
Teaching Hours/Week	0:1:1:0	SEE Marks	50
Total No. of Hours	12T + 12P	Total Marks	100
Credits	01	Exam Hours	02
<p><b>Course Objectives:</b> The student should be made to:</p> <p>CLO 1. To learn the basics of Angular JS.</p> <p>CLO 2. To understand the Angular JS Modules.</p> <p>CLO 3. To implement Forms, inputs and Services</p> <p>CLO 4. To implement Directives and Databases</p> <p>CLO 5. To understand basics of Node JS.</p>			
<p><b>Teaching-Learning Process (General Instructions)</b></p> <p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction To Angular JS:</b> Introduction – Features – Angular JSModel-View-Controller – Expression - Directives and Controllers.			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-2</b>			
<b>Angular JS Modules:</b> Arrays –Working with ng-model – Working with Forms – Form Validation – Error Handling with Forms – Nested Forms with ng-form – Other Form Controls.			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-3</b>			
<b>Directives&amp; Building Databases:</b>			
<b>Part I-</b> Filters – Using Filters in Controllers and Services – Angular JS Services – Internal Angular JS Services – Custom Angular JS Services			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-4</b>			
<b>Directives&amp; Building Databases:</b>			
<b>Part-II-</b> Directives – Alternatives to Custom Directives – Understanding the Basic options – Interacting with Server –HTTP Services – Building Database, Front End and BackEnd			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning		
<b>Module-5</b>			
<b>Introduction to NODE JS:</b> Introduction –Using the Terminals – Editors –Building a Webserver with Node – The HTTPModule – Views and Layouts.			

<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, practical based learning
<b>Course Outcomes (Course Skill Set)</b>	
At the end of the course the student will be able to:	
CO 1. Describe the features of Angular JS.	
CO 2. Recognize the form validations and controls.	
CO 3. Implement Directives and Controllers.	
CO 4. Evaluate and create database for simple application.	
CO 5. Plan and build webservers with node using Node .JS.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).	
<b>Continuous Internal Evaluation (CIE):</b>	
<b>NOTE: List of experiments to be prepared by the faculty based on the syllabus mentioned above</b>	
CIE marks for the practical course is <b>50 Marks</b> .	
The split-up of CIE marks for record/ journal and test are in the ratio <b>60:40</b> .	
<ul style="list-style-type: none"> <li>• Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.</li> <li>• Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.</li> <li>• Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).</li> <li>• Weightage to be given for neatness and submission of record/write-up on time.</li> <li>• Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.</li> <li>• In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.</li> <li>• The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book</li> <li>• The average of 02 tests is scaled down to <b>20 marks</b> (40% of the maximum marks).</li> </ul>	
The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.	
<b>Semester End Evaluation (SEE):</b>	
<ul style="list-style-type: none"> <li>• SEE marks for the practical course is 50 Marks.</li> <li>• SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University</li> <li>• All laboratory experiments are to be included for practical examination.</li> <li>• (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. <b>OR</b> based on the course requirement evaluation rubrics shall be decided jointly by examiners.</li> <li>• Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.</li> <li>• Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.</li> </ul>	

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- The duration of SEE is 02 hours

Rubrics suggested in Annexure-II of Regulation book

### **Suggested Learning Resources:**

#### **Textbooks**

1. Adam Freeman - ProAngular JS, Apress, First Edition, 2014.
2. ShyamSeshadri, Brad Green –“AngularJS: Up and Running: Enhanced Productivity with Structured Web Apps”, Apress, O'Reilly Media, Inc.
3. AgusKurniawan–“AngularJS Programming by Example”, First Edition, PE Press, 2014.

#### **Reference Books**

1. Brad Dayley, “Learning Angular JS”, Addison-Wesley Professional, First Edition, 2014.
2. Steve Hoberman, “Data Modelling for MongoDB”, Technics Publication, First Edition, 2014..

#### **Weblinks and Video Lectures (e-Resources):**

1. Introduction to Angular JS : <https://www.youtube.com/watch?v=HEbphzK-0xE>
2. Angular JS Modules : <https://www.youtube.com/watch?v=gWmOKmgnQkU>
3. Directives& Building Databases: [https://www.youtube.com/watch?v=R\\_okHflzgm0](https://www.youtube.com/watch?v=R_okHflzgm0)
4. Introduction to NODE .JS: <https://www.youtube.com/watch?v=8u1o-OmOeGQ>
5. <https://www.youtube.com/watch?v=7F1nLajs4Eo>
6. <https://www.youtube.com/watch?v=t7x7c-x90FU>

#### **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Demonstration of simple projects

## V Semester

<b>C# AND .NET FRAMEWORK</b>			
Course Code:	<b>21CS582</b>	CIE Marks	50
Teaching Hours/Week	1:0:0:0	SEE Marks	50
Total No. of Hours	12	Total Marks	100
Credits	01	Exam Hours	01
<b>Course Objectives:</b>			
<p>CLO 1. Understand the basics of C# and .NET</p> <p>CLO 2. Learn the variables and constants of C#</p> <p>CLO 3. Know the object-oriented aspects and applications.</p> <p>CLO 4. Learn the basic structure of .NET framework.</p> <p>CLO 5. Learn to create a simple project of .NET Core</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to C#</b>			
<b>Part-I:</b> Understanding C#, .NET, overview of C#, Variables, Data Types, Operators, Expressions, Branching, Looping, Methods, implicit and explicit casting.			
<b>Teaching-Learning Process</b>	Active learning		
<b>Module-2</b>			
<b>Part-II:</b> Constants, Arrays, Array Class, Array List, String, String Builder, Structure, Enumerations, boxing and unboxing.			
<b>Teaching-Learning Process</b>	Active learning		
<b>Module-3</b>			
<b>Object Oriented Concepts-I:</b>			
Class, Objects, Constructors and its types, inheritance, properties, indexers, index overloading, polymorphism.			
<b>Teaching-Learning Process</b>	Active learning		
<b>Module-4</b>			
<b>Object Oriented Concepts-II:</b>			

Sealed class and methods, interface, abstract class, abstract and interface, operator overloading, delegates, events, errors and exception, Threading.

<b>Teaching-Learning Process</b>	Active learning
----------------------------------	-----------------

**Module-5**

**Introduction to .NET FRAMEWORK:**

Assemblies, Versioning, Attributes, reflection, viewing meta data, remoting, security in .NET, Environment Setup of .NET Core and create a small project.

<b>Teaching-Learning Process</b>	Active learning
----------------------------------	-----------------

**Course Outcomes (Course Skill Set)**

At the end of the course the student will be able to:

- CO 1. Able to explain how C# fits into the .NET platform.
- CO 2. Describe the utilization of variables and constants of C#
- CO 3. Use the implementation of object-oriented aspects in applications.
- CO 4. Analyze and Set up Environment of .NET Core.
- CO 5. Evaluate and create a simple project application.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

- 1. First test at the end of 5<sup>th</sup> week of the semester
- 2. Second test at the end of the 10<sup>th</sup> week of the semester
- 3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

- 4. First assignment at the end of 4<sup>th</sup> week of the semester
- 5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

- 6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

**Theory SEE** will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 01 hours**)

SEE paper will be set for 50 questions of each of 01 marks. The pattern of the question paper is MCQ. The time allotted for SEE is 01 hours

**Suggested Learning Resources:****Textbooks**

1. Herbert Schildt, "The Complete Reference: C# 4.0", Tata McGraw Hill, 2012.
2. Christian Nagel et al. "Professional C# 2012 with .NET 4.5", Wiley India, 2012.

**Reference Books**

1. Andrew Troelsen, "Pro C# 2010 and the .NET 4 Platform, Fifth edition, A Press, 2010.
2. Ian Griffiths, Matthew Adams, Jesse Liberty, "Programming C# 4.0", Sixth Edition, O'Reilly, 2010.

**Weblinks and Video Lectures (e-Resources):**

1. Introduction to C# : <https://www.youtube.com/watch?v=ItoIFCT9P90>
2. Object Oriented Concepts : <https://www.youtube.com/watch?v=LP3llcExPK0>
3. .NET FRAMEWORK : <https://www.youtube.com/watch?v=h7huHkvPoEE>

**Tutorial Link:**

1. <https://www.tutorialsteacher.com/csharp>
2. <https://www.w3schools.com/cs/index.php>
3. <https://www.javatpoint.com/net-framework>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving using group discussion.

## VI Semester

<b>SOFTWARE ENGINEERING &amp; PROJECT MANAGEMENT</b>			
Course Code	<b>21CS61</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Outline software engineering principles and activities involved in building large software programs. Identify ethical and professional issues and explain why they are of concern to Software Engineers.</p> <p>CLO 2. Describe the process of requirement gathering, requirement classification, requirement specification and requirements validation.</p> <p>CLO 3. Infer the fundamentals of object oriented concepts, differentiate system models, use UML diagrams and apply design patterns.</p> <p>CLO 4. Explain the role of DevOps in Agile Implementation.</p> <p>CLO 5. Discuss various types of software testing practices and software evolution processes.</p> <p>CLO 6. Recognize the importance Project Management with its methods and methodologies.</p> <p>CLO 7. Identify software quality parameters and quantify software using measurements and metrics. List software quality standards and outline the practices involved</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Introduction:</b> The evolving role of software, Software, The changing nature of software, Software engineering, A Process Framework, Process Patterns, Process Assessment, Personal and Team Process Models, Process Technology, Product and Process.</p>			
<p><b>Textbook 1: Chapter 1: 1.1 to 1.3</b></p>			
<p><b>Process Models:</b> Prescriptive models, Waterfall model, Incremental process models, Evolutionary process models, Specialized process models.</p>			
<p><b>Textbook 1: Chapter 2: 2.1, 2.2, 2.4 to 2.7</b></p>			
<p><b>Requirements Engineering:</b> Requirements Engineering Task, Initiating the Requirements Engineering process, Eliciting Requirements, Developing use cases, Building the analysis model, Negotiating Requirements, Validating Requirements, Software Requirement Document (<b>Sec 4.2</b>)</p>			
<p><b>Textbook 1: Chapter 3: 3.1 to 3.6, Textbook 5: Chapter 4: 4.2</b></p>			

<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning
<b>Module-2</b>	
<p><b>Introduction, Modelling Concepts and Class Modelling:</b> What is Object orientation? What is OO development? OO Themes; Evidence for usefulness of OO development; OO modelling history. Modelling as Design technique: Modelling, abstraction, The Three models. Class Modelling: Object and Class Concept, Link and associations concepts, Generalization and Inheritance, A sample class model, Navigation of class models, Introduction to RUP(<b>Textbook: 5 Sec 2.4</b>) and UML diagrams</p> <p><b>Textbook 2: Chapter 1,2,3</b></p> <p><b>Building the Analysis Models:</b> Requirement Analysis, Analysis Model Approaches, Data modelling Concepts, Object Oriented Analysis, Scenario-Based Modeling, Flow-Oriented Modeling, class Based Modeling, Creating a Behavioral Model.</p> <p><b>Textbook 1: Chapter 8: 8.1 to 8.8</b></p>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-3</b>	
<p><b>Software Testing:</b> A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object -Oriented Software, Validation Testing, System Testing, The Art of Debugging.</p> <p><b>Textbook 1: Chapter 13: 13.1 to 13.7</b></p> <p><b>Agile Methodology &amp; DevOps:</b> Before Agile – Waterfall, Agile Development,</p> <p><b>Self-Learning Section:</b> What is DevOps?, DevOps Importance and Benefits, DevOps Principles and Practices, 7 C's of DevOps Lifecycle for Business Agility, DevOps and Continuous Testing, How to Choose Right DevOps Tools?, Challenges with DevOps Implementation.</p> <p><b>Textbook 4: Chapter 2: 2.1 to 2.9</b></p>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-4</b>	
<p><b>Introduction to Project Management:</b> Introduction, Project and Importance of Project Management, Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some ways of categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success and Failure, Management and Management Control, Project Management life cycle, Traditional versus Modern Project Management Practices.</p> <p><b>Textbook 3: Chapter 1: 1.1 to 1.17</b></p>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-5</b>	
<p><b>Activity Planning:</b> Objectives of Activity Planning, When to Plan, Project Schedules, Sequencing and Scheduling Activities, Network Planning Models, Forward Pass– Backward Pass, Identifying critical path, Activity Float, Shortening Project Duration, Activity on Arrow Networks.</p> <p><b>Textbook 3: Chapter 6: 6.1 to 6.16</b></p> <p><b>Software Quality:</b> Introduction, The place of software quality in project planning, Importance of software quality, software quality models, ISO 9126, quality management systems, process capability models, techniques to enhance software quality, quality plans.</p> <p><b>Textbook 3: Chapter 13: (13.1 to 13.6 , 13.9, 13.11, 13.14),</b></p>	



<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<p><b>Course Outcomes</b></p> <p>At the end of the course the student will be able to:</p> <ul style="list-style-type: none"> <li>CO 1. Understand the activities involved in software engineering and analyze the role of various process models</li> <li>CO 2. Explain the basics of object-oriented concepts and build a suitable class model using modelling techniques</li> <li>CO 3. Describe various software testing methods and to understand the importance of agile methodology and DevOps</li> <li>CO 4. Illustrate the role of project planning and quality management in software development</li> <li>CO 5. Understand the importance of activity planning and different planning models</li> </ul>	
<p><b>Assessment Details (both CIE and SEE)</b></p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together</p> <p><b>Continuous Internal Evaluation:</b></p> <p>Three Unit Tests each of <b>20 Marks (duration 01 hour)</b></p> <ul style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ul> <p>Two assignments each of <b>10 Marks</b></p> <ul style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ul> <p>Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b></p> <ul style="list-style-type: none"> <li>6. At the end of the 13<sup>th</sup> week of the semester</li> </ul> <p>The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b></p> <p>(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).</p> <p><b>CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.</b></p> <p><b>Semester End Examination:</b></p> <p>Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (<b>duration 03 hours</b>)</p> <ul style="list-style-type: none"> <li>1. The question paper will have ten questions. Each question is set for 20 marks.</li> <li>2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), <b>should have a mix of topics</b> under that module.</li> </ul> <p>The students have to answer 5 full questions, selecting one full question from each module</p>	
<p><b>Suggested Learning Resources:</b></p> <p><b>Textbooks</b></p> <ul style="list-style-type: none"> <li>1. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.</li> <li>2. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML, 2nd Edition, Pearson Education, 2005.</li> <li>3. Bob Hughes, Mike Cotterell, Rajib Mall: Software Project Management, 6<sup>th</sup> Edition, McGraw Hill Education, 2018.</li> </ul>	

4. Deepak Gaikwad, Viral Thakkar, DevOps Tools From Practitioner's Viewpoint, Wiley.
5. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012.

**Reference:**

1. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India.

**Weblinks and Video Lectures (e-Resources):**

1. [https://onlinecourses.nptel.ac.in/noc20\\_cs68/preview](https://onlinecourses.nptel.ac.in/noc20_cs68/preview)
2. [https://www.youtube.com/watch?v=WxkP5KR\\_Emk&list=PLrjkTql3jnm9b5nr-ggx7Pt1G4UAHeFJ](https://www.youtube.com/watch?v=WxkP5KR_Emk&list=PLrjkTql3jnm9b5nr-ggx7Pt1G4UAHeFJ)
3. <http://elearning.vtu.ac.in/econtent/CSE.php>
4. <http://elearning.vtu.ac.in/econtent/courses/video/CSE/15CS42.html>
5. <https://nptel.ac.in/courses/128/106/128106012/> (DevOps)

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Case study, Field visit

## VI Semester

<b>FULLSTACK DEVELOPMENT</b>			
Course Code	21CS62	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 T + 20 P	Total Marks	100
Credits	04	Exam Hours	03
<b>Course Learning Objectives:</b> CLO 1.Explain the use of learning fullstack web development. CLO 2.Make use of rapid application development in the design of responsive web pages. CLO 3.Illustrate Models, Views and Templates with their connectivity in Django for full stack web development. CLO 4.Demonstrate the use of state management and admin interfaces automation in Django. CLO 5.Design and implement Django apps containing dynamic pages with SQL databases.			
<b>Teaching-Learning Process (General Instructions)</b>  These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none"> <li>Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>Show Video/animation films to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Topics will be introduced in a multiple representation.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1: MVC based Web Designing</b>			
Web framework, MVC Design Pattern, Django Evolution, Views, Mapping URL to Views, Working of Django URL Confs and Loose Coupling, Errors in Django, Wild Card patterns in URLS.			
<b>Textbook 1: Chapter 1 and Chapter 3</b>			
<b>Laboratory Component:</b> <ol style="list-style-type: none"> <li>Installation of Python, Django and Visual Studio code editors can be demonstrated.</li> <li>Creation of virtual environment, Django project and App should be demonstrated</li> <li>Develop a Django app that displays current date and time in server</li> <li>Develop a Django app that displays date and time four hours ahead and four hours before as an offset of current date and time in server.</li> </ol>			
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>Demonstration using Visual Studio Code</li> <li>PPT/Prezi Presentation for Architecture and Design Patterns</li> <li>Live coding of all concepts with simple examples</li> </ol>		
<b>Module-2: Django Templates and Models</b>			
Template System Basics, Using Django Template System, Basic Template Tags and Filters, MVT Development Pattern, Template Loading, Template Inheritance, MVT Development Pattern.			

Configuring Databases, Defining and Implementing Models, Basic Data Access, Adding Model String Representations, Inserting/Updating data, Selecting and deleting objects, Schema Evolution

**Textbook 1: Chapter 4 and Chapter 5**

**Laboratory Component:**

1. Develop a simple Django app that displays an unordered list of fruits and ordered list of selected students for an event
2. Develop a layout.html with a suitable header (containing navigation menu) and footer with copyright and developer information. Inherit this layout.html and create 3 additional pages: contact us, About Us and Home page of any website.
3. Develop a Django app that performs student registration to a course. It should also display list of students registered for any selected course. Create students and course as models with enrolment as ManyToMany field.

