Mahatma Education Society's

Pillai College of Engineering

(Autonomous)

Affiliated to University of Mumbai

Dr. K. M. Vasudevan Pillai's Campus , Sector 16, New Panvel – 410 206.

Department of Electronics & Computer Science

Syllabus

of

B.Tech. in Electronics & Computer Science

for

The Admission Batch of AY 2022-23

First Year - Effective from Academic Year **2022-23**

Second Year - Effective from Academic Year **2023-24**

Third Year - Effective from Academic Year **2024-25**

Fourth Year - Effective from Academic Year **2025-26**

as per Choice Based Credit and Grading System

Mahatma Education Society's

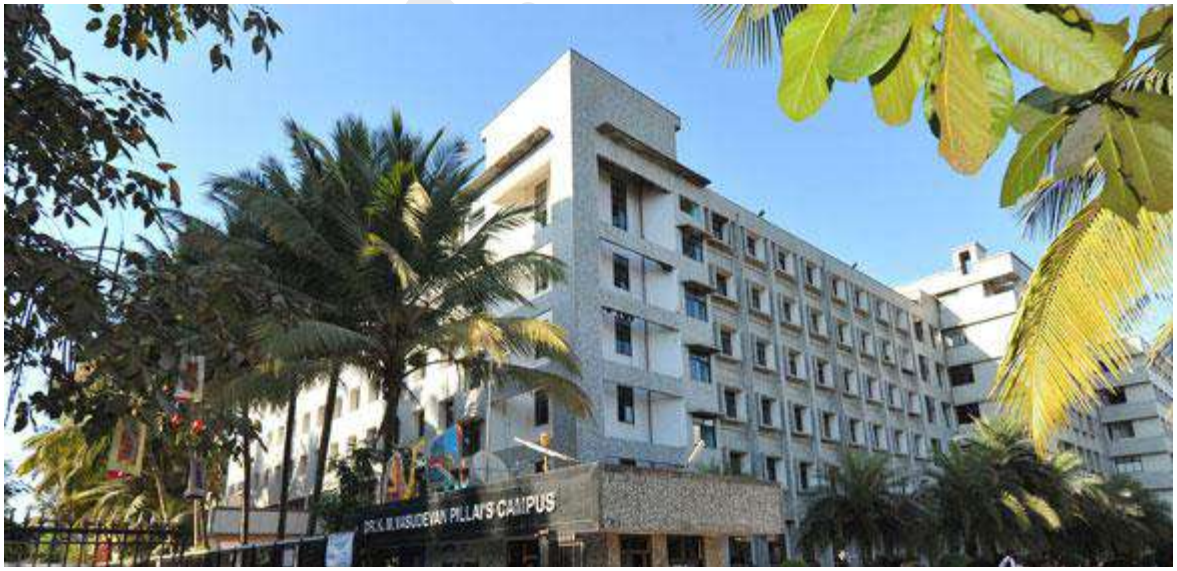
Pillai College of Engineering

Vision

Pillai College of Engineering (PCE) will admit, educate and train a diverse population of students who are academically prepared to benefit from the Institute's infrastructure and faculty experience, to become responsible professionals or entrepreneurs in a technical arena. It will further attract, develop and retain, dedicated, excellent teachers, scholars and professionals from diverse backgrounds whose work gives them knowledge beyond the classroom and who are committed to making a significant difference in the lives of their students and the community.

Mission

To develop professional engineers with respect for the environment and make them responsible citizens in technological development both from an Indian and global perspective. This objective is fulfilled through quality education, practical training and interaction with industries and social organizations.



Dr. K. M. Vasudevan Pillai's Campus , Sector - 16, New Panvel – 410 206

Department of Electronics & Computer Science

Vision

To produce professionally competent and socially responsible engineers capable of working globally.

Mission

To provide in-depth quality education in Electronics & Computer Science Engineering and prepare the students for lifelong learning.

To develop professional engineers who can critically and creatively apply the knowledge of engineering principles to solve real world problems.

To inculcate entrepreneurship skills and impart ethical and social values.

Program Educational Objectives (PEOs):

I. Graduates will have the ability to apply engineering knowledge and skills to provide solutions to real world technical problems.
II. Graduates will be successful as engineering professionals, innovators or entrepreneurs with a multidisciplinary approach contributing towards research and technological developments.
III. Graduates will have the ability to pursue higher education in Electronics Engineering, Computer Science and allied streams.
IV. Graduates will function in their profession with social awareness and responsibility while maintaining ethical standards.