**Teaching-Learning Process**

1. Demonstration using Visual Studio Code
2. PPT/Prezi Presentation for Architecture and Design Patterns
3. Live coding of all concepts with simple examples
4. Case Study: Apply concepts learnt for an Online Ticket Booking System

**Module-3: Django Admin Interfaces and Model Forms**

Activating Admin Interfaces, Using Admin Interfaces, Customizing Admin Interfaces, Reasons to use Admin Interfaces.

Form Processing, Creating Feedback forms, Form submissions, custom validation, creating Model Forms, URLConf Ticks, Including Other URLConfs.

**Textbook 1: Chapters 6, 7 and 8**

**Laboratory Component:**

1. For student and course models created in Lab experiment for Module2, register admin interfaces, perform migrations and illustrate data entry through admin forms.
2. Develop a Model form for student that contains his topic chosen for project, languages used and duration with a model called project.

**Teaching-Learning Process**

1. Demonstration using Visual Studio Code
2. PPT/Prezi Presentation for Architecture and Design Patterns
3. Live coding of all concepts with simple examples

**Module-4: Generic Views and Django State Persistence**

Using Generic Views, Generic Views of Objects, Extending Generic Views of objects, Extending Generic Views.

MIME Types, Generating Non-HTML contents like CSV and PDF, Syndication Feed Framework, Sitemap framework, Cookies, Sessions, Users and Authentication.

**Textbook 1: Chapters 9, 11 and 12**

**Laboratory Component:**

1. For students enrolment developed in Module 2, create a generic class view which displays list of students and detailview that displays student details for any selected student in the list.
2. Develop example Django app that performs CSV and PDF generation for any models created in previous laboratory component.

**Teaching-Learning Process**

1. Demonstration using Visual Studio Code
2. PPT/Prezi Presentation for Architecture and Design Patterns
3. Live coding of all concepts with simple examples

	4. Project Work: Implement all concepts learnt for Student Admission Management.
<b>Module-5: jQuery and AJAX Integration in Django</b>	
Ajax Solution, Java Script, XMLHttpRequest and Response, HTML, CSS, JSON, iFrames, Settings of Java Script in Django, jQuery and Basic AJAX, jQuery AJAX Facilities, Using jQuery UI Autocomplete in Django	
<b>Textbook 2: Chapters 1, 2 and 7.</b>	
<b>Laboratory Component:</b>	
<ol style="list-style-type: none"> <li>1. Develop a registration page for student enrolment as done in Module 2 but without page refresh using AJAX.</li> <li>2. Develop a search application in Django using AJAX that displays courses enrolled by a student being searched.</li> </ol>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Demonstration using Visual Studio Code</li> <li>2. PPT/Prezi Presentation for Architecture and Design Patterns</li> <li>3. Live coding of all concepts with simple examples</li> <li>4. Case Study: Apply the use of AJAX and jQuery for development of EMI calculator.</li> </ol>
<b>Course outcome (Course Skill Set)</b>	
At the end of the course the student will be able to:	
CO 1. Understand the working of MVT based full stack web development with Django.	
CO 2. Designing of Models and Forms for rapid development of web pages.	
CO 3. Analyze the role of Template Inheritance and Generic views for developing full stack web applications.	
CO 4. Apply the Django framework libraries to render nonHTML contents like CSV and PDF.	
CO 5. Perform jQuery based AJAX integration to Django Apps to build responsive full stack web applications,	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
<ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol>	
Two assignments each of <b>10 Marks</b>	
<ol style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol>	
Practical Sessions need to be assessed by appropriate rubrics and viva-voce method. This will	

contribute to **20 marks**.

*Note: Minimum of 80% of the laboratory components have to be covered.*

- Rubrics for each Experiment taken average for all Lab components – 15 Marks.
- Viva-Voce– 5 Marks (more emphasized on demonstration topics)

The sum of three tests, two assignments, and practical sessions will be out of 100 marks and will be **scaled down to 50 marks**

(to have a less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

#### **Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

#### **Suggested Learning Resources:**

##### **Textbooks**

1. Adrian Holovaty, Jacob Kaplan Moss, The Definitive Guide to Django: Web Development Done Right, Second Edition, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG Publishers, 2009
2. Jonathan Hayward, Django Java Script Integration: AJAX and jQuery, First Edition, Pack Publishing, 2011

##### **Reference Books**

1. Aidas Bendroraitis, Jake Kronika, Django 3 Web Development Cookbook, Fourth Edition, Packt Publishing, 2020
2. William Vincent, Django for Beginners: Build websites with Python and Django, First Edition, Amazon Digital Services, 2018
3. Antonio Mele, Django3 by Example, 3<sup>rd</sup> Edition, Pack Publishers, 2020
4. Arun Ravindran, Django Design Patterns and Best Practices, 2<sup>nd</sup> Edition, Pack Publishers, 2020.
5. Julia Elman, Mark Lavin, Light weight Django, David A. Bell, 1<sup>st</sup> Edition, Oreily Publications, 2014

##### **Weblinks and Video Lectures (e-Resources):**

1. MVT architecture with Django: <https://freevideolectures.com/course/3700/django-tutorials>
2. Using Python in Django: <https://www.youtube.com/watch?v=2BqoLiMT3Ao>
3. Model Forms with Django: <https://www.youtube.com/watch?v=gMM1rtTwKxE>
4. Real time Interactions in Django: <https://www.youtube.com/watch?v=3gHmfoeZ45k>
5. AJAX with Django for beginners: <https://www.youtube.com/watch?v=3VaKNyjlxAU>

##### **Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

1. Real world problem solving - applying the Django framework concepts and its integration with AJAX to develop any shopping website with admin and user dashboards.



## VI Semester

<b>COMPUTER GRAPHICS AND FUNDAMENTALS OF IMAGE PROCESSING</b>			
Course Code	<b>21CS63</b>	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Objectives:</b>			
CLO 1. Overview of Computer Graphics along with its applications.			
CLO 2. Exploring 2D and 3D graphics mathematics along with OpenGL API's.			
CLO 3. Use of Computer graphics principles for animation and design of GUI's .			
CLO 4. Introduction to Image processing and Open CV.			
CLO 5. Image segmentation using Open CV.			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Overview:</b> Computer Graphics hardware and software and OpenGL: Computer Graphics: Video Display Devices, Raster-Scan Systems Basics of computer graphics, Application of Computer Graphics. OpenGL: Introduction to OpenGL, coordinate reference frames, specifying two-dimensional world coordinate reference frames in OpenGL, OpenGL point functions, OpenGL line functions, point attributes, line attributes, curve attributes, OpenGL point attribute functions, OpenGL line attribute functions, Line drawing algorithms (DDA, Bresenham's).			
<b>Textbook 1: Chapter -1,2,3, 5(1 and 2 only)</b>			
<b>Self-study topics :</b> Input devices, hard copy devices, coordinate representation, graphics functions, fill area primitives, polygon fill areas, pixel arrays, Parallel Line algorithms			
<b>Teaching-Learning Process</b>	Chalk&board, Active Learning Virtual Lab		
<b>Module-2</b>			
<b>2D and 3D graphics with OpenGL:</b> 2D Geometric Transformations: Basic 2D Geometric Transformations, matrix representations and homogeneous coordinates, 2D Composite transformations, other 2D transformations, raster methods for geometric transformations, OpenGL raster transformations, OpenGL geometric transformations function,			
<b>3D Geometric Transformations:</b> Translation, rotation, scaling, composite 3D transformations, other 3D transformations, OpenGL geometric transformations functions			



**Textbook 1: Chapter -6, 8**

**Self-study topics:** Transformation between 2D coordinate system, OpenGL geometric-transformation, Transformation between 3D coordinate system.

<b>Teaching-Learning Process</b>	Chalk & board, Active Learning, Problem based learning Virtual Lab:
----------------------------------	--

**Module-3**

**Interactive Input Methods and Graphical User Interfaces:** Graphical Input Data ,Logical Classification of Input Devices, Input Functions for Graphical Data , Interactive Picture-ConstructionTechniques, Virtual-Reality Environments, OpenGL Interactive Input-DeviceFunctions, OpenGL Menu Functions , Designing a Graphical User Interface.

**Computer Animation :**Design of Animation Sequences, Traditional Animation Techniques, General Computer-AnimationFunctions, Computer-Animation Languages, Character Animation, Periodic Motions, OpenGL Animation Procedures.

**Textbook 1: Chapter -11, 18**

**Self-study topics:** Raster methods for computer animation, Key frame systems, Motion specification.

<b>Teaching-Learning Process</b>	Chalk & board, MOOC, Active Learning
----------------------------------	--------------------------------------

**Module-4**

**Introduction to Image processing:** overview, Nature of IP, IP and its related fields, Digital Image representation, types of images.

**Digital Image Processing Operations:** Basic relationships and distance metrics, Classification of Image processing Operations.

**Text book 2: Chapter 3**

*( Below topics is for experiential learning only , No questions in SEE)*

*Computer vision and OpenCV: What is computer vision, Evolution of computer vision, Application of Computer vision, Feature of OpenCV, OpenCV library modules, OpenCV environment, Reading, writing and storing images using OpenCV. OpenCV drawing Functions. OpenCV Geometric Transformations.*

**(Note : Computer vision and OpenCV for experimental learning or Activity Based Learning using web sources, Preferred for assignments. No questions in SEE )**

**Web Source:** <https://www.tutorialspoint.com/opencv/>

<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning Lab practice for OpenCV for basic geometric objects and basic image operation
----------------------------------	---

**Module-5**

**Image Segmentation:** Introduction, classification, detection of discontinuities, Edge detection (up to canny edge detection(included)).

**Text Book 2: Chapter 9: 9.1 to 9.4.4.4**

*( Below topics is for experiential learning only , No questions in SEE)*

*Image processing with Open CV: Resizing , Rotation/ Flipping, Blending, Creating region of Interest (ROI), Image Thresholding, Image Blurring and smoothing, Edge Detection, Image contours and Face Detection on images using OpenCV.*

**(Note :Image Processing withOpenCV for experimental learning or Activity Based**

**Learning using web sources, Preferred for assignments. No questions in SEE)**

Web source: <https://medium.com/analytics-vidhya/introduction-to-computer-vision-opencv-in-python-fb722e805e8b>

<b>Teaching-Learning Process</b>	Chalk & board, MOOC Lab practice on image processing. Virtual Lab:
----------------------------------	--

**Course Outcomes:**

At the end of the course the student will be able to:

- CO 1. Construct geometric objects using Computer Graphics principles and OpenGL APIs.
- CO 2. Use OpenGL APIs and related mathematics for 2D and 3D geometric Operations on the objects.
- CO 3. Design GUI with necessary techniques required to animate the created objects
- CO 4. Apply OpenCV for developing Image processing applications.
- CO 5. Apply Image segmentation techniques along with programming, using OpenCV, for developing simple applications.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

- 1. First test at the end of 5<sup>th</sup> week of the semester
- 2. Second test at the end of the 10<sup>th</sup> week of the semester
- 3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

- 4. First assignment at the end of 4<sup>th</sup> week of the semester
- 5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

- 6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(To have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

- 1. The question paper will have ten questions. Each question is set for 20 marks.
- 2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text Books**

- 1. Donald D Hearn, M Pauline Baker and WarrenCarithers: Computer Graphics with OpenGL 4th

Edition, Pearson, 2014

2. S. Sridhar, Digital Image Processing, second edition, Oxford University press 2016.

**Reference Books**

1. Edward Angel: Interactive Computer Graphics- A Top Down approach with OpenGL, 5th edition. Pearson Education, 2008
2. James D Foley, Andries Van Dam, Steven K Feiner, John F Huges Computer graphics with OpenGL: Pearson education

**Web links and Video Lectures (e-Resources):**

**Web links and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/106/106/106106090/>
2. <https://nptel.ac.in/courses/106/102/106102063/>
3. <https://nptel.ac.in/courses/106/103/106103224/>
4. <https://nptel.ac.in/courses/106/102/106102065/>
5. <https://www.tutorialspoint.com/opency/> (Tutorial, Types of Images, Drawing Functions )

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

2. Mini project on computer graphics using Open GL/Python/Open CV.

## VI Semester

<b>DESIGN OF IOT SYSTEMS</b>			
Course Code	21CD641	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Define and explain basic issues, policy and challenges in the IoT</p> <p>CLO 2. Illustrate Mechanism and Key Technologies in IoT</p> <p>CLO 3. Explain the Standard of the IoT</p> <p>CLO 4. Describe IoT design methodologies</p> <p>CLO 5. Demonstrate data analytics for IoT</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecture method (L) needs not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Introduction to Internet of Things(IoT):</b> What is The Internet of Things? Overview and Motivations, Examples of Applications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation.</p> <p><b>Internet of Things Definitions and frameworks:-</b>IoT Definitions, IoT Frameworks, Basic Nodal Capabilities.</p> <p><b>Internet of Things Application Examples:-</b>Overview, Smart Metering/Advanced Metering Infrastructure e-Health/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications.</p> <p><b>Text book 1: Chapter 1, Chapter 2 and Chapter 3</b></p>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Collaborative Learning		
<b>Module-2</b>			
<p><b>Fundamental IoT Mechanism and Key Technologies:-</b>Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies.</p> <p><b>Evolving IoT Standards:-</b>Overview and Approaches, IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol, Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF IPV6 Over Low power WPAN, Zigbee IP(ZIP),IPSO.</p>			

<b>Text book 1: Chapter 4 and Chapter 5</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-3</b>	
<b>Layer 12 Connectivity:</b> Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M.	
<b>Layer 3 Connectivity :</b> IPv6 Technologies for the IoT: Overview and Motivations. Address Capabilities,IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6,Header Compression Schemes, Quality of Service in IPv6, Migration Strategies to IPv6.	
<b>Text book 1: Chapter 6 and Chapter 7</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-4</b>	
<b>IoT Platforms Design Methodology:</b> IoT Design Methodology,	
<b>IoT System-logical design using python:</b> Python data types and data structures, control flow, functions, modules, python packages of interest for IoT.	
<b>IoT Physical servers and cloud offerings:</b> Python web application framework, Amazon web services for IoT.	
<b>Text book 2: Chapter 5- 5.1, 5.2, Chapter 6- 6.1,6.3,6.4,6.5,6.6,6.11 and Chapter 8-8.4,8.6</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Project based learning and Collaborative Learning
<b>Module-5</b>	
<b>Data Analytics for IoT:</b> Introduction, Apache Hadoop, Using Hadoop Map Reduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study.	
<b>Text Book 2: Chapter 10</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Project based learning and Collaborative Learning
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Develop schemes for the applications of IoT in real time scenarios	
CO 2. Accomplish the Internet resources required for IoT	
CO 3. Model & design the Internet of things to business	
CO 4. Demonstrate the practical knowledge through different case studies	
CO 5. Implement data sets received through IoT devices and tools used for analysis	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books**

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", Wiley, 2013.
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands on Approach" Universities Press., 2015

**Reference:**

1. Michael Miller, "The Internet of Things", First Edition, Pearson, 2015.
2. Claire Rowland, Elizabeth Goodman et.al., "Designing Connected Products", First Edition, O'Reilly, 2015.

**Web links and Video Lectures (e-Resources):**

- <https://nptel.ac.in/courses/106/105/106105166/>
- <https://nptel.ac.in/courses/106/105/106105195/>
- <https://www.youtube.com/watch?v=unlPb-dfW7s>
- <https://www.coursera.org/lecture/iot/lecture-1-2-iot-devices-BYmZZ>
- <https://ocw.cs.pub.ro/courses/iot/courses/01>
- <https://freevideolectures.com/course/4638/nptel-introduction-internet-things/1>
- <https://freevideolectures.com/course/4638/nptel-introduction-internet-things/2>
- <https://freevideolectures.com/course/4638/nptel-introduction-internet-things/3>
- <https://freevideolectures.com/course/4638/nptel-introduction-internet-things/4>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VI Semester

<b>ADVANCED JAVA PROGRAMMING</b>			
Course Code	21CS642	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Understanding the fundamental concepts of Enumerations and Annotations</p> <p>CLO 2. Apply the concepts of Generic classes in Java programs</p> <p>CLO 3. Demonstrate the fundamental concepts of String operations</p> <p>CLO 4. Design and develop web applications using Java servlets and JSP</p> <p>CLO 5. Apply database interaction through Java database Connectivity</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same program</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Enumerations, Autoboxing and Annotations:</b>			
<p>Enumerations, Enumeration fundamentals, the values() and valueOf() methods, Java enumerations are class types, enumerations inherits Enum, example, type wrappers, Autoboxing, Autoboxing methods, Autoboxing/Unboxing occurs in Expressions, Autoboxing/Unboxing, Boolean and character values, Autoboxing/Unboxing helps prevent errors, A word of warning</p> <p>Annotations, Annotation basics, specifying retention policy, obtaining annotations at run time by use of reflection, Annotated element interface, Using default values, Marker Annotations, Single member annotations, Built in annotations</p>			
<b>Textbook 1: Chapter12</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Online demonstration, Problem based learning		
<b>Module-2</b>			
<b>Generics:</b> What are Generics, A Simple Generics Example, A Generic Class with Two Type Parameters, The General Form of a Generic Class, Bounded Types, Using Wildcard Arguments, Bounded Wildcards, Creating a Generic Method, Generic Interfaces, Raw types and Legacy code, Generic Class Hierarchies, Erasure, Ambiguity errors, Some Generic Restrictions			
<b>Textbook 1: Chapter 14</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration		
<b>Module-3</b>			
<b>String Handling:</b> The String Constructors, String Length, Special String Operations, Character Extraction,			

String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf(), Changing the case of characters within a String, String Buffer, String Builder

**Textbook 1: Chapter 15**

<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration
----------------------------------	---------------------------------------

**Module-4**

Background; The life cycle of a servlet; A simple servlet; the servlet API; The javax.servlet package Reading servlet parameter; the javax.servlet.http package; Handling HTTP Requests and Responses; using Cookies; Session Tracking, Java Server Pages (JSP); JSP tags, Variables and Objects, Methods, Control statements, Loops, Request String, Parsing other information, User sessions, Cookies, Session Objects

**Textbook 1: Chapter 31**

**Textbook 2: Chapter 11**

<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration
----------------------------------	---------------------------------------

**Module-5**

The concept of JDBC; JDBC Driver Types; JDBC packages; A brief overview of the JDBC Process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; ResultSet; Transaction Processing; Metadata, Data Types; Exceptions.

**Textbook 2: Chapter 6**

<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration
----------------------------------	---------------------------------------

**Course Outcomes**

At the end of the course the student will be able to:

- CO 1. Understanding the fundamental concepts of Enumerations and Annotations
- CO 2. Apply the concepts of Generic classes in Java programs
- CO 3. Demonstrate the concepts of String operations in Java
- CO 4. Develop web based applications using Java servlets and JSP
- CO 5. Illustrate database interaction and transaction processing in Java

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

- 1. First test at the end of 5<sup>th</sup> week of the semester
- 2. Second test at the end of the 10<sup>th</sup> week of the semester
- 3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

- 4. First assignment at the end of 4<sup>th</sup> week of the semester
- 5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

- 6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**



Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Herbert Schildt: JAVA the Complete Reference. 9<sup>th</sup> Edition, Tata McGraw-Hill
2. Jim Keogh, The Complete Reference J2EE, Tata McGraw-Hill

**Reference Books:**

1. Y. Daniel Liang: Introduction to JAVA Programming, 7<sup>th</sup> Edition, Pearson Education, 2007.

**Weblinks and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/106/105/106105191/>
2. <https://nptel.ac.in/courses/106/105/106105225/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Programming exercises

## VI Semester

<b>ADVANCED COMPUTER ARCHITECTURE</b>			
Course Code	21CS643	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Describe computer architecture.</p> <p>CLO 2. Measure the performance of architectures in terms of right parameters.</p> <p>CLO 3. Summarize parallel architecture and the software used for them</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same program</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p>Theory of Parallelism: Parallel Computer Models, The State of Computing, Multiprocessors and Multicomputer, Multivector and SIMD Computers, PRAM and VLSI Models, Program and Network Properties, Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures, Principles of Scalable Performance, Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws. For all Algorithm or mechanism any one example is sufficient.</p> <p><b>Chapter 1 (1.1to 1.4), Chapter 2( 2.1 to 2.4) Chapter 3 (3.1 to 3.3)</b></p>			
<b>Teaching-Learning Process</b>	Chalk and board, Online demonstration, Problem based learning		
<b>Module-2</b>			
<p>Hardware Technologies 1: Processors and Memory Hierarchy, Advanced Processor Technology, Superscalar and Vector Processors, Memory Hierarchy Technology, Virtual Memory Technology. For all Algorithms or mechanisms any one example is sufficient.</p> <p><b>Chapter 4 ( 4.1 to 4.4)</b></p>			
<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration		
<b>Module-3</b>			
<p>Hardware Technologies 2: Bus Systems, Cache Memory Organizations, Shared Memory Organizations, Sequential and Weak Consistency Models, Pipelining and Superscalar Techniques, Linear Pipeline Processors, Nonlinear Pipeline Processors. For all Algorithms or mechanisms any one example is sufficient.</p>			

<b>Chapter 5 (5.1 to 5.4) Chapter 6 (6.1 to 6.2)</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration
<b>Module-4</b>	
Parallel and Scalable Architectures: Multiprocessors and Multicomputers, Multiprocessor System Interconnects, Cache Coherence and Synchronization Mechanisms, Message-Passing Mechanisms, Multivector and SIMD Computers, Vector Processing Principles, Multivector Multiprocessors, Compound Vector Processing, Scalable, Multithreaded, and Dataflow Architectures, Latency-Hiding Techniques, Principles of Multithreading, Fine- Grain Multicomputers. For all Algorithms or mechanisms any one example is sufficient.	
<b>Chapter 7 (7.1,7.2 and 7.4) Chapter 8( 8.1 to 8.3) Chapter 9(9.1 to 9.3)</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration
<b>Module-5</b>	
Software for parallel programming: Parallel Models, Languages, and Compilers ,Parallel Programming Models, Parallel Languages and Compilers, Dependence Analysis of Data Arrays. Instruction and System Level Parallelism, Instruction Level Parallelism, Computer Architecture, Contents, Basic Design Issues, Problem Definition, Model of a Typical Processor, Compiler-detected Instruction Level Parallelism ,Operand Forwarding ,Reorder Buffer, Register Renaming ,Tomasulo’s Algorithm. For all Algorithms or mechanisms any one example is sufficient.	
<b>Chapter 10(10.1 to 10.3) Chapter 12( 12.1 to 12.9)</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Online Demonstration
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
<ul style="list-style-type: none"> <li>CO 1. Explain the concepts of parallel computing</li> <li>CO 2. Explain and identify the hardware technologies</li> <li>CO 3. Compare and contrast the parallel architectures</li> <li>CO 4. Illustrate parallel programming concepts</li> </ul>	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
<ul style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ul>	
Two assignments each of <b>10 Marks</b>	
<ul style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ul>	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
<ul style="list-style-type: none"> <li>6. At the end of the 13<sup>th</sup> week of the semester</li> </ul>	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy</b>	

**as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Kai Hwang and Naresh Jotwani, Advanced Computer Architecture (SIE): Parallelism, Scalability, Programmability, McGraw Hill Education 3/e. 2015

**Reference Books:**

1. John L. Hennessy and David A. Patterson, Computer Architecture: A quantitative approach, 5th edition, Morgan Kaufmann Elsevier, 2013

**Weblinks and Video Lectures (e-Resources):**

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VI Semester

<b>DATA SCIENCE AND VISUALIZATION</b>			
Course Code	21CS644	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. To introduce data collection and pre-processing techniques for data science</p> <p>CLO 2. Explore analytical methods for solving real life problems through data exploration techniques</p> <p>CLO 3. Illustrate different types of data and its visualization</p> <p>CLO 4. Find different data visualization techniques and tools</p> <p>CLO 5. Design and map element of visualization well to perceive information</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to Data Science</b>			
<p><b>Introduction:</b> What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, Current landscape of perspectives, Skill sets. Needed Statistical Inference: Populations and samples, Statistical modelling, probability distributions, fitting a model.</p>			
<b>Textbook 1: Chapter 1</b>			
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. PPT – Recognizing different types of data, Data science process</li> <li>2. Demonstration of different steps, learning definition and relation with data science</li> </ol>		
<b>Module-2</b>			
<b>Exploratory Data Analysis and the Data Science Process</b>			
<p>Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: Real Direct (online realstate firm). Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (k- NN), k-means.</p>			
<b>Textbook 1: Chapter 2, Chapter 3</b>			
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. PPT –Plots, Graphs, Summary Statistics</li> <li>2. Demonstration of Machine Learning Algorithms</li> </ol>		

<b>Module-3</b>	
<b>Feature Generation and Feature Selection</b>	
Extracting Meaning from Data: Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters; Wrappers; Decision Trees; Random Forests. Recommendation Systems: Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system.	
<b>Textbook 1: Chapter 6</b>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. PPT – Feature generation, selection</li> <li>2. Demonstration recommendation engine</li> </ol>
<b>Module-4</b>	
<b>Data Visualization and Data Exploration</b>	
<b>Introduction:</b> Data Visualization, Importance of Data Visualization, Data Wrangling, Tools and Libraries for Visualization	
<b>Comparison Plots:</b> Line Chart, Bar Chart and Radar Chart; <b>Relation Plots:</b> Scatter Plot, Bubble Plot , Correlogram and Heatmap; <b>Composition Plots:</b> Pie Chart, Stacked Bar Chart, Stacked Area Chart, Venn Diagram; <b>Distribution Plots:</b> Histogram, Density Plot, Box Plot, Violin Plot; <b>Geo Plots:</b> Dot Map, Choropleth Map, Connection Map; What Makes a Good Visualization?	
<b>Textbook 2: Chapter 1, Chapter 2</b>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Demonstration of different data visualization tools.</li> </ol>
<b>Module-5</b>	
<b>A Deep Dive into Matplotlib</b>	
Introduction, Overview of Plots in Matplotlib, <b>Pyplot Basics:</b> Creating Figures, Closing Figures, Format Strings, Plotting, Plotting Using pandas DataFrames, Displaying Figures, Saving Figures; <b>Basic Text and Legend Functions:</b> Labels, Titles, Text, Annotations, Legends; <b>Basic Plots:</b> Bar Chart, Pie Chart, Stacked Bar Chart, Stacked Area Chart, Histogram, Box Plot, Scatter Plot, Bubble Plot; <b>Layouts:</b> Subplots, Tight Layout, Radar Charts, GridSpec; <b>Images:</b> Basic Image Operations, Writing Mathematical Expressions	
<b>Textbook 2: Chapter 3</b>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. PPT – Comparison of plots</li> <li>2. Demonstration charts</li> </ol>
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Understand the data in different forms	
CO 2. Apply different techniques to Explore Data Analysis and the Data Science Process	
CO 3. Analyze feature selection algorithms & design a recommender system.	
CO 4. Evaluate data visualization tools and libraries and plot graphs.	
CO 5. Develop different charts and include mathematical expressions.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Doing Data Science, Cathy O'Neil and Rachel Schutt, O'Reilly Media, Inc O'Reilly Media, Inc, 2013
2. Data Visualization workshop, Tim Grobmann and Mario Dobler, Packt Publishing, ISBN 9781800568112

**Reference:**

1. Mining of Massive Datasets, Anand Rajaraman and Jeffrey D. Ullman, Cambridge University Press, 2010
2. Data Science from Scratch, Joel Grus, Shroff Publisher /O'Reilly Publisher Media
3. A handbook for data driven design by Andy krik

**Weblinks and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/106/105/106105077/>
2. <https://www.oreilly.com/library/view/doing-data-science/9781449363871/toc01.html>
3. <http://book.visualisingdata.com/>
4. <https://matplotlib.org/>
5. <https://docs.python.org/3/tutorial/>
6. <https://www.tableau.com/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Demonstration using projects

## VI Semester

<b>INTRODUCTION TO DATA STRUCTURES</b>			
Course Code	21CS651	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Introduce elementary data structures.</p> <p>CLO 2. Analyze Linear Data Structures: Stack, Queues, Lists</p> <p>CLO 3. Analyze Non Linear Data Structures: Trees</p> <p>CLO 4. Assess appropriate data structure during program development/Problem Solving.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> </ol> <p>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</p>			
<b>Module-1</b>			
<b>Introduction:</b>			
Introduction to arrays: one-dimensional arrays, two dimensional arrays, initializing two dimensional arrays, Multidimensional arrays.			
Introduction to Pointers: Pointer concepts, accessing variables through pointers, Dynamic memory allocation, pointers applications.			
Introduction to structures and unions: Declaring structures, Giving values to members, structure initialization, arrays of structures, nested structure, unions, size of structures.			
<b>Textbook 1: Ch 8.3 to 8.15,Ch 12.3 to 12.19</b>			
<b>Textbook 2:Ch 2.1 to2.13,2.51 ,2.80 to 2.98</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-2</b>			
<b>Linear Data Structures-Stacks and queues:</b>			
Introduction, Stack representation in Memory, Stack Operations, Stack Implementation, Applications of Stack. Introduction, Queues-Basic concept, Logical representation of Queues, Queue Operations and its types, Queue Implementation, Applications of Queue.			
<b>Textbook 2: Ch 6.1 to 6.14 ,Ch 8.1,8.2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem Based Learning		
<b>Module-3</b>			
<b>Linear Data Structures-Linked List:</b>			
Introduction, Linked list Basic concept, Logical representation of Linked list, Self-Referential structure, Singly-linked List Operations and Implementation, Circular Linked List, applications of Linked list.			



<b>Textbook 1: Ch 15.1 ,15.3,15.4,15.8</b>	
<b>Textbook 2: Ch 9.2.9.5</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning
<b>Module-4</b>	
<b>Non Linear Data Structures – Trees</b>	
Introduction, Basic concept, Binary Tree and its types, Binary Tree Representation, Binary Tree Traversal, Binary Search tree, Expression Trees.	
<b>Textbook1: Ch 16.1,16.2</b>	
<b>Textbook2:Ch 10.1,10.2,10.4,10.6.3</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Active Learning, Problem based learning
<b>Module-5</b>	
<b>Sorting and Searching</b>	
Sorting: Introduction, Bubble sort, Selection sort, Insertion sort	
Searching: Introduction, Linear search, Binary search.	
<b>Textbook1: Ch 17.1,17.2.2, 17.2.4, 17.3.1,17.3.2</b>	
<b>Textbook2: Ch 11.1.,11.2,11.3,11.7,11.10.1,11.10.2</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Express the fundamentals of static and dynamic data structure.	
CO 2. Summarize the various types of data structure with their operations.	
CO 3. Interpret various searching and sorting techniques.	
CO 4. Choose appropriate data structure in problem solving.	
CO 5. Develop all data structures in a high level language for problem solving.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.</b>	
<b>Semester End Examination:</b>	
Theory SEE will be conducted by University as per the scheduled timetable, with common question	

papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. C Programming and data structures, E Balaguruswamy 4<sup>th</sup> Edition, 2007, McGraw Hill
2. Systematic approach to Data structures using C, A M Padma Reddy, 7<sup>th</sup> Edition 2007, Sri Nandi Publications.

**References**

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2<sup>nd</sup> Ed, Universities Press, 2014.
2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1<sup>st</sup> Ed, McGraw Hill, 2014.

**Weblinks and Video Lectures (e-Resources):**

1. [https://www.youtube.com/watch?v=DFpWCl\\_49i0](https://www.youtube.com/watch?v=DFpWCl_49i0)
2. <https://www.youtube.com/watch?v=x7t-ULoAZM>
3. <https://www.youtube.com/watch?v=I37kGX-nZEI>
4. <https://www.youtube.com/watch?v=XuCbpw6Bj1U>
5. <https://www.youtube.com/watch?v=R9PTBwOzceo>
6. <https://www.youtube.com/watch?v=qH6yxkw0u78>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Demonstration of projects developed using Linear/Non-linear data structures

## VI Semester

<b>INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS</b>			
Course Code	21CS652	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b> CLO 1. Understand the basic concepts and the applications of database systems. CLO 2. Understand the relational database design principles. CLO 3. Master the basics of SQL and construct queries using SQL. CLO 4. Familiar with the basic issues of transaction processing and concurrency control.			
<b>Teaching-Learning Process (General Instructions)</b>  These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain the functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to Databases:</b> Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.			
<b>Overview of Database Languages and Architectures:</b> Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.			
<b>Conceptual Data Modelling using Entities and Relationships:</b> Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, Examples			
<b>Textbook 1: Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.7</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<b>Relational Model:</b> Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.			
<b>Relational Algebra:</b> Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison. Examples of Queries in relational algebra.			
<b>Mapping Conceptual Design into a Logical Design:</b> Relational Database Design using ER-to-Relational mapping.			
<b>Textbook 1; ch5.1 to 5.3, 8.1 to 8.5, 9.1;</b>			

<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-3</b>	
<p><b>SQL:</b>SQL data definition and data types, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL.</p> <p><b>Advances Queries:</b> More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL, Schema change statements in SQL.Database</p> <p><b>Textbook 1: Ch 6.1 to 6.5, 7.1 to 7.4; Textbook 2: 6.1 to 6.6;</b></p>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-4</b>	
<p><b>Normalization: Database Design Theory</b> – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Examples on normal forms.</p> <p><b>Textbook 1: Ch 14.1 to -14.7, 15.1 to 15.6</b></p>	
<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning
<b>Module-5</b>	
<p><b>Transaction management and Concurrency</b> –Control Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management.</p> <p><b>Textbook 1: Ch 20.1 to 20.6, 21.1 to 21.7;</b></p>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<p><b>Course Outcomes</b> At the end of the course the student will be able to:</p> <ul style="list-style-type: none"> <li>CO 1. Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS</li> <li>CO 2. Use Structured Query Language (SQL) for database manipulation.</li> <li>CO 3. Design and build simple database systems</li> <li>CO 4. Develop application to interact with databases.</li> </ul>	
<p><b>Assessment Details (both CIE and SEE)</b> The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together</p> <p><b>Continuous Internal Evaluation:</b> Three Unit Tests each of <b>20 Marks (duration 01 hour)</b></p> <ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol> <p>Two assignments each of <b>10 Marks</b></p> <ol style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol> <p>Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b></p> <ol style="list-style-type: none"> <li>6. At the end of the 13<sup>th</sup> week of the semester</li> </ol>	

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Fundamentals of Database Systems, RamezElmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.youtube.com/watch?v=3EJlovevfcA>
2. <https://www.youtube.com/watch?v=9TwMRs3qTcU>
3. <https://www.youtube.com/watch?v=ZWl0Xow304I>
4. <https://www.youtube.com/watch?v=4YilEjkNPrQ>
5. <https://www.youtube.com/watch?v=CZTkgMoqVss>
6. <https://www.youtube.com/watch?v=HI4NZB1XR9c>
7. [https://www.youtube.com/watch?v=EGEwkad\\_IIA](https://www.youtube.com/watch?v=EGEwkad_IIA)
8. <https://www.youtube.com/watch?v=t5hsV9lC1rU>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Developing and demonstration of models / projects based on DBMS application

## VI Semester

<b>INTRODUCTION TO CYBER SECURITY</b>			
Course Code	21CS653	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b> CLO 1. To familiarize cybercrime terminologies and ACTs CLO 2. Understanding cybercrime in mobiles and wireless devices along with the tools for Cybercrime and prevention CLO 3. Understand the motive and causes for cybercrime, cybercriminals, and investigators CLO 4. Understanding criminal case and evidence, detection standing criminal case and evidence.			
<b>Teaching-Learning Process (General Instructions)</b>  These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to Cybercrime:</b>  <b>Cybercrime:</b> Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes,  <b>Cybercrime:</b> The Legal Perspectives,  <b>Cybercrimes:</b> An Indian Perspective, Cybercrime and the Indian ITA 2000.			
<b>Textbook1:Ch1 (1.1 to 1.8).</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-2</b>			
<b>Cyber offenses:</b> <b>How Criminals Plan Them:</b> Introduction, How Criminals Plan the Attacks, Social Engineering, Cyber stalking, Cybercafe and Cybercrimes.			
<b>Botnets:</b> The Fuel for Cybercrime, Attack Vector			
<b>Textbook1: Ch2 (2.1 to 2.7).</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-3</b>			
<b>Tools and Methods Used in Cybercrime:</b> Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, Attacks on Wireless Networks.			