Program Outcomes:

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis, and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling of complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project Management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognized the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

Engineering Graduates will be able to

1. Gain knowledge and skills to analyse and design Electronics circuits as well as Computer Programs.
2. Develop hardware and software systems in the areas like Artificial Intelligence & Machine learning, Big Data, Information Security, Automation, Embedded Systems, Signal Processing and Communication Systems.
3. Apply modern Electronics and Computer engineering techniques and tools to find solutions for real life interdisciplinary problems.

The Autonomous status of the institute has given an opportunity to design and frame the curriculum in such a way that it incorporates all the needs and requirements of recent developments in all fields within the scope of the Technical education. This curriculum will help graduates to attain excellence in their respective field. The curriculum has a blend of basic and advanced courses along with provision of imparting practical knowledge to students through minor and major projects. The syllabus has been approved and passed by the Board of Studies.

Outcome based education is implemented in the academics and every necessary step is undertaken to attain the requirements. Every course has its objectives and outcomes defined in the syllabus which are met through continuous assessment and end semester examinations. Evaluation is done on the basis of Choice Based Credit and Grading System (CBCGS). Optional courses are offered at department and institute level. Selection of electives from the same specialization makes the student eligible to attain a B. Tech. degree with respective specialization.

Every learner/student will be assessed for each course through (i) an Internal/Continuous assessment during the semester in the form of either Practical Performance, Presentation, Demonstration or written examination and (ii) End Semester Examination (ESE), in the form of either theory or viva voce or practical, as prescribed by the respective Board Studies and mentioned in the assessment scheme of the course content/syllabus. This system involves the Continuous Evaluation of students' progress Semester wise. The number of credits assigned with a course is based on the number of contact hours of instruction per week for the course. The credit allocation is available in the syllabus scheme of each semester.

The performance of a learner in a semester is indicated by a number called Semester Grade Performance Index (SGPI). The SGPI is the weighted average of the grade points obtained in all the courses by the learner during the semester. For example, if a learner passes five courses (Theory/labs./Projects/ Seminar etc.) in a semester with credits C1, C2, C3, C4 and C5 and learners grade points in these courses are G1, G2, G3, G4 and G5 respectively, then learners SGPI is equal to:

$$SGPI = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4G_4 + C_5G_5}{C_1 + C_2 + C_3 + C_4 + C_5}$$

The learner's up to date assessment of the overall performance from the time s/he entered for the programme is obtained by calculating a number called the Cumulative Grade Performance Index (CGPI), in a manner similar to the calculation of SGPI. The CGPI therefore considers all the courses mentioned in the scheme of instructions and examinations, towards the minimum requirement of the degree learners have enrolled for. The CGPI at the end of this semester is calculated as,

$$CGPI = \frac{C_1G_1 + C_2G_2 + C_3G_3 + \ldots + C_i * G_i + \ldots + C_nG_n}{C_1 + C_2 + C_3 + \cdots + C_i + \ldots + C_n}$$

The Department of Electronics & Computer Science offers a B. Tech. programme in Electronics & Computer Science. This is an eight semester course. The complete course is a 163 credit course which comprises core courses and elective courses. The elective courses are distributed over 8 specializations. The specializations are:

1. AIML
2. Robotics
3. Data Analytics
4. System Security
5. High Performance Computing
6. Cloud Computing
7. VLSI Design
8. IOT

The students also have a choice of opting for Institute level specializations. These are

1. Entrepreneurship Development and Management
2. Business Management
3. Intellectual Property Management
4. Bioengineering
5. Bio Instrumentation
6. Engineering Design
7. Sustainable Technologies
8. Contemporary Studies
9. Art and Journalism
10. Applied Science
11. Green Technologies
12. Maintenance Engineering
13. Life Skills
14. Environment & Safety

As minimum requirements for the credits to be earned during the B.Tech in Electronics & Computer Science program, a student will have to complete a minimum of three specializations of which two are to be chosen from the department list and one has to be from the Institute level specialization list. In order to complete each specialization, a minimum of three courses under that specialization has to be completed. The credit requirement for the B.Tech. in Electronics & Computer Science is tabulated in Table 1.