<b>Textbook1: Ch4 (4.1 to 4.9, 4.12).</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Case studies
<b>Module-4</b>	
<b>Understanding the people on the scene:</b> Introduction, understanding cyber criminals, understanding cyber victims, understanding cyber investigators.	
<b>The Computer Investigation process:</b> investigating computer crime.	
<b>Understanding Cybercrime Prevention:</b> Understanding Network Security Concepts, Understanding Basic Cryptography Concepts, Making the Most of Hardware and Software Security	
<b>Textbook 2:Ch3,Ch 4, Ch 7.</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Case studies
<b>Module-5</b>	
<b>Cybercrime Detection Techniques:</b> Security Auditing and Log Firewall Logs, Reports, Alarms, and Alerts, Commercial Intrusion Detection Systems, Understanding E-Mail Headers Tracing a Domain Name or IP Address.	
<b>Collecting and preserving digital Evidence:</b> Introduction, understanding the role of evidence in a criminal case, collecting digital evidence, preserving digital evidence, recovering digital evidence, documenting evidence.	
<b>TextBook 2:Ch 9, Ch 10.</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Case studies
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Describe the cyber crime terminologies	
CO 2. Analyze cybercrime in mobiles and wireless devices along with the tools for Cybercrime and prevention	
CO 3. Analyze the motive and causes for cybercrime, cybercriminals, and investigators	
CO 4. Apply the methods for understanding criminal case and evidence, detection standing criminal case and evidence.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the	

methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. SunitBelapure and Nina Godbole, “Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives”, Wiley India Pvt Ltd, ISBN: 978-81- 265-21791, 2013
2. Debra Little John Shinder and Michael Cross, “Scene of the cybercrime”, 2nd edition, Syngress publishing Inc, Elsevier Inc, 2008

**Reference Books:**

1. Robert M Slade, “Software Forensics”, Tata McGraw Hill, New Delhi, 2005.
2. Bernadette H Schell, Clemens Martin, “Cybercrime”, ABC – CLIO Inc, California, 2004.
3. Nelson Phillips and EnfingerSteuart, “Computer Forensics and Investigations”, Cengage Learning, New Delhi, 2009.
4. Kevin Mandia, Chris Prosize, Matt Pepe, “Incident Response and Computer Forensics”, Tata McGraw -Hill, New Delhi, 2006.

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.youtube.com/watch?v=czDzUP1HclQ>
2. <https://www.youtube.com/watch?v=qS4ViqnjcC8>
3. [https://www.trendmicro.com/en\\_nz/ciso/21/h/cybercrime-today-and-the-future.html](https://www.trendmicro.com/en_nz/ciso/21/h/cybercrime-today-and-the-future.html)

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of projects related to Cyber security.



## VI Semester

<b>PROGRAMMING IN JAVA</b>			
Course Code	21CS654	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b> CLO 1. Learn fundamental features of object oriented language and JAVA. CLO 2. To create, debug and run simple Java programs. CLO 3. Learn object oriented concepts using programming examples. CLO 4. Study the concepts of importing of packages and exception handling mechanism. CLO 5. Discuss the String Handling examples with Object Oriented concepts.			
<b>Teaching-Learning Process (General Instructions)</b>  These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none"> <li>Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>An Overview of Java:</b> Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries.			
<b>Data Types, Variables, and Arrays:</b> Java Is a Strongly Typed Language, The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, A Closer Look at Literals, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, A Few Words About Strings			
<b>Textbook 1:Ch 2,Ch 3.</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning.		
<b>Module-2</b>			
<b>Operators:</b> Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses,			
<b>Control Statements:</b> Java's Selection Statements, Iteration Statements, Jump Statements.			
<b>Textbook 1:Ch 4,Ch 5.</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<b>Introducing Classes:</b> Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection, The finalize( ) Method, A Stack Class.			
<b>A Closer Look at Methods and Classes:</b> Overloading Methods, Using Objects as Parameters, A Closer			

Look at Argument Passing, Returning Objects, Recursion, Introducing Access Control, Understanding static, Introducing final, Arrays Revisited. **Inheritance:** Inheritance, Using super, Creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding.

**Textbook 1: Ch 6, Ch 7.1-7.9, Ch 8.1-8.5**

<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
----------------------------------	--

**Module-4**

**Packages and Interfaces:** Packages, Access Protection, Importing Packages, Interfaces.

**Exception Handling:** Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Using Exceptions

**Textbook 1: Ch 9, Ch 10.**

<b>Teaching-Learning Process</b>	Chalk & board, Problem based learning, Demonstration
----------------------------------	--

**Module-5**

**Enumerations :** Enumerations, Type Wrappers.

**String Handling:** The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf( ), Changing the Case of Characters Within a String, Additional String Methods, StringBuffer, StringBuilder.

**Textbook 1: Ch 12.1, 12.2, Ch 15.**

<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
----------------------------------	--

**Course Outcomes**

At the end of the course the student will be able to:

- CO 1. Develop JAVA programs using OOP principles and proper program structuring.
- CO 2. Develop JAVA program using packages, inheritance and interface.
- CO 3. Develop JAVA programs to implement error handling techniques using exception handling
- CO 4. Demonstrate string handling concepts using JAVA.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:****Textbooks**

1. Herbert Schildt, Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007. (Chapters 2, 3, 4, 5, 6,7, 8, 9,10, 12,15)

**Reference Books:**

1. Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, Pearson Education,2008, ISBN:9788131720806.
2. Rajkumar Buyya,SThamarasiselvi, xingchen chu, Object oriented Programming with java, Tata McGraw Hill education private limited.
3. E Balagurusamy, Programming with Java A primer, Tata McGraw Hill companies.
4. Anita Seth and B L Juneja, JAVA One step Ahead, Oxford University Press, 2017.

**Weblinks and Video Lectures (e-Resources):****Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of projects developed using JAVA

## VI Semester

<b>COMPUTER GRAPHICS AND IMAGE PROCESSING LABORATORY</b>			
Course Code	21CSL66	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	1	Exam Hours	03
<b>Course Objectives:</b>			
CLO 1: Demonstrate the use of Open GL.			
CLO 2: Demonstrate the different geometric object drawing using OpenGL			
CLO 3: Demonstration of 2D/3D transformation on simple objects.			
CLO 4: Demonstration of lighting effects on the created objects.			
CLO 5: Demonstration of Image processing operations on image/s.			
<b>Sl. No.</b>	<b>Practise Programs</b>		
	<ul style="list-style-type: none"> <li>• Installation of OpenGL /OpenCV/ Python and required headers</li> <li>• Simple programs using OpenGL (Drawing simple geometric object like line, circle, rectangle, square)</li> <li>• Simple programs using OpenCV (operation on an image/s)</li> </ul>		
	<b>PART A</b>		
	<b>List of problems for which student should develop program and execute in the Laboratory using OpenGL/openCV/ Python</b>		
1.	Develop a program to draw a line using Bresenham's line drawing technique		
2.	Develop a program to demonstrate basic geometric operations on the 2D object		
3.	Develop a program to demonstrate basic geometric operations on the 3D object		
4.	Develop a program to demonstrate 2D transformation on basic objects		
5.	Develop a program to demonstrate 3D transformation on 3D objects		
6.	Develop a program to demonstrate Animation effects on simple objects.		
7.	Write a Program to read a digital image. Split and display image into 4 quadrants, up, down, right and left.		
8.	Write a program to show rotation, scaling, and translation on an image.		
9.	Read an image and extract and display low-level features such as edges, textures using filtering techniques.		
10.	Write a program to blur and smoothing an image.		
11.	Write a program to contour an image.		
12.	Write a program to detect a face/s in an image.		
	<b>PART B</b>		
	<b>Practical Based Learning</b>		
	<p>Student should develop a mini project and it should be demonstrate in the laboratory examination, Some of the projects are listed and it is not limited to:</p> <ul style="list-style-type: none"> <li>➤ Recognition of License Plate through Image Processing</li> <li>➤ Recognition of Face Emotion in Real-Time</li> <li>➤ Detection of Drowsy Driver in Real-Time</li> <li>➤ Recognition of Handwriting by Image Processing</li> <li>➤ Detection of Kidney Stone</li> <li>➤ Verification of Signature</li> <li>➤ Compression of Color Image</li> <li>➤ Classification of Image Category</li> <li>➤ Detection of Skin Cancer</li> <li>➤ Marking System of Attendance using Image Processing</li> <li>➤ Detection of Liver Tumor</li> <li>➤ IRIS Segmentation</li> <li>➤ Detection of Skin Disease and / or Plant Disease</li> <li>➤ Biometric Sensing System .</li> <li>➤ Projects which helps to formers to understand the present developments in agriculture.</li> <li>➤ Projects which helps high school/college students to understand the scientific</li> </ul>		

- problems.
- Simulation projects which helps to understand innovations in science and technology

### Course Outcome (Course Skill Set)

At the end of the course the student will be able to:

- CO 1: Use OpenGL /OpenCV for the development of mini Projects.
- CO 2: Analyze the necessity mathematics and design required to demonstrate basic geometric transformation techniques.
- CO 3: Demonstrate the ability to design and develop input interactive techniques.
- CO 4: Apply the concepts to Develop user friendly applications using Graphics and IP concepts.

### Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

#### Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8<sup>th</sup> week of the semester and the second test shall be conducted after the 14<sup>th</sup> week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).  
The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

#### Semester End Evaluation (SEE):

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Students can pick one experiment from the questions lot of PART A with equal choice to all the students in a batch.
- **PART B** : Student should develop a mini project and it should be demonstrated in the laboratory examination (with report and presentation).
- Weightage of marks for **PART A is 60%** and for **PART B is 40%**. General rubrics suggested to be followed for part A and part B.
- Change of experiment is allowed only once (in part A) and marks allotted to the procedure part to be made zero.
- The duration of SEE is 03 hours.

**Suggested Learning Resources:**

1. Donald Hearn & Pauline Baker: Computer Graphics with OpenGL Version,3rd/4th Edition, Pearson Education,2011
2. James D Foley, Andries Van Dam, Steven K Feiner, John F Huges Computer graphics with OpenGL: Pearson education

**Weblinks and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/106/106/106106090/>
2. <https://nptel.ac.in/courses/106/102/106102063/>
3. <https://nptel.ac.in/courses/106/103/106103224/>
4. <https://nptel.ac.in/courses/106/102/106102065/>
5. <https://www.tutorialspoint.com/opencv/>
6. <https://medium.com/analytics-vidhya/introduction-to-computer-vision-opencv-in-python-fb722e805e8b>

## VII Semester

<b>ROBOTIC PROCESS AUTOMATION DESIGN AND DEVELOPMENT</b>			
Course Code	21CD71	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3
<b>Course Learning Objectives</b>			
<p>CLO 1. To understand basic concepts of RPA            CLO 2. To Describe RPA, where it can be applied and how its implemented            CLO 3. To Describe the different types of variables, Control Flow and data manipulation techniques            CLO 4. To Understand Image, Text and Data Tables Automation            CLO 5. To Describe various types of Exceptions and strategies to handle</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>RPA Foundations-</b> What is RPA – Flavors of RPA- History of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA – Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- OCR-Databases-APIs- AI-Cognitive Automation-Agile, Scrum, Kanban and Waterfall0 DevOps-Flowcharts.</p>			
<b>Textbook 1: Ch 1, Ch 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<p><b>RPA Platforms-</b> Components of RPA- RPA Platforms-About Ui Path- About UiPath - The future of automation - Record and Play - Downloading and installing UiPath Studio -Learning Ui Path Studio- - Task recorder - Step-by-step examples using the recorder.</p>			
<b>Textbook 2: Ch 1, Ch 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<p><b>Sequence, Flowchart, and Control Flow-</b>Sequencing the workflow-Activities-Control flow, various types of loops, and decision making-Step-by-step example using Sequence and Flowchart-Step-by-step</p>			

example using Sequence and Control flow-Data Manipulation-Variables and Scope-Collections-Arguments – Purpose and use-Data table usage with examples-Clipboard management-File operation with step-by-step example-CSV/Excel to data table and vice versa (with a step-by-step example).

**Textbook 2: Ch 3, Ch 4**

**Teaching-Learning Process**

Chalk and board, Problem based learning, Demonstration

**Module-4**

**Taking Control of the Controls-** Finding and attaching windows- Finding the control- Techniques for waiting for a control- Act on controls – mouse and keyboard activities- Working with UiExplorer- Handling events- Revisit recorder- Screen Scraping- When to use OCR- Types of OCR available- How to use OCR- Avoiding typical failure points.

**Textbook 2: Ch 5**

**Teaching-Learning Process**

Chalk& board, Problem based learning

**Module-5**

Exception Handling, Debugging, and Logging- Exception handling- Common exceptions and ways to handle them- Logging and taking screenshots- Debugging techniques- Collecting crash dumps- Error reporting- Future of RPA

**Textbook 2: Ch 8**

**Textbook 1: Ch 13**

**Teaching-Learning Process**

Chalk and board, MOOC

**Course Outcomes**

- CO 1. To Understand the basic concepts of RPA
- CO 2. To Describe various components and platforms of RPA
- CO 3. To Describe the different types of variables, control flow and data manipulation techniques
- CO 4. To Understand various control techniques and OCR in RPA
- CO 5. To Describe various types and strategies to handle exceptions

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the



methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Tom Taulli , The Robotic Process Automation Handbook : A Guide to Implementing RPA Systems, 2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher : Apress
2. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940

**Reference:**

1. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, “Introduction to Robotic Process Automation: a Primer”, Institute of Robotic Process Automation.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant
3. Srikanth Merianda,Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation

**Weblinks and Video Lectures (e-Resources):**

- <https://www.uipath.com/rpa/robotic-process-automation>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>CLOUD COMPUTING</b>			
Course Code	21CS72	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:0:0:0	SEE Marks	50
Total Hours of Pedagogy	24	Total Marks	100
Credits	02	Exam Hours	03
<b>Course Learning Objectives:</b>			
<p>CLO 1. Introduce the rationale behind the cloud computing revolution and the business drivers</p> <p>CLO 2. Introduce various models of cloud computing</p> <p>CLO 3. Introduction on how to design cloud native applications, the necessary tools and the design tradeoffs.</p> <p>CLO 4. Realize the importance of Cloud Virtualization, Abstraction`s and Enabling Technologies and cloud security</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>2. Show Video/animation films to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Topics will be introduced in a multiple representation.</li> <li>7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction:</b>			
Introduction ,Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka			
<b>Textbook 1: Chapter 1: 1.1,1.2 and 1.3</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-2</b>			
<b>Virtualization:</b> Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples			
<b>Textbook 1 : Chapter 3: 3.1 to 3.6</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-3</b>			
<b>Cloud Computing Architecture:</b> Introduction, Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges			
<b>Textbook 1: Chapter 4: 4.1 to 4.5</b>			

<b>Teaching-Learning Process</b>	Chalk and board, Demonstration
<b>Module-4</b>	
<b>Cloud Security:</b> Risks, Top concern for cloud users, privacy impact assessment, trust, OS security, VM Security, Security Risks posed by shared images and management OS.	
<b>Textbook 2: Chapter 9: 9.1 to 9.6, 9.8, 9.9</b>	
<b>Teaching-Learning Process</b>	Chalk and board
<b>Module-5</b>	
<b>Cloud Platforms in Industry</b> Amazon web services: - Compute services, Storage services, Communication services, Additional services. Google AppEngine: - Architecture and core concepts, Application life cycle, Cost model, Observations.	
<b>Textbook 1: Chapter 9: 9.1 to 9.2</b>	
<b>Cloud Applications:</b> Scientific applications: - HealthCare: ECG analysis in the cloud, Biology: gene expression data analysis for cancer diagnosis, Geoscience: satellite image processing. Business and consumer applications: CRM and ERP, Social networking, media applications.	
<b>Textbook 1: Chapter 10: 10.1 to 10.2</b>	
<b>Teaching-Learning Process</b>	Chalk and board
<b>Course outcome (Course Skill Set)</b> At the end of the course the student will be able to: CO 1. Understand and analyze various cloud computing platforms and service provider. CO 2. Illustrate various virtualization concepts. CO 3. Identify the architecture, infrastructure and delivery models of cloud computing. CO 4. Understand the Security aspects of CLOUD. CO 5. Define platforms for development of cloud applications	
<b>Assessment Details (both CIE and SEE)</b>  The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>  Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>  1. First test at the end of 5 <sup>th</sup> week of the semester 2. Second test at the end of the 10 <sup>th</sup> week of the semester 3. Third test at the end of the 15 <sup>th</sup> week of the semester  Two assignments each of <b>10 Marks</b>  4. First assignment at the end of 4 <sup>th</sup> week of the semester 5. Second assignment at the end of 9 <sup>th</sup> week of the semester  Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi Mastering Cloud Computing McGraw Hill Education.
2. Dan C. Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, Elsevier 2013

**Reference Books**

1. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Osborne Media.
2. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly Publication.
3. John Rhoton, Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press.

**Weblinks and Video Lectures (e-Resources):**

- <https://www.youtube.com/watch?v=1N3oqYhzHv4>
- <https://www.youtube.com/watch?v=RWgW-CgdIk0>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>MULTIMEDIA DESIGN</b>			
Course Code	21CD731	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Understand characteristics of Multimedia contents</p> <p>CLO 2. Understand and compare different text and image standards.</p> <p>CLO 3. Understand audio digitization, processing, and storage.</p> <p>CLO 4. Understand video digitization, processing, and storage.</p> <p>CLO 5. Ability to build simple multimedia solutions that utilizes knowledge of text, image, audio and video standards.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Overview:</b> Introduction, Multimedia Presentation and Production, Characteristics of a Multimedia Presentation, Hardware and Software Requirements, Analog and Digital Representations, Digitization.			
<b>Textbook1: Chapter 1</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Demonstrations		
<b>Module-2</b>			
<b>Text &amp; Image:</b> Text - Introduction, Types of Text, Unicode Standard, Font, Text Compression, Text File Formats. Image - Introduction, Image Data Representation, Image Processing, Image File Formats, Image-Processing Software			
<b>Textbook1: Chapter 2 &amp; 3</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Demonstration, Experimentation		
<b>Module-3</b>			

**Audio:** Introduction, Acoustics, Types and Properties of Sounds, Psycho-Acoustics, Digital Audio, Musical Instrument Digital Interface (MIDI), Digital Audio Processing, Speech, Audio File Formats.

**Textbook 1: chapter 5**

<b>Teaching-Learning Process</b>	Chalk and board, Demonstration, Experimentation
----------------------------------	---

**Module-4**

**Video:** Introduction, Motion Video, Digital Video, Digital Video Processing, Video Recording and Storage Formats, Video File Formats, Video Editing Concepts.

**Textbook 1: Chapter 6**

<b>Teaching-Learning Process</b>	Chalk and board, Demonstration, Experimentation
----------------------------------	---

**Module-5**

**Architecture and Design:** Introduction, User Interfaces, OS Multimedia Support, Multimedia Extensions, Distributed Multimedia Applications, Real-time Protocols, Synchronization.

**Textbook 1: Chapter 10**

<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
----------------------------------	--

**Course Outcomes**

At the end of the course the student will able to:

- CO 1. Use optimally Multimedia content
- CO 2. Understand different text and image standards.
- CO 3. Appreciate audio digitization, processing, and storage.
- CO 4. Appreciate video digitization, processing, and storage.
- CO 5. Build simple multimedia solutions that utilizes knowledge of text, image, audio and video standards.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester
6. At the end of the 13<sup>th</sup> week of the semester- Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the**

**outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbook:**

1. Principles of Multimedia – 2nd edition by Ranjan Parekh. McGraw Hill publication

**Web links and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/117/105/117105083/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>ANIMATION AND GAME DESIGN</b>			
Course Code	21CD732	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Understand the basics of animation and game theory</p> <p>CLO 2. Demonstrate the principles of animations and operations</p> <p>CLO 3. Explain 2D animation techniques</p> <p>CLO 4. Describing and Solving Game theory problems</p> <p>CLO 5. Demonstrate applications of the Game Designs</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) needs not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Basics of Animations- Development:</b> Idea Creation, Evolving a Storyline.</p> <p><b>Character Design:</b> The Evolution of 2D Character Design, The Evolution of 3D Character Design, Animation Style, Concept and Environment Design.</p> <p><b>Project Financing:</b> Animation Markets, Scheduling and Budgeting, Investment, Marketing, and Distribution Possibilities.</p>			
<b>Text book 1: Chapter 1, Chapter 2 and Chapter 3</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Animation Videos		
<b>Module-2</b>			
<p><b>Principles of Animation:</b> Key Poses, Breakdowns, and Inbetweens, Timing, Extreme Positions, Arcs and Paths of Action, Holds, Emphasis, Anticipation, Weight and Weighted Movement, Flexibility and Fluid Joint Movement, Overlapping Action, Generic Walks, Walk Cycles, Runs and Run Cycles, Silhouetting, Dialogue and Lip Sync, Laughter, Takes, Eyes and Expressions.</p>			
<b>Text book 1: Chapter 8</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Animation Videos		
<b>Module-3</b>			
<b>2D Animation Overview:</b> It's All about Pencils and Paper Script, The Tools of the Trade.			



**2D Animation Basics:** Keys, In-betweens, and Timing, Dope (Exposure) Sheets and Production Folders, Flipping and Peg Bars, Using Peg Bars

**Text book 1: Chapter 10 and Chapter 11**

<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
----------------------------------	--

**Module-4**

**Introduction to Game theory:** What is game theory? An outline of the history of game theory , John von Neumann, The theory of rational choice, Coming attractions.

**Games with Perfect Information:** Nash Equilibrium: Theory , Strategic games, Nash equilibrium, Examples of Nash equilibrium, Experimental evidence on the Prisoner's Dilemma, Focal points, Best response functions, Dominated actions, Equilibrium in a single population: symmetric games and symmetric equilibria

**Text book 2: Chapter 1 and Chapter 2**

<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning and Collaborative Learning
----------------------------------	---

**Module-5**

**Nash Equilibrium:** Illustrations, Cournot's model of oligopoly, Bertrand's model of oligopoly, Cournot, Bertrand, and Nash: some historical notes, Electoral competition, The War of Attrition, Auctions, Auctions from Babylonia to eBay, Accident law

**Text Book 2: Chapter 3**

<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning and Collaborative Learning
----------------------------------	---

**Course Outcomes**

At the end of the course the student will be able to:

- CO 1. Understand the Basics of Animation techniques.
- CO 2. Describe principles animation techniques.
- CO 3. Demonstrate the functions of 2D Animation techniques.
- CO 4. Apply game theory in real-time animated projects.
- CO 5. Apply the models of the Game theory problems

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

- 1. First test at the end of 5<sup>th</sup> week of the semester
- 2. Second test at the end of the 10<sup>th</sup> week of the semester
- 3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

- 4. First assignment at the end of 4<sup>th</sup> week of the semester
- 5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

- 6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books**

1. Animation From Pencil to Pixels, Tony White, Classical Techniques for Digital Animators, Focal Press is an imprint of Elsevier.
2. Martin Osborne: An introduction to game theory, Oxford University Press, Indian Edition,2004.

**Reference:**

1. 1. Sketching for Beginners: Step-by-step Guide to Getting Started With Your Drawing
2. Perspective Made Easy (Dover Art Instruction)
3. Roger B Myerson: Game theory: Analysis of Conflict, Harvard University Press, 1997
4. An Introduction to Game Theory: Strategy, Joel Watson, W W Norton and Company.
5. Algorithmic Game Theory, Noam Nisan, Tim Roughgarden, Eva Tardos, Vijay V Vazirani, Cambridge University Press

**Web links and Video Lectures (e-Resources):**

- <https://www.youtube.com/watch?v=zJonHY5BcTQ> – Animation & Game Art Design
- <https://www.youtube.com/watch?v=yyKctxdo9KI> - Gaming , VFX and Animation course at IIT Bombay
- <https://www.youtube.com/watch?v=-woaDyBXkyU> - Animation Tutorial
- <https://www.linkedin.com/learning/topics/3d-animation> - 3D Animation
- <https://www.youtube.com/watch?v=n7u1puLdP90> – Game Design Fundamentals
- <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-189-multicore-programming-primer-january-iap-2007/lecture-notes-and-video/116-introduction-to-game-development/> - Game Development
- <https://ocw.mit.edu/courses/comparative-media-studies-writing/cms-608-game-design-spring-2008/lecture-notes/>
- <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-838-algorithms-for-computer-animation-fall-2002/download-course-materials/>
- <https://ocw.mit.edu/courses/comparative-media-studies-writing/cms-608-game-design-fall-2010/audio-lectures/lecture-25-fiction-and-stories-in-games/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>USER INTERFACE DESIGN</b>			
Course Code	21IS733	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives:</b>			
<p>CLO 1. To study the concept of menus, windows, interfaces.</p> <p>CLO 2. To study about business functions.</p> <p>CLO 3. To study the characteristics and components of windows and the various controls for the windows.</p> <p>CLO 4. To study about various problems in windows design with color, text, graphics and</p> <p>CLO 5. To study the testing methods.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>Lecturer method (L) needs not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>Use of Video/Animation to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>Introduce Topics in manifold representations.</li> <li>Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
The User Interface-Introduction, Overview, The importance of user interface Defining the user interface, The importance of Good design, Characteristics of graphical and web user interfaces, Principles of user interface design.			
<b>Textbook 1: Ch. 1,2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Demonstration, MOOC		
<b>Module-2</b>			
The User Interface Design process- Obstacles, Usability, Human characteristics in Design, Human Interaction speeds, Business functions-Business definition and requirement analysis, Basic business functions, Design standards.			
<b>Textbook 1: Part-2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-3</b>			
System menus and navigation schemes- Structures of menus, Functions of menus, Contents of menus, Formatting of menus, Phrasing the menu, Selecting menu choices, Navigating menus, Kinds of graphical menus.			

<b>Textbook 1: Part-2</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Demonstration
<b>Module-4</b>	
Windows - Characteristics, Components of window, Window presentation styles, Types of window, Window management, Organizing window functions, Window operations, Web systems, Characteristics of device based controls.	
<b>Textbook 1: Part-2</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning, Demonstration
<b>Module-5</b>	
Screen based controls- Operable control, Text control, Selection control, Custom control, Presentation control, Windows Tests-prototypes, kinds of tests.	
<b>Textbook 1: Part-2</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Demonstration, MOOC
<b>Course Outcomes:</b>	
At the end of the course the student will be able to:	
CO 1. Understand importance and characteristics of user interface design	
CO 2. Apply user interface design process on business functions	
CO 3. Demonstrate system menus, navigation schemes and windows characteristics	
CO 4. Analyze screen based controls and device based controls	
CO 5. Design the prototypes and test plans of user interface	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy</b>	

**as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks:**

1. Wilbert O, Galitz, "The Essential Guide to User Interface Design", John Wiley & Sons, Second Edition 2002

**Reference Books:**

1. Ben Sheiderman, "Design the User Interface", Pearson Education, 1998
2. Alan Cooper, "The Essential of User Interface Design", Wiley-Dream Tech Ltd.,2002

**Web links and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ar10/>
2. <https://www.vtupulse.com/cbcs-cse-notes/17cs832-user-interface-design-uid-notes/>
3. [https://www.brainkart.com/subject/User-Interface-Design\\_145/](https://www.brainkart.com/subject/User-Interface-Design_145/)
4. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-831-user-interface-design-and-implementation-spring-2011/lecture-notes/>
5. <https://lecturenotes.in/download/material/21405-user-interface-design>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>BLOCKCHAIN TECHNOLOGY</b>			
Course Code	21CS734	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Explain the fundamentals of distributed computing and blockchain</p> <p>CLO 2. Discuss the concepts in bitcoin</p> <p>CLO 3. Demonstrate Ethereum platform</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Blockchain 101:</b> Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.			
<b>Decentralization and Cryptography:</b> Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations.			
<b>Textbook 1: Chapter 1, 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning – Oral presentations.		
<b>Module-2</b>			
<b>Introduction to Cryptography &amp; Cryptocurrencies:</b> Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency,			
<b>How Bitcoin Achieves Decentralization:</b> Distributed consensus, Consensus without identity using a block chain, Incentives and proof of work, Putting it all together,			
<b>Textbook 2: Chapter 1, 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Demonstration		
<b>Module-3</b>			
<b>Mechanics of Bitcoin:</b> Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network, Limitations and improvements			
<b>How to Store and Use Bitcoins:</b> Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys,			

Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets	
<b>Textbook2: Chapter 3,4</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration, MOOC
<b>Module-4</b>	
<b>Bitcoin Mining:</b> The task of Bitcoin miners, Mining Hardware, Energy consumption and ecology, Mining pools, Mining incentives and strategies,	
<b>Bitcoin and Anonymity:</b> Anonymity Basics, How to De-anonymize Bitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash,	
<b>Textbook2: Chapter 5,6</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning, MOOC
<b>Module-5</b>	
<b>Smart Contracts and Ethereum 101:</b> Smart Contracts: Definition, Ricardian contracts.	
<b>Ethereum 101:</b> Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts.	
<b>Textbook 1: Chapter 10</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC, Practical Demonstration
<b>Course Outcomes</b> At the end of the course the student will be able to: CO 1. Describe the concepts of Distributed computing and its role in Blockchain CO 2. Describe the concepts of Cryptography and its role in Blockchain CO 3. List the benefits, drawbacks and applications of Blockchain CO 4. Appreciate the technologies involved in Bitcoin CO 5. Appreciate and demonstrate the Ethereum platform to develop blockchain application.	
<b>Assessment Details (both CIE and SEE)</b> The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together <b>Continuous Internal Evaluation:</b> Three Unit Tests each of <b>20 Marks (duration 01 hour)</b> 1. First test at the end of 5 <sup>th</sup> week of the semester 2. Second test at the end of the 10 <sup>th</sup> week of the semester 3. Third test at the end of the 15 <sup>th</sup> week of the semester Two assignments each of <b>10 Marks</b> 4. First assignment at the end of 4 <sup>th</sup> week of the semester 5. Second assignment at the end of 9 <sup>th</sup> week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b> 6. At the end of the 13 <sup>th</sup> week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b> (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course). <b>CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy</b>	

**as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbooks**

1. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1-78712-544-5, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward W. Felten, Andrew Miller, Steven Goldfeder and Jeremy Clark., Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction. Princeton University Press, 2016.

**Reference:**

1. Mastering Bitcoins: Unlocking Digital Cryptocurrencies by Andreas Antonopoulos. O'Reilly Media, Inc, 2013.

**Weblinks and Video Lectures (e-Resources):**

1. [http://bitcoinbook.cs.princeton.edu/?\\_ga=2.8302578.1344744326.1642688462-86383721.1642688462](http://bitcoinbook.cs.princeton.edu/?_ga=2.8302578.1344744326.1642688462-86383721.1642688462)
2. <https://nptel.ac.in/courses/106/105/106105184/>
3. <https://ethereum.org/en/developers/>
4. <https://developer.ibm.com/components/hyperledger-fabric/tutorials/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**



## VII Semester

<b>OPERATING SYSTEMS CONCEPTS AND DESIGN</b>			
Course Code	21CD735	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Define the fundamentals of Operating Systems.</p> <p>CLO 2. Understand process and threads, microkernel and illustration of these in Windows and Linux operating Systems</p> <p>CLO 3. Explain distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols</p> <p>CLO 4. Illustrate concepts of embedded systems and different types of Embedded Operating Systems and security issues</p> <p>CLO 5. Study Kernel organization</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecture method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Operating System Overview:</b> Process description &amp; Control: Operating System Objectives and Functions, The Evolution of Operating Systems, Major Achievements, Developments Leading to Modern Operating Systems, Microsoft Windows Overview, Traditional UNIX Systems, Modern UNIX Systems,</p> <p><b>Process Description and Control:</b> What is a Process?, Process States, Process Description, Process Control, Operations on Processes, Inter Process Communication(IPC),Execution of the Operating System, Security Issues.</p> <p><b>Text 1: Chapter 2, Chapter 3</b></p>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Collaborative Learning		
<b>Module-2</b>			
<p><b>Threads, SMP, and Microkernel:</b> Processes and Threads, Symmetric Multiprocessing (SMP), Micro Kernels, Windows Vista Thread and SMP Hours Management, Linux Process and Thread Management. Hardware and Control Structures, Operating System Software, UNIX Memory Management, Windows Vista Memory Management.</p>			

<b>Text 1: Chapter 4</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Collaborative Learning
<b>Module-3</b>	
<b>Multiprocessor and Real-Time Scheduling:</b> Multiprocessor Scheduling, Real-Time Scheduling, Linux Scheduling, UNIX Preclsl) Scheduling, Windows Vista Hours Scheduling,	
<b>Process Migration:</b> Distributed Global States, Distributed Mutual Exclusion, Distributed Deadlock	
<b>Text 1: Chapter 10 and Chapter 16</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Collaborative Learning
<b>Module-4</b>	
<b>Embedded Operating Systems:</b> Embedded Systems, Characteristics of Embedded Operating Systems, eCOS, TinyOS, Computer Security Concepts, Threats, Attacks, and Assets, Intruders, Malicious Software Overview, Viruses, Worms, and Bots, Rootkits.	
<b>Text 1: Chapter 13</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Project based learning and Collaborative Learning
<b>Module-5</b>	
<b>Kernel Organization:</b> Using Kernel Services, Daemons, Starting the Kernel, Control in the Machine , Modules and Device Management, MODULE Organization, MODULE Installation and Removal, Process and Resource Management, Running Process Manager, Creating a new Task , IPC and Synchronization, The Scheduler , Memory Manager , The Virtual Address Space, The Page Fault Handler , File Management.	
<b>Text 2: Chapter 20</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Project based learning and Collaborative Learning
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Describe basics Operating system, Process creation and management for Inter process Communication.	
CO 2. Explain Concepts process and threads, microkernel and illustration of these in Windows and Linux operating Systems	
CO 3. Describe multiprocessor and real time scheduling in Windows and Linux operating Systems and demonstrate distributed Mutual exclusion and Deadlock	
CO 4. Explain the concepts of embedded systems and different types of Embedded Operating Systems like TinyOS and security concepts related to OS	
CO 5. Illustrate the concepts of Kernel organization	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester
6. At the end of the 13<sup>th</sup> week of the semester- Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books**

1. William Stallings: Operating Systems: Internals and Design Principles, 6th Edition, Prentice Hall, 2013.
2. Gary Nutt: Operating Systems, 3rd Edition, Pearson, 2014.