Structure of Undergraduate Engineering program

Sr. No.	Category	Breakup of ECS Credits
1	Humanities and Social Sciences including Management courses	9
2	Basic Science courses	25
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	20
4	Professional Core Courses	61
5	Professional Elective Courses	22
6	Open subjects – Electives from other technical and /or emerging subjects	9
7	Project work, seminar and internship in industry or elsewhere	16
8	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Traditional Knowledge]	(non-credit)
	Total	162

Semester-wise Credits and Marks

Sr. No.	Semester	Credits Assigned	Marks Assigned
1	I	18	675
2	II	21	775
3	III	23	800
4	IV	25	900
5	V	24	875
6	VI	23	800
7	VII	17	610
8	VIII	11	300
Total Credits & Marks		162	5735

Preface by Board of Studies in Electronics & Computer Science

Dear Students and Teachers, we, the members of Board of Studies Electronics & Computer Science, are very happy to present the B.Tech Electronics & Computer Science syllabus effective from the Academic Year 2022-23 . We are sure you will find this syllabus interesting, challenging, and up to date to fulfill specific needs and expectations.

The Electronics and Computer Science discipline combines two important disciplines of engineering: Electronics and Computer Science. The syllabus focuses on providing a sound theoretical background as well as good practical exposure to students in the relevant areas. It is intended to provide a modern, industry-oriented education in Electronics & Computer Science. Its primary goal is to offer a contemporary and industry-centric education, preparing individuals to effectively meet the global demands of the field.

The syllabus is meticulously crafted to align with the vision and mission of the Electronics & Computer Science Department as well as the standards set by various accreditation agencies. It takes into account technological advancements, innovations, and industry requirements, ensuring that the curriculum remains up-to-date and relevant to the evolving landscape of the field.

The development of this syllabus involves a collaborative brainstorming session, which includes the participation of Heads of Department and senior faculty members from the Department of Electronics & Computer Science.

We express our sincere appreciation and gratitude to the faculty, students, industry experts, and all the stakeholders for their invaluable contributions towards the formulation of this syllabus. Their expertise, insights, and active involvement have been instrumental in shaping and refining the curriculum.

Board of Studies in Electronics & Computer Science

1. Dr. Monika Bhagwat	Coordinator (Chairman)
2. Dr. Rajendrakumar H. Khade	Faculty
3. Prof. Ajit Saraf	Faculty
4. Prof. K.S. Charumathi	Faculty
5. Dr Bhavana Ambudkar	Academic Council Nominee
6. Dr. Seema Shah	Academic Council Nominee
7. Dr. S J Bhosale	Vice Chancellor's Nominee
8. Mr. Sambhaji N. Kadam	Industry Representative relating to placement
9. Mr. Rajat Tyagi	Alumnus Nominee
10. Mr Prashant Kathole	Industry Expert
11. Prof. Ravi Biradar	Other Member of Staff of Same Faculty

Program Structure for
Bachelor of Technology in Electronics & Computer Science

Semester I

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract / Tuts	Theory	Pract /Tuts	Total
FY 101	Engineering Mathematics I	TLP	3	2	3	1	4
FY 103	Engineering Physics I	TL	2	1	2	0.5	2.5
FY 105	Engineering Chemistry I	TL	2	1	2	0.5	2.5
FY 107	Basic Electrical Engineering	TL	3	2	3	1	4
FY 111	C Programming	TLP	3	2	3	1	4
FY 117	Basic Workshop Practice I	L	-	2	-	1	1
Total			**13**	**10**	**13**	**5**	**18**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
FY 101	Engineering Mathematics I	40	40	40	60	2	25	-	125
FY 103	Engineering Physics I	30	30	30	45	2	25	-	100
FY 105	Engineering Chemistry I	30	30	30	45	2	25	-	100
FY 107	C Programming	40	40	40	60	2	25	25	150
FY 111	Basic Electrical Engineering	40	40	40	60	2	25	25	150
FY 117	Basic Workshop Practice I	-	-	-	-	-	50	-	50
Total									**675**