**Reference:**

1. Silberschatz, Galvin, Gagne: Operating System Concepts, 8th Edition, Wiley, 2008
2. Andrew S. Tanenbaum, Albert S. Woodhull: Operating Systems, Design and Implementation, 3<sup>rd</sup> Edition, Prentice Hall, 2006.
3. Pradeep K Sinha: Distribute Operating Systems, Concept and Design, PHI, 2007

**Web links and Video Lectures (e-Resources):**

- <https://nptel.ac.in/courses/106/106/106106144/>
- <https://nptel.ac.in/courses/106/105/106105214/>
- <https://nptel.ac.in/courses/106/105/106105172/>
- <https://nptel.ac.in/courses/106/102/106102132/>
- <https://nptel.ac.in/courses/106/108/106108101/>
- <http://web.stanford.edu/class/cs240/>
- <https://www.youtube.com/watch?v=EgC997B2JVY>
- <https://www.cse.iitb.ac.in/~mythili/os/> - Lectures on OS IIT Bombay
- <https://csd.cmu.edu/course-profiles/15-410.605-Operating-System-Design-and-Implementation>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>SOFTWARE ARCHITECTURE AND DESIGN PATTERNS</b>			
Course Code	21CS741	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Learn How to add functionality to designs while minimizing complexity.</p> <p>CLO 2. What code qualities are required to maintain to keep code flexible?</p> <p>CLO 3. To Understand the common design patterns.</p> <p>CLO 4. To explore the appropriate patterns for design problems</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<p><b>Introduction:</b> what is a design pattern? describing design patterns, the catalog of design pattern, organizing the catalog, how design patterns solve design problems, how to select a design pattern, how to use a design pattern. A Notation for Describing Object-Oriented Systems</p> <p><b>Textbook 1: Chapter 1 and 2.7</b></p> <p><b>Analysis a System:</b> overview of the analysis phase, stage 1: gathering the requirements functional requirements specification, defining conceptual classes and relationships, using the knowledge of the domain. Design and Implementation, discussions and further reading.</p> <p><b>Textbook 1: Chapter 6</b></p>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<p><b>Design Pattern Catalog:</b> Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, proxy.</p> <p><b>Textbook 2: chapter 4</b></p>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			

<b>BehavioralPatterns:</b> Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, State, Template Method	
<b>Textbook 2: chapter 5</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration
<b>Module-4</b>	
<b>Interactive systems and the MVC architecture:</b> Introduction, The MVC architectural pattern, analyzing a simple drawing program, designing the system, designing of the subsystems, getting into implementation, implementing undo operation, drawing incomplete items, adding a new feature, pattern-based solutions.	
<b>Textbook 1: Chapter 11</b>	
<b>Teaching-Learning Process</b>	Chalk & board, Problem based learning
<b>Module-5</b>	
<b>Designing with Distributed Objects:</b> Client server system, java remote method invocation, implementing an object-oriented system on the web (discussions and further reading) a note on input and output, selection statements, loops arrays.	
<b>Textbook 1: Chapter 12</b>	
<b>Teaching-Learning Process</b>	Chalk and board
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Design and implement codes with higher performance and lower complexity	
CO 2. Experience core design principles and be able to assess the quality of a design.	
CO 3. Apply design pattern principles in the design of object oriented systems.	
CO 4. Demonstrate the range of design patterns that can be used to solve the given problem.	
CO 5. Select and apply suitable patterns in specific contexts.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
6. At the end of the 13 <sup>th</sup> week of the semester- Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.</b>	

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:****Textbooks**

1. Brahma Dathan, Sarnath Rammath, Object-oriented analysis, design and implementation, Universities Press,2013
2. Erich Gamma, Richard Helan, Ralph Johman, John Vlissides , Design Patterns, Pearson Publication,2013.

**Reference:**

1. Frank Bachmann, RegineMeunier, Hans Rohnert "Pattern Oriented Software Architecture" -Volume 1, 1996.
2. William J Brown et al., "Anti-Patterns: Refactoring Software, Architectures and Projects in Crisis", John Wiley, 1998.

**Weblinks and Video Lectures (e-Resources):****Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>COMPILER DESIGN</b>			
Course Code	21CD742	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Ability to describe the functionality of a compiler and its major functional partitions</p> <p>CLO 2. Ability to implement simple parsing with error handling</p> <p>CLO 3. Ability to build simple intermediate code generator</p> <p>CLO 4. Ability to illustrate with examples concepts storage management at run time</p> <p>CLO 5. Ability to demonstrate strategies of code optimization</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to Compilers:</b> Overview of a compiler – Lexical Analysis – Tokens - Specification of Tokens – Recognition of Tokens – Finite Automata – Regular Expressions to Automata.			
<b>Textbook1: Chapter 1 (1.1, 1.2), Chapter 3 (3.1 to 3.7)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning		
<b>Module-2</b>			
<b>Syntax Analysis:</b> Overview of Parsing – Grammars – Error Handling – Context-free grammars – Top-Down Parsing - General Strategies - Recursive Descent Parser - Predictive Parser - Error Handling and Recovery in Syntax Analyzer-YACC			
<b>Textbook1: Chapter 4 (4.1 to 4.9)</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration		
<b>Module-3</b>			
<b>Intermediate Code Generation:</b> Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Types and Declarations, Translation of Expressions.			

<b>Textbook 1: Chapter 6 (6.1 to 6.4)</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Team project
<b>Module-4</b>	
<b>Run-Time Environment and Code Generation:</b> Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management Concepts.	
<b>Textbook 1: Chapter 7 (7.1 to 7.4)</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Team project
<b>Module-5</b>	
<b>Code Optimization:</b> Principal Sources of Optimization – Peep-hole optimization - DAG- Optimization of Basic Blocks - Efficient Data Flow Algorithm	
<b>Textbook 1: Chapter 8 (8.1 to 8.7), Chapter 9 (9.1 to 9.3)</b>	
<b>Pedagogy:</b>	Chalk and board, Problem based learning, Demonstration
<b>Course Outcomes</b>	
CO 1. Apply the concepts of Finite Automata in the design lexical analyser CO 2. Analyse the role of grammar in Parsers CO 3. Demonstrate intermediate code generation CO 4. Explore and study the storage management at runtime CO 5. Apply various strategies for code optimization and code generation	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
<ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol>	
Two assignments each of <b>10 Marks</b>	
<ol style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol>	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
<ol style="list-style-type: none"> <li>6. At the end of the 13<sup>th</sup> week of the semester</li> </ol>	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper is designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.</b>	
<b>Semester End Examination:</b>	



Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbook:**

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques and Tools||, Second Edition, Pearson Education, 2009. Principles of Multimedia – 2nd edition by Ranjan Parekh. McGraw Hill publication

**Web links and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/106/105/106105190/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>VIRTUAL REALITY</b>			
Course Code	21CD743	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Understand the basic concepts and framework of virtual reality.</p> <p>CLO 2. To introduce the relevance of this course to the existing technology.</p> <p>CLO 3. Provides students with an opportunity to explore the research issues in Augmented Reality and Virtual Reality (VR &amp; AR).</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to Virtual Reality:</b> Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality.			
<b>Text Book 1: Chapter 1</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning		
<b>Module-2</b>			
<b>Multiple Models of Input and Output Interface in Virtual Reality:</b> Input - Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices.			
<b>Text Book 1: Chapter 2, Chapter 3</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration		
<b>Module-3</b>			
<b>Visual Computation in Virtual Reality:</b> Fundamentals of Computer Graphics. Software and Hardware Technology on Stereoscopic Display. Advanced Techniques in CG: Management of			

Large Scale Environments & Real Time Rendering.	
<b>Text Book 1: Chapter 4</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Team project
<b>Module-4</b>	
<b>Interactive Techniques in Virtual Reality:</b> Body Track, Hand Gesture, 3D Manus, Object Grasp Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR.X3D Standard; Vega, MultiGen, Virtools etc.	
<b>Text Book 1: Chapter5, Chapter 6</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Team project
<b>Module-5</b>	
<b>Augmented and Mixed Reality:</b> Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.	
<b>Text Book 2: Chapters 2</b>	
<b>Pedagogy:</b>	Chalk and board, Problem based learning, Demonstration
<b>Course Outcomes</b>	
CO 1. Understand the basic concepts and terminologies of Virtual Reality CO 2. Apply the concepts of Computer Graphics and allied concepts for design of Virtual Reality CO 3. Choose, develop, explain, and defend the use of particular designs for VR experiences. CO 4. Evaluate the benefits and drawbacks of specific VR techniques on the human body. CO 5. Identify and examine state-of-the-art VR design problems and solutions from the industry and academia	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
<ol style="list-style-type: none"> <li>1. First test at the end of 5<sup>th</sup> week of the semester</li> <li>2. Second test at the end of the 10<sup>th</sup> week of the semester</li> <li>3. Third test at the end of the 15<sup>th</sup> week of the semester</li> </ol>	
Two assignments each of <b>10 Marks</b>	
<ol style="list-style-type: none"> <li>4. First assignment at the end of 4<sup>th</sup> week of the semester</li> <li>5. Second assignment at the end of 9<sup>th</sup> week of the semester</li> </ol>	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
<ol style="list-style-type: none"> <li>6. At the end of the 13<sup>th</sup> week of the semester</li> </ol>	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and	

will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Textbook:**

1. Virtual Reality Technology Burdea, G. C. P. Coffet Wiley-IEEE Press 2nd Edition 2003/2006
2. Understanding Augmented Reality, Concepts and Application Alan B. Craig Morgan Kaufmann 2013

**Reference Books**

1. Developing Virtual Reality Applications, Foundations of Effective Design Alan Craig William Sherman Jeffrey Will Morgan Kaufmann 2009

**Web links and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/121/106/121106013/>
2. <https://nptel.ac.in/courses/106/106/106106138/>
3. <https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-ge08/>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Group Projects
- Promote Learning in slow learners
- Reflective Learning
- Learning through analysis Case studies
- Collaborative Learning
- Variety of Assignments and test – Knowledge level

## VII Semester

<b>BIG DATA ANALYTICS</b>			
Course Code	21CD744	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives:</b>			
CLO 1. Understand fundamentals and applications of Big Data analytics			
CLO 2. Explore the Hadoop framework and Hadoop Distributed File system and essential Hadoop Tools			
CLO 3. Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data			
CLO 4. Employ MapReduce programming model to process the big data			
CLO 5. Understand various machine learning algorithms for Big Data Analytics, Web Mining and Social Network Analysis.			
<b>Teaching-Learning Process (General Instructions)</b>			
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.			
<ol style="list-style-type: none"> <li>Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.</li> <li>Show Video/animation films to explain functioning of various concepts.</li> <li>Encourage collaborative (Group Learning) Learning in the class.</li> <li>Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.</li> <li>Topics will be introduced in a multiple representation.</li> <li>Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.</li> <li>Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction to Big Data Analytics:</b> Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies.			
<b>Text book 1: Chapter 1: 1.2 -1.7</b>			
<b>Teaching-Learning Process</b>	Chalk and board <a href="https://www.youtube.com/watch?v=n_Krer6YWY4">https://www.youtube.com/watch?v=n_Krer6YWY4</a> <a href="https://onlinecourses.nptel.ac.in/noc20_cs92/preview">https://onlinecourses.nptel.ac.in/noc20_cs92/preview</a>		
<b>Module-2</b>			
<b>Introduction to Hadoop (T1):</b> Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools.			
<b>Hadoop Distributed File System Basics (T2):</b> HDFS Design Features, Components, HDFS User Commands.			
<b>Essential Hadoop Tools (T2):</b> Using Apache Pig, Hive, Sqoop, Flume, Oozie, HBase.			
<b>Text book 1: Chapter 2 :2.1-2.6</b>			
<b>Text Book 2: Chapter 3</b>			

<b>Text Book 2: Chapter 7 (except walk throughs)</b>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Chalk and Board</li> <li>2. Laboratory Demonstration</li> </ol>
<b>Module-3</b>	
<b>NoSQL Big Data Management, MongoDB and Cassandra:</b> Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases.	
<b>Text book 1: Chapter 3: 3.1-3.7</b>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Chalk and Board</li> <li>2. Laboratory Demonstration</li> </ol> <a href="https://www.youtube.com/watch?v=pWbMrx5rVBE">https://www.youtube.com/watch?v=pWbMrx5rVBE</a>
<b>Module-4</b>	
Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, Composing MapReduce for Calculations and Algorithms, Hive, HiveQL, Pig.	
<b>Text book 1: Chapter 4: 4.1-4.6</b>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Chalk and Board</li> <li>2. Laboratory Demonstration</li> </ol>
<b>Module-5</b>	
<b>Machine Learning Algorithms for Big Data Analytics:</b> Introduction, Estimating the relationships, Outliers, Variances, Probability Distributions, and Correlations, Regression analysis, Finding Similar Items, Similarity of Sets and Collaborative Filtering, Frequent Itemsets and Association Rule Mining.	
<b>Text, Web Content, Link, and Social Network Analytics:</b> Introduction, Text mining, Web Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and analyzing a Web Graph, Social Network as Graphs and Social Network Analytics:	
<b>Text book 1: Chapter 6: 6.1 to 6.5</b>	
<b>Text book 1: Chapter 9: 9.1 to 9.5</b>	
<b>Teaching-Learning Process</b>	<ol style="list-style-type: none"> <li>1. Chalk and Board</li> <li>2. Laboratory Demonstration</li> </ol>
<b>Course outcome (Course Skill Set)</b>	
At the end of the course the student will be able to:	
CO 1. Understand fundamentals and applications of Big Data analytics.	
CO 2. Investigate Hadoop framework, Hadoop Distributed File system and essential Hadoop tools.	
CO 3. Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.	
CO 4. Demonstrate the MapReduce programming model to process the big data along with Hadoop tools.	
CO 5. Apply Machine Learning algorithms for real world big data, web contents and Social Networks to provide analytics with relevant visualization tools.	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end	

examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books**

1. Raj Kamal and Preeti Saxena, "Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning", McGraw Hill Education, 2018 ISBN: 9789353164966, 9353164966
2. Douglas Eadline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1 stEdition, Pearson Education, 2016. ISBN13: 978-9332570351

**Reference Books**

1. Tom White, "Hadoop: The Definitive Guide", 4 th Edition, O'Reilly Media, 2015.ISBN-13: 978-9352130672
2. Boris Lublinsky, Kevin T Smith, Alexey Yakubovich, "Professional Hadoop Solutions", 1 stEdition, Wrox Press, 2014ISBN-13: 978-8126551071
3. Eric Sammer, "Hadoop Operations: A Guide for Developers and Administrators",1 stEdition, O'Reilly Media, 2012.ISBN-13: 978-9350239261
4. ArshdeepBahga, Vijay Madiseti, "Big Data Analytics: A Hands-On Approach", 1st Edition, VPT Publications, 2018. ISBN-13: 978-0996025577

**Web links and Video Lectures (e-Resources):**

1. [https://www.youtube.com/watch?v=n\\_Krer6YWY4](https://www.youtube.com/watch?v=n_Krer6YWY4)
2. [https://onlinecourses.nptel.ac.in/noc20\\_cs92/preview](https://onlinecourses.nptel.ac.in/noc20_cs92/preview)
3. <https://www.digimat.in/nptel/courses/video/106104189/L01.html>
4. [https://web2.qatar.cmu.edu/~mhhammou/15440-f19/recitations/Project4\\_Handout.pdf](https://web2.qatar.cmu.edu/~mhhammou/15440-f19/recitations/Project4_Handout.pdf)

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**Mini Project Topics for Practical Based Learning** :Search Engine Optimization, Social Media Reputation Monitoring, Equity Research, Detection of Global Suicide rate, Find the Percentage of Pollution in India, Analyse crime rate in India, Health Status Prediction, Anomaly Detection in cloud server, Tourist Behaviour Analysis, BusBest Not limited to above topics



## VII Semester

<b>DESIGN THINKING</b>			
Course Code	21CD745	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Basic concepts and techniques of engineering and reverse engineering</p> <p>CLO 2. Process of design, analytical thinking and ideas</p> <p>CLO 3. Basics and development of engineering drawing</p> <p>CLO 4. Application of engineering drawing with computer aide.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecture method (L) needs not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>PROCESS OF DESIGN:</b> Introduction – Product Life Cycle - Design Ethics - Design Process - Four Step - Five Step - Twelve Step - Creativity and Innovation in Design Process - Design limitation.			
<b>Text 1: Chapter 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Collaborative Learning		
<b>Module-2</b>			
<b>GENERATING AND DEVELOPING IDEAS :</b> Introduction - Create Thinking - Generating Design Ideas - Lateral Thinking – Analogies – Brainstorming - Mind mapping - National Group Technique – Synaptic - Development of work - Analytical Thinking - Group Activities Recommended.			
<b>Text 1: Chapter 4</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Collaborative Learning		
<b>Module-3</b>			
<b>REVERSE ENGINEERING:</b> Introduction - Reverse Engineering Leads to New Understanding about Products - Reasons for Reverse Engineering - Reverse Engineering Process - Step by Step - Case Study.			
<b>Text 1: Chapter 6</b>			
<b>Teaching-</b>	Chalk and board, Active Learning, Collaborative Learning		

<b>Learning Process</b>	
<b>Module-4</b>	
<b>BASICS OF DRAWING TO DEVELOP DESIGN IDEAS</b> : Introduction - Many Uses of Drawing - Communication through Drawing - Drawing Basis – Line - Shape/ Form – Value – Color – Texture - Practice using Auto CAD recommended.	
<b>Text 1: Chapter 5</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Project based learning and Collaborative Learning
<b>Module-5</b>	
<b>TECHNICAL DRAWING TO DEVELOP DESIGN:</b> Introduction - Perspective Drawing - One Point Perspective - Two Point Perspective - Isometric Drawing - Orthographic Drawing - Sectional Views - Practice using Auto CAD recommended.	
<b>Text 1: Chapter 8</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Project based learning and Collaborative Learning
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Understand the concept of “ design Process” and “ Design Ethics”	
CO 2. Develop the ideas for the contemporary problems through different techniques	
CO 3. Identify the significance of reverse Engineering to understand products	
CO 4. Understand the basics of drawing to develop design ideas	
CO 5. Apply the knowledge of design ideas for developing technical drawing design	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper is designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.</b>	
<b>Semester End Examination:</b>	

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Suggested Learning Resources:**

**Text Books**

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.

**Reference:**

1. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.

**Web links and Video Lectures (e-Resources):**

1. [www.tutor2u.net/business/presentations/.../productlifecycle/default.html](http://www.tutor2u.net/business/presentations/.../productlifecycle/default.html)
2. [https://docs.oracle.com/cd/E11108\\_02/otn/pdf/.../E11087\\_01.pdf](https://docs.oracle.com/cd/E11108_02/otn/pdf/.../E11087_01.pdf) [www.bizfilings.com](http://www.bizfilings.com) › Home › Marketing › Product Developmen <https://www.mindtools.com/brainstm.html>
3. <https://www.quicksprout.com/.../how-to-reverse-engineer-your-competit>  
[www.vertabelo.com/blog/documentation/reverse-engineering](http://www.vertabelo.com/blog/documentation/reverse-engineering)
4. <https://support.microsoft.com/en-us/kb/273814>
5. <https://support.google.com/docs/answer/179740?hl=en>
6. <https://www.youtube.com/watch?v=2mjSDIBaUIM>
7. [thevirtualinstructor.com/foreshortening.html](http://thevirtualinstructor.com/foreshortening.html)

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

## VII Semester

<b>PROGRAMMING IN PYTHON</b>			
Course Code	21CS751	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. To understand why Python is a useful scripting language for developers</p> <p>CLO 2. To read and write simple Python programs</p> <p>CLO 3. To learn how to identify Python object types.</p> <p>CLO 4. To learn how to write functions and pass arguments in Python.</p> <p>CLO 5. To use Python data structures -- lists, tuples, dictionaries.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>INTRODUCTION DATA, EXPRESSIONS, STATEMENTS:08 Hours</b>			
Introduction: Creativity and motivation, understanding programming, Terminology: Interpreter and compiler, Running Python, The First Program; Data types: Int, float, Boolean, string, and list, variables, expressions, statements, Operators and operands.			
<b>Textbook 1: Chapter 1.1,1.2,1.3,1.6, Chapter 2.1-2.6</b>			
<b>Textbook 2: Chapter 1</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning		
<b>Module-2</b>			
<b>CONTROL FLOW, LOOPS:</b>			
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for, break, continue, pass statement.			
<b>Textbook 1: Chapter 3.1-3.6, chapter 5</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<b>FUNCTIONS AND STRINGS:</b>			
Functions: Function calls, adding new functions, definition and uses, local and global scope, return values. Strings: strings, length of string, string slices, immutability, multiline comments, string functions and methods;			

<b>Textbook 1: Chapter 6</b>	
<b>Textbook 2: Chapter 3</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration
<b>Module-4</b>	
<b>LISTS, TUPLES, DICTIONARIES:08 Hours</b>	
<b>Lists:</b> List operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters, list comprehension;	
<b>Tuples:</b> tuple assignment, tuple as return value, tuple comprehension;	
<b>Dictionaries:</b> operations and methods, comprehension;	
<b>Textbook 2: Chapter 10,11,12</b>	
<b>Teaching-Learning Process</b>	Chalk& board, Active Learning
<b>Module-5</b>	
<b>REGULAR EXPRESSIONS,FILES AND EXCEPTION:</b>	
<b>Regular expressions:</b> Character matching in regular expressions, extracting data using regular expressions, Escape character	
<b>Files and exception:</b> Text files, reading and writing files, command line arguments, errors andexceptions, handling exceptions, modules.	
<b>Textbook 1: Chapter 11.1,11.2,11.4</b>	
<b>Textbook 2: Chapter 14</b>	
<b>Teaching-Learning Process</b>	Chalk and board, MOOC
<b>Suggested Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Understand Python syntax and semantics and be fluent in the use of Python flow control and functions.	
CO 2. Demonstrate proficiency in handling Strings and File Systems.	
CO 3. Represent compound data using Python lists, tuples, Strings, dictionaries.	
CO 4. Read and write data from/to files in Python Programs	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the	

methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Textbooks**

1. Charles R. Severance, “Python for Everybody: Exploring Data Using Python 3”, 1st Edition, CreateSpace Independent Publishing Platform, 2016.  
[http://do1.dr-chuck.com/pythonlearn/EN\\_us/pythonlearn.pdf](http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf)
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2ndEdition, Green Tea Press, 2015. (Chapters 15, 16, 17)  
<http://greenteapress.com/thinkpython2/thinkpython2.pdf>

**REFERENCE BOOKS:**

1. R. Nageswara Rao, “Core Python Programming”, dreamtech
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
3. Python Programming , Reema theraja, OXFORD publication

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.w3resource.com/python/python-tutorial.php>
2. <https://data-flair.training/blogs/python-tutorials-home/>
3. <https://www.youtube.com/watch?v=c235EsGFcZs>
4. <https://www.youtube.com/watch?v=v4e6oMRS2QA>
5. <https://www.youtube.com/watch?v=Uh2ebFW8OYM>
6. <https://www.youtube.com/watch?v=oSPMmeaiQ68>
7. <https://www.youtube.com/watch?v=uQrj0TkZlc>
8. <https://www.youtube.com/watch?v=K8L6KVGg-7o>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of projects developed using python language

## VII Semester

<b>INTRODUCTION TO AI AND ML</b>			
Course Code	21CS752	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b> CL01. Understands the basics of AI, history of AI and its foundations, basic principles of AI for problem solving CL02. Explore the basics of Machine Learning & Machine Learning process, understanding data CL03. Understand the Working of Artificial Neural Networks			
<b>Teaching-Learning Process (General Instructions)</b> These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Introduction:</b> What is AI, The foundation of Artificial Intelligence, The history of Artificial Intelligence, Intelligent Agents: Agents and Environments, Good Behaviour: The concept of rationality, the nature of Environments, the structure of Agents.			
<b>Textbook 1: Chapter: 1 and 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<b>Problem solving by searching:</b> Problem solving agents, Example problems, Searching for solutions, Uniformed search strategies, Informed search strategies, Heuristic functions			
<b>Textbook 1: Chapter: 3</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<b>Introduction to machine learning:</b> Need for Machine Learning, Machine Learning Explained, and Machine Learning in relation to other fields, Types of Machine Learning. Challenges of Machine Learning, Machine Learning process, Machine Learning applications.			
<b>Understanding Data:</b> What is data, types of data, Big data analytics and types of analytics, Big data analytics framework, Descriptive statistics, univariate data analysis and visualization			
<b>Textbook 2: Chapter: 1 and 2.1 to 2.5</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration		
<b>Module-4</b>			

**Understanding Data**

Bivariate and Multivariate data, Multivariate statistics , Essential mathematics for Multivariate data, Overview hypothesis, Feature engineering and dimensionality reduction techniques,

**Basics of Learning Theory:** Introduction to learning and its types, Introduction computation learning theory, Design of learning system, Introduction concept learning.

**Similarity-based learning:** Introduction to Similarity or instance based learning, Nearest-neighbour learning, weighted k- Nearest - Neighbour algorithm.

**Textbook 2: Chapter: 2.6 to 2.10, 3.1 to 3.4, 4.1 to 4.3**

**Teaching-Learning Process**

Chalk& board, Problem based learning

**Module-5**

**Artificial Neural Network:** Introduction, Biological neurons, Artificial neurons, Perceptron and learning theory, types of Artificial neural Network, learning in multilayer Perceptron, Radial basis function neural network, self-organizing feature map,

**Textbook 2: Chapter: 10**

**Teaching-Learning Process**

Chalk and board, MOOC

**Course Outcomes**

At the end of the course the student will be able to:

- CO 1. Design intelligent agents for solving simple gaming problems.
- CO 2. Have a good understanding of machine learning in relation to other fields and fundamental issues and Challenges of machine learning
- CO 3. Understand data and applying machine learning algorithms to predict the outputs.
- CO 4. Model the neuron and Neural Network, and to analyze ANN learning and its applications.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5<sup>th</sup> week of the semester
2. Second test at the end of the 10<sup>th</sup> week of the semester
3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4<sup>th</sup> week of the semester
5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question



papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Textbooks**

1. Stuart Russel, Peter Norvig: "Artificial Intelligence A Modern Approach", 3<sup>rd</sup> Edition, Pearson Education, 2015.
2. S. Sridhar, M Vijayalakshmi "Machine Learning". Oxford ,2021

**REFERENCE BOOKS:**

1. Elaine Rich, Kevin Knight: "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2009, ISBN-10: 0070087709
2. Nils J. Nilsson: "Principles of Artificial Intelligence", Elsevier, 1980, ISBN: 978-3-540-11340-9.

**Weblinks and Video Lectures (e-Resources):**

<http://stpk.cs.rtu.lv/sites/all/files/stpk/materiali/MI/Artificial%20Intelligence%20A%20Modern%20Approach.pdf>

1. [http://www.getfreebooks.com/16-sites-with-free-artificial-intelligence-e-books/https://www.tutorialspoint.com/artificial\\_intelligence/artificial\\_intelligence\\_overview.htm](http://www.getfreebooks.com/16-sites-with-free-artificial-intelligence-e-books/https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_overview.htm)
2. [Problem solving agent:https://www.youtube.com/watch?v=KTPmo-KsOis.](https://www.youtube.com/watch?v=KTPmo-KsOis)
3. [https://www.youtube.com/watch?v=X\\_Qt0U66aH0&list=PLwdnzlV3ogoXaceHrrFVZCJkbm\\_laSHcH](https://www.youtube.com/watch?v=X_Qt0U66aH0&list=PLwdnzlV3ogoXaceHrrFVZCJkbm_laSHcH)
4. <https://www.javatpoint.com/history-of-artificial-intelligence>
5. <https://www.tutorialandexample.com/problem-solving-in-artificial-intelligence>
6. <https://techvidvan.com/tutorials/ai-heuristic-search/>
7. <https://www.analyticsvidhya.com/machine-learning/>
8. <https://www.hackerearth.com/practice/machine-learning/machine-learning-algorithms/ml-decision-tree/tutorial/>
9. <https://www.javatpoint.com/unsupervised-artificial-neural-networks>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of projects related to AI and ML.

## VII Semester

<b>INTRODUCTION TO BIG DATA</b>			
Course Code	21CS753	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. Understand Hadoop Distributed File system and examine MapReduce Programming</p> <p>CLO 2. Explore Hadoop tools and manage Hadoop with Sqoop</p> <p>CLO 3. Appraise the role of data mining and its applications across industries</p> <p>CLO 4. Identify various Text Mining techniques</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>Hadoop Distributed file system:</b> HDFS Design, Features, HDFS Components, HDFS user commands Hadoop MapReduce Framework: The MapReduce Model, Map-reduce Parallel Data Flow,Map Reduce Programming			
<b>Textbook 1: Chapter 3,5,6,8hr</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Problem based learning		
<b>Module-2</b>			
<b>Essential Hadoop Tools:</b> Using apache Pig, Using Apache Hive, Using Apache Sqoop, Using Apache Flume, Apache H Base			
<b>Textbook 1: Chapter 7,8hr</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, Demonstration		
<b>Module-3</b>			
<b>Data Warehousing:</b> Introduction, Design Consideration, DW Development Approaches, DW Architectures			
<b>Data Mining:</b> Introduction, Gathering, and Selection, data cleaning and preparation, outputs of Data Mining, Data Mining Techniques			
<b>Textbook 2: Chapter 4,5</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Problem based learning, Demonstration		
<b>Module-4</b>			

**Decision Trees:** Introduction, Decision Tree Problem, Decision Tree Constructions, Lessons from Construction Trees. Decision Tree Algorithm

**Regressions:** Introduction, Correlations and Relationships, Non-Linear Regression, Logistic Regression, Advantages and disadvantages.

**Textbook 2: Chapter 6,7**

<b>Teaching-Learning Process</b>	Chalk& board, Problem based learning
----------------------------------	--------------------------------------

**Module-5**

**Text Mining:** Introduction, Text Mining Applications, Text Mining Process, Term Document Matrix, Mining the TDM, Comparison, Best Practices

**Web Mining:** Introduction, Web Content Mining, Web Structured Mining, Web Usage Mining, Web Mining Algorithms.

**Textbook 2: Chapter 11,14**

<b>Teaching-Learning Process</b>	Chalk and board, MOOC
----------------------------------	-----------------------

**Suggested Course Outcomes**

At the end of the course the students will be able to:

- CO 1. Master the concepts of HDFS and MapReduce framework.
- CO 2. Investigate Hadoop related tools for Big Data Analytics and perform basic
- CO 3. Infer the importance of core data mining techniques for data analytics
- CO 4. Use Machine Learning algorithms for real world big data.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour)**

- 1. First test at the end of 5<sup>th</sup> week of the semester
- 2. Second test at the end of the 10<sup>th</sup> week of the semester
- 3. Third test at the end of the 15<sup>th</sup> week of the semester

Two assignments each of **10 Marks**

- 4. First assignment at the end of 4<sup>th</sup> week of the semester
- 5. Second assignment at the end of 9<sup>th</sup> week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

- 6. At the end of the 13<sup>th</sup> week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

- 1. The question paper will have ten questions. Each question is set for 20 marks.
- 2. There will be 2 questions from each module. Each of the two questions under a module (with a

maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

**Textbooks**

1. Douglas Eadline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1<sup>st</sup> Edition, Pearson Education, 2016.
2. Anil Maheshwari, "Data Analytics", 1<sup>st</sup> Edition, McGraw Hill Education, 2017

**Weblinks and Video Lectures (e-Resources):**

1. <https://nptel.ac.in/courses/106/104/106104189/>
2. <https://www.youtube.com/watch?v=mNP44rZYiAU>
3. [https://www.youtube.com/watch?v=qr\\_awo5vz0g](https://www.youtube.com/watch?v=qr_awo5vz0g)
4. <https://www.youtube.com/watch?v=rr17cbPGWGA>
5. <https://www.youtube.com/watch?v=G4NYQox4n2g>
6. <https://www.youtube.com/watch?v=owI7zxCqNY0>
7. <https://www.youtube.com/watch?v=FuJVLsZYkuE>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of Big Data related projects

Exploring the applications which involves big data.

## VII Semester

<b>INTRODUCTION TO DATA SCIENCE</b>			
Course Code	21CS754	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<b>Course Learning Objectives</b>			
<p>CLO 1. To provide a foundation in data Science terminologies</p> <p>CLO 2. To familiarize data science process and steps</p> <p>CLO 3. To Demonstrate the data visualization tools</p> <p>CLO 4. To analyze the data science applicability in real time applications.</p>			
<b>Teaching-Learning Process (General Instructions)</b>			
<p>These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none"> <li>1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.</li> <li>2. Use of Video/Animation to explain functioning of various concepts.</li> <li>3. Encourage collaborative (Group Learning) Learning in the class.</li> <li>4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.</li> <li>5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.</li> <li>6. Introduce Topics in manifold representations.</li> <li>7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.</li> <li>8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.</li> </ol>			
<b>Module-1</b>			
<b>PREPARING AND GATHERING DATA AND KNOWLEDGE</b>			
<p>Philosophies of data science - Data science in a big data world - Benefits and uses of data science and big data - facts of data: Structured data, Unstructured data, Natural Language, Machine generated data, Audio, Image and video streaming data - The Big data Eco system: Distributed file system, Distributed Programming framework, Data Integration frame work, Machine learning Framework, NoSQL Databases, Scheduling tools, Benchmarking Tools, System Deployment, Service programming and Security.</p>			
<b>Textbook 1: Ch 1.1 to 1.4</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, PPT Based presentation		
<b>Module-2</b>			
<b>THE DATA SCIENCE PROCESS</b> -Overview of the data science process- defining research goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory data analysis, Build the models, presenting findings and building application on top of them.			
<b>Textbook 1;Ch 2</b>			
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, PPT Based presentation		
<b>Module-3</b>			
<b>MACHINE LEARNING:</b> Application for machine learning in data science- Tools used in machine learning-Modelling Process – Training model – Validating model – Predicting new observations –Types of machine Learning Algorithm : Supervised learning algorithms, Unsupervised learning algorithms.			
<b>Textbook 1: Ch 3.1 to 3.3</b>			

<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, PPT Based presentation, Video
<b>Module-4</b>	
<b>VISUALIZATION</b> –Introduction to data visualization – Data visualization options – Filters – MapReduce – Dashboard development tools.	
<b>Textbook 1: Ch 9</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, PPT Based presentation, MOOC
<b>Module-5</b>	
<b>CASE STUDIES</b> Distributing data storage and processing with frameworks - Case study: e.g, Assessing risk when lending money.	
<b>Textbook 1: Ch 5.1, 5.2</b>	
<b>Teaching-Learning Process</b>	Chalk and board, Active Learning, PPT Based presentation, Video
<b>Course Outcomes</b>	
At the end of the course the student will be able to:	
CO 1. Describe the data science terminologies	
CO 2. Apply the Data Science process on real time scenario.	
CO 3. Analyze data visualization tools	
CO 4. Apply Data storage and processing with frameworks	
<b>Assessment Details (both CIE and SEE)</b>	
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together	
<b>Continuous Internal Evaluation:</b>	
Three Unit Tests each of <b>20 Marks (duration 01 hour)</b>	
1. First test at the end of 5 <sup>th</sup> week of the semester	
2. Second test at the end of the 10 <sup>th</sup> week of the semester	
3. Third test at the end of the 15 <sup>th</sup> week of the semester	
Two assignments each of <b>10 Marks</b>	
4. First assignment at the end of 4 <sup>th</sup> week of the semester	
5. Second assignment at the end of 9 <sup>th</sup> week of the semester	
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for <b>20 Marks (duration 01 hours)</b>	
6. At the end of the 13 <sup>th</sup> week of the semester	
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be <b>scaled down to 50 marks</b>	
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).	
<b>CIE methods /question paper has to be designed to attain the different levels of Bloom’s taxonomy as per the outcome defined for the course.</b>	
<b>Semester End Examination:</b>	
Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject ( <b>duration 03 hours</b> )	
1. The question paper will have ten questions. Each question is set for 20 marks.	
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), <b>should have a mix of topics</b> under that module.	
The students have to answer 5 full questions, selecting one full question from each module	

**Textbooks**

1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman and Mohamed Ali, Manning Publications, 2016.

**Reference Books**

1. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013.
2. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014
3. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013
4. Think Like a Data Scientist, Brian Godsey, Manning Publications, 2017.

**Weblinks and Video Lectures (e-Resources):**

1. <https://www.simplilearn.com/tutorials/data-science-tutorial/what-is-data-science>
2. <https://www.youtube.com/watch?v=N6BghzuFLlg>
3. <https://www.coursera.org/lecture/what-is-datascience/fundamentals-of-data-science-tPgFU>
4. <https://www.youtube.com/watch?v=ua-CiDNNj30>

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving using Data science techniques and demonstration of data visualization methods with the help of suitable project.

## VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

**B.E. in Computer Science and Design****Scheme of Teaching and Examinations 2022**

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

## III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC/BSC	BCG301	Mathematics for Computer Science	TD:- Maths PSB: Maths	3	2	0		03	50	50	100	4
2	IPCC	BCG302	Digital Design & Computer Organization	TD: CG PSB: CG	3	0	2		03	50	50	100	4
3	IPCC	BCG303	Operating Systems	TD: CG PSB: CG	3	0	2		03	50	50	100	4
4	PCC	BCG304	Data Structures and Application	TD: CG PSB: CG	3	0	0		03	50	50	100	3
5	PCCL	BCGL305	Data Structures Lab	TD: CG PSB: CG	0	0	2		03	50	50	100	1
6	ESC	BCG306x	ESC/ETC/PLC	TD: CG PSB: CG	2	0	2		03	50	50	100	3
7	UHV	BSCK307	<b>Social Connect and Responsibility</b>	Any Department	0	0	2		01	100	---	100	1
8	AEC/SEC	BCG358x	Ability Enhancement Course/Skill Enhancement Course - III	TD and PSB: Concerned department	If the course is a Theory				01	50	50	100	1
					1	0	0						
					If a course is a laboratory				02				
		0	0	2									
9	MC	BNSK359	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK359	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK359	Yoga	Yoga Teacher									
<b>Total</b>									<b>550</b>	<b>350</b>	<b>900</b>	<b>21</b>	

**PCC:** Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **MC:** Mandatory Course (Non-credit), **AEC:** Ability Enhancement Course, **SEC:** Skill Enhancement Course, **L:** Lecture, **T:** Tutorial, **P:** Practical **S= SDA:** Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation. **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **ETC:** Emerging



Technology Course, PLC: Programming Language Course			
.			
<b>Engineering Science Course (ESC/ETC/PLC) (Note- Student should opt for the course which should not be similar to the course opted in 1<sup>st</sup> Year)</b>			
BCG306A	OOP with Java	BCG306C	
BCG306B	OOP with C++	BCG306D	
<b>Ability Enhancement Course – III</b>			
BCG358A	Web Application Design with HTML and PHP	BCG358C	Version controller with GiT
BCG358B	Data Analytics with R	BCG358D	Data Visualization with Phyton
<p><b>Professional Core Course (IPCC):</b> Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 may please be refered.</p> <p><b>National Service Scheme /Physical Education/Yoga:</b> All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.</p>			

VARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI  
**B.E. in Computer Science and Design**  
**Scheme of Teaching and Examinations 2022**  
 Outcome Based Education (OBE) and Choice Based Credit System (CBCS)  
 (Effective from the academic year 2023-24)

IV SEMESTER													
Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination			Credits	
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks		Total Marks
					L	T	P	S					
1	PCC/BSC	BCG401	Analysis & Design of Algorithms	TD:CG PSB:CG	3	0	0		03	50	50	100	3
2	IPCC	BCG402	Computer Graphics and Visualization	TD:CG PSB:CG	3	0	2		03	50	50	100	4
3	IPCC	BCG403	Database Management Systems	TD:CG PSB:CG	3	0	2		03	50	50	100	4
4	PCCL	BCGL404	Analysis & Design of Algorithms Lab	TD:CG PSB:CG	0	0	2		03	50	50	100	1
5	ESC	BCG405x	ESC/ETC/PLC	TD:CG PSB:CG	2	2	0		03	50	50	100	3
6	AEC/ SEC	BCG456x	Ability Enhancement Course/Skill Enhancement Course- IV	TD and PSB: Concerned department	If the course is Theory				01	50	50	100	1
					1	0	0						
					If the course is a lab				02				
0	0	2											
4	BSC	BBOK407	Biology For Engineers	TD / PSB: BT, CHE,	2	0	0		03	50	50	100	2
7	UHV	BUHK408	Universal human values course	Any Department	1	0	0		01	50	50	100	1
9	MC	BNSK459	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK459	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK459	Yoga	Yoga Teacher									
<b>Total</b>									<b>500</b>	<b>400</b>	<b>900</b>	<b>19</b>	

**PCC:** Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **MC:** Mandatory Course (Non-credit), **AEC:** Ability Enhancement Course, **SEC:** Skill Enhancement Course, **L:** Lecture, **T:** Tutorial, **P:** Practical **S= SDA:** Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SEE:**

Semester End Evaluation. K :This letter in the course code indicates common to all the stream of engineering.			
<b>Ability Enhancement Course / Skill Enhancement Course – IV</b>			
BCG456A	JavaScript and jQuery: Interactive Front-End Web Development	BCG456C	Mobile First Web design with W3.CSS
BCG456B	Responsive Web design with Bootstrap 5.0	BCG456D	Progressive App Development
<b>Engineering Science Course (ESC/ETC/PLC)</b>			
BCG405A	Discrete Mathematical Structures	BCG405C	Optimization Technique
BCG405B	Graph Theory	BCG405D	
<p><b>Professional Core Course (IPCC):</b> Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23</p> <p><b>National Service Scheme /Physical Education/Yoga:</b> All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses is mandatory for the award of degree.</p>			

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI  
**B.E. in Computer Science and Design**  
**Scheme of Teaching and Examinations 2022**  
 Outcome Based Education (OBE) and Choice Based Credit System (CBCS)  
 (Effective from the academic year 2023-24)

V SEMESTER													
Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination			Credits	
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks		Total Marks
					L	T	P	S					
1	HSMS	BCG501	Software Engineering & Project Management <i>(This course must be pertaining to economics and management of the concerned degree program. The course syllabus should have both economics and management topics and the course title should bear the word Management.)</i>	TD:CG PSB:CG	3	0	0		03	50	50	100	3
2	IPCC	BCG502	Computer Networks	TD:CG PSB:CG	3	0	2		03	50	50	100	4
3	PCC	BCG503	Theory of Computation	TD:CG PSB:CG	3	2	0		03	50	50	100	4
4	PCCL	BCGL504	OO Design Pattern Lab	TD:CG PSB:CG	0	0	2		03	50	50	100	1
5	PEC	BCG515x	Professional Elective Course	TD:CG PSB:CG	3	0	0		03	50	50	100	3
6	PROJ	BCG586	Mini Project	TD:CG PSB:CG	0	0	4		03	100		100	2
7	AEC	BRMK557	Research Methodology and IPR	TD: HSM PSB : HSM	2	2	0		02	50	50	100	3
8	MC	BESK508	Environmental Studies	TD: HSM PSB : HSM	2	0	0		02	50	50	100	2
9	MC	BNSK559	National Service Scheme (NSS)	NSS coordinator	0	0	2			100		100	0
		BPEK559	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK559	Yoga	Yoga Teacher									
									<b>Total</b>	<b>500</b>	<b>300</b>	<b>800</b>	<b>22</b>
<b>Professional Elective Course</b>													

BCG515A	Video Processing	BCG515C	Unix System Programming
BCG515B	Artificial Intelligence	BCG515D	Designing human centred systems
<p><b>PCC:</b> Professional Core Course, <b>PCCL:</b> Professional Core Course laboratory, <b>UHV:</b> Universal Human Value Course, <b>MC:</b> Mandatory Course (Non-credit), <b>AEC:</b> Ability Enhancement Course, <b>SEC:</b> Skill Enhancement Course, <b>L:</b> Lecture, <b>T:</b> Tutorial, <b>P:</b> Practical <b>S= SDA:</b> Skill Development Activity, <b>CIE:</b> Continuous Internal Evaluation, <b>SXX:</b> Semester End Evaluation. <b>K :</b> The letter in the course code indicates common to all the stream of engineering. <b>PROJ:</b> Project /Mini Project. <b>PEC:</b> Professional Elective Course</p>			
<p><b>Professional Core Course (IPCC):</b> Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23</p>			
<p><b>National Service Scheme /Physical Education/Yoga:</b> All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.</p>			
<p><b>Mini-project work:</b> Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.</p>			
<p><b>CIE procedure for Mini-project:</b></p> <p><b>(i) Single discipline:</b> The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.</p> <p><b>(ii) Interdisciplinary:</b> Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project. The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.</p>			
<p><b>No SEE component for Mini-Project.</b></p>			
<p><b>Professional Elective Courses (PEC):</b> A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.</p>			



**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**B.E. in Computer Science and Design**  
**Scheme of Teaching and Examinations 2022**  
 Outcome Based Education (OBE) and Choice Based Credit System (CBCS)  
 (Effective from the academic year 2023-24)

VI SEMESTER													
Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BCG601	Machine Learning	TD: CG PSB : CG	3	0	2		03	50	50	100	4
2	PCC	BCG602	Design Processes and Perspectives	TD: CG PSB : CG	4	0	0		03	50	50	100	4
3	PEC	BCG613x	Professional Elective Course	TD: CG PSB : CG	3	0	0		03	50	50	100	3
4	OEC	BCG654x	Open Elective Course	TD: CG PSB : CG	3	0	0		03	50	50	100	3
5	PROJ	BCG685	Project Phase I	TD: CG PSB : CG	0	0	4		03	100	--	100	2
6	PCCL	BCGL606	UI/UX lab	TD: CG PSB : CG	0	0	2		03	50	50	100	1
7	AEC/SDC	BCG657x	Ability Enhancement Course/Skill Development Course V	TD and PSB: Concerned department	If the course is offered as a Theory				01	50	50	100	1
					1	0	0						
					If course is offered as a practical								
					0	0	2						
8	MC	BNSK658	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK658	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK658	Yoga	Yoga Teacher									
<b>Total</b>									<b>500</b>	<b>300</b>	<b>800</b>	<b>18</b>	
<b>Professional Elective Course</b>													
BCG613A		Multimedia Systems Design			BCG613C		Blockchain Technology						
BCG613B		Cloud Computing			BCG613D		Advanced JAVA						
<b>Open Elective Course</b>													
BCG654A		Introduction to Data Structures			BCG654C		Mobile Application Development						

BCG654B	Fundamentals of Operating Systems	BCG654D	
<b>Ability Enhancement Course / Skill Enhancement Course-V</b>			
BCG657A	MEAN	BCG657C	MERN
BCG657B	PyTorch	BCG657D	Devops
<p><b>PCC:</b> Professional Core Course, <b>PCCL:</b> Professional Core Course laboratory, <b>UHV:</b> Universal Human Value Course, <b>MC:</b> Mandatory Course (Non-credit), <b>AEC:</b> Ability Enhancement Course, <b>SEC:</b> Skill Enhancement Course, <b>L:</b> Lecture, <b>T:</b> Tutorial, <b>P:</b> Practical <b>S= SDA:</b> Skill Development Activity, <b>CIE:</b> Continuous Internal Evaluation, <b>SEE:</b> Semester End Evaluation. <b>K :</b> The letter in the course code indicates common to all the stream of engineering. <b>PROJ:</b> Project /Mini Project. <b>PEC:</b> Professional Elective Course. <b>PROJ:</b> Project Phase -I, <b>OEC:</b> Open Elective Course</p>			
<p><b>Professional Core Course (IPCC):</b> Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23</p>			
<p><b>National Service Scheme /Physical Education/Yoga:</b> All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.</p>			
<p><b>Professional Elective Courses (PEC):</b> A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students’ strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.</p>			
<p><b>Open Elective Courses:</b> Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students’ strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.</p>			
<p><b>Project Phase-I :</b> Students have to discuss with the mentor /guide and with their helpe/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.</p>			





VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI  
**B.E. in Computer Science and Design**  
**Scheme of Teaching and Examinations 2022**  
 Outcome Based Education (OBE) and Choice Based Credit System (CBCS)  
 (Effective from the academic year 2023-24)

**VI SEMESTER (Swappable VII and VIII SEMESTER)**

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination			Credits	
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks		Total Marks
					L	T	P	S					
1	IPCC	BCG701	Robotic Process Automation Design and Development (UiPath)	TD: CG PSB : CG	3	0	2		03	50	50	100	4
2	IPCC	BCG702	Design of Parallel and High-Performance Computing	TD: CG PSB : CG	3	0	2		03	50	50	100	4
3	PCC	BCG703	Cryptography & Network Security	TD: CG PSB : CG	4	0	0		03	50	50	100	4
4	PEC	BCG714x	<b>Professional Elective Course</b>	TD: CG PSB : CG	3	0	0		03	50	50	100	3
5	OEC	BCG755x	<b>Open Elective Course</b>	TD: CG PSB : CG	3	0	0		01	50	50	100	3
6	PROJ	BCG786	<b>Major Project Phase-II</b>	TD: CG PSB : CG	0	0	12		03	100	100	200	6
										<b>400</b>	<b>300</b>	<b>700</b>	<b>24</b>

**Professional Elective Course**

BCG714A	Virtual Reality and Augmented Reality	BCG714C	Deep Learning
BCG714B	Multimedia data base systems	BCG714D	Animation Principles and Design

**Open Elective Course**

BCG755A	Introduction to DBMS	BCG755C	Software Engineering
BCG755B	Introduction to Algorithms	BCG755D	Computer Graphics

**PCC:** Professional Core Course, **PCCL:** Professional Core Course laboratory, **PEC:** Professional Elective Course, **OEC:** Open Elective Course **PR:** Project Work, **L:** Lecture, **T:** Tutorial, **P:** Practical **S= SDA:** Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation. **TD-** Teaching Department, **PSB:** Paper Setting department, **OEC:** Open Elective Course, **PEC:** Professional Elective Course. **PROJ:** Project work

**Note: VII and VIII semesters of IV years of the program**

**(1)** Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/ industry internships after the VI

semester.

**(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether the VII or VIII semesters is completed during the beginning of the IV year or the later part of IV years of the program.**

**Professional Elective Courses (PEC):** A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

**Open Elective Courses:**

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

**PROJECT WORK (21XXP75):** The objective of the Project work is

- (i)** To encourage independent learning and the innovative attitude of the students.
- (ii)** To develop interactive attitude, communication skills, organization, time management, and presentation skills.
- (iii)** To impart flexibility and adaptability.
- (iv)** To inspire team working.
- (v)** To expand intellectual capacity, credibility, judgment and intuition.
- (vi)** To adhere to punctuality, setting and meeting deadlines.
- (vii)** To install responsibilities to oneself and others.
- (viii)** To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

**CIE procedure for Project Work:**

**(1) Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**(2) Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question

and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**SEE procedure for Project Work:** SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI  
**B.E. in Computer Science and Design**  
**Scheme of Teaching and Examinations 2022**  
 Outcome Based Education (OBE) and Choice Based Credit System (CBCS)  
 (Effective from the academic year 2023-24)

**VIII SEMESTER (Swappable VII and VIII SEMESTER)**

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination			Credits	
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks		Total Marks
					L	T	P	S					
1	PEC	BCG801x	Professional Elective (Online Courses) Only through NPTEL,	PSB : CG	3	0	0		03	50	50	100	3
2	OEC	BCG802x	Open Elective (Online Courses) Only through NPTEL,	PSB : CG	3	0	0		01	50	50	100	3
3	INT	BCG803	Internship (Industry/Research) (14 - 20 weeks)		0	0	12		03	100	100	200	10
										<b>200</b>	<b>200</b>	<b>400</b>	<b>16</b>

**Professional Elective Course (Online courses)**

BCG801A	BOS will publish courses based on the availability	BCG801C	
BCG801B		BCG801D	

**Open Elective Courses (Online Courses)**

BCG802A	BOS will publish courses based on the availability	BCG802C	
BCG802B		BCG802D	

**L:** Lecture, **T:** Tutorial, **P:** Practical **S= SDA:** Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation. **TD-** Teaching Department, **PSB:** Paper Setting department, **OEC:** Open Elective Course, **PEC:** Professional Elective Course. **PROJ:** Project work, **INT:** Industry Internship / Research Internship / Rural Internship

**Note: VII and VIII semesters of IV years of the program**

**Swapping Facility**

- Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate **research internships/ industry internships/Rural Internship** after the VI semester.

- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.
- **Note:** For BCG801x and BCG802x courses BOS will announce list of courses in 6<sup>th</sup>, 7<sup>th</sup> & 8<sup>th</sup> Sem. Students can register in any of the semester to earn the credits in 8<sup>th</sup> Sem.

**Elucidation:**

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

**Research internship:** A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

**Industry internship:** Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

**Rural Internship:** Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **University shall not bear any cost involved in carrying out the internship by students.** However, students can receive any financial assistance extended by the organization.

**Professional Elective /Open Elective Course:**These are ONLINE courses suggested by the respective Board of Studies. Details of these courses shall be made available for students on the VTU web portal.

**Please note:** If any clarifications / suggestions please email to [sbhvtuso@yahoo.com](mailto:sbhvtuso@yahoo.com)