T- Theory , L- Lab , P-Programming, C- Communication

Program Structure for
Bachelor of Technology in Electronics & Computer Science

Semester II

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract/ Tuts	Theory	Pract/ Tuts	Total
FY 102	Engineering Mathematics II	TLP	3	2	3	1	4
FY 104	Engineering Physics II	TL	2	1	2	0.5	2.5
FY 106	Engineering Chemistry II	TL	2	1	2	0.5	2.5
FY 108	Engineering Mechanics and Graphics	TL	2	4	2	2	4
FY 112	Python Programming	TLP	3	2	3	1	4
FY 114	Professional Communication & Ethics I	TLC	2	2	2	1	3
FY 118	Basic Workshop Practice II	L	-	2	-	1	1
Total			**14**	**14**	**14**	**7**	**21**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
FY 102	Engineering Mathematics II	40	40	40	60	2	25	-	125
FY 104	Engineering Physics II	30	30	30	45	2	25	-	100
FY 106	Engineering Chemistry II	30	30	30	45	2	25	-	100
FY 108	Engineering Mechanics and Graphics	40	40	40	60	3	25	50	175
FY 112	Python Programming	40	40	40	60	2	25	25	150
FY 114	Professional Communication & Ethics I	20	20	20	30	1	25	-	75
FY 118	Basic Workshop Practice II	-	-	-	-	-	50	-	50
Total									**775**

T- Theory , L- Lab , P-Programming, C- Communication

Program Structure for
Bachelor of Technology in Electronics & Computer Science

Semester III

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract /Tuts	Theory	Pract /Tuts	Total
EC 201	Engineering Mathematics III	T	3	1	3	1	4
EC 202	Communication Engineering	TL	3	2	3	1	4
EC 203	Analog Electronics Circuits	TL	3	2	3	1	4
EC 204	Digital Circuits & System Design	TL	3	2	3	1	4
EC 205	Data Structures & Algorithms	TLP	3	2	3	1	4
EC 206	Human Values and Social Ethics	T	2	-	2	-	2
EC 291	Programming Lab I (Java Programming)	LPC	-	1#+2	-	1	1
Total			**17+1#**	**11**	**17**	**6**	**23**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
EC 201	Engineering Mathematics III	40	40	40	60	2	25	-	125
EC 202	Communication Engineering	40	40	40	60	2	25	-	125
EC 203	Analog Electronics Circuits	40	40	40	60	2	25	25	150
EC 204	Digital Circuits & System Design	40	40	40	60	2	25	25	150
EC 205	Data Structures & Algorithms	40	40	40	60	2	25	25	150
EC 206	Human Values and Social Ethics	-	-	-	-	-	50	-	50
EC 291	Programming Lab I (Java Programming)	-	-	-	-	-	25	25	50
Total									**800**

1# to be taken class wise **T- Theory , L- Lab , P-Programming, C- Communication**

Program Structure for
Bachelor of Technology in Electronics & Computer Science
Semester IV

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract/ Tuts	Theory	Pract/ Tuts	Total
EC 208	Engineering Mathematics IV	T	3	1	3	1	4
EC 209	Basics of VLSI Design	T	3	2	3	1	4
EC 210	Database Management System	TLP	3	2	3	1	4
EC 211	Microprocessor and Microcontrollers	TL	3	2	3	1	4
EC 212	Analysis of Algorithms	TLP	3	2	3	1	4
EC 213	System Software & Operating Systems	TLP	3	2	3	1	4
EC 292	Programming Lab II(Web Programming)	LPC	-	1#+2	-	1	1
Total			**18+1#**	**13**	**18**	**7**	**25**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
EC 208	Engineering Mathematics IV	40	40	40	60	2	25	-	125
EC 209	Basics of VLSI Design	40	40	40	60	2	25	25	150
EC 210	Database Management System	40	40	40	60	2	25	25	150
EC 211	Microprocessor and Microcontrollers	40	40	40	60	2	25	25	150
EC 212	Analysis of Algorithms	40	40	40	60	2	25	25	150
EC 213	System Software & Operating Systems	40	40	40	60	2	25	-	125
EC 292	Programming Lab II (Web Programming)	-	-	-	-	-	25	25	50
Total									**900**

1# to be taken class wise

T- Theory , L- Lab , P-Programming, C- Communication

Program Structure for
Bachelor of Technology in Electronics & Computer Science

Semester V

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract/ Tuts	Theory	Pract/ Tuts	Total
EC 301	Signals & Systems	TL	3	1	3	1	4
EC 302	Computer Networks	TL	3	2	3	1	4
EC 303	Professional Communication & Ethics II	TC	1	2	1	1	2
EC 304	Software Engineering	TL	3	2	3	1	4
EC 305	Programming Lab III (R-Programming)	TP	-	1#+2	-	1	1
EC 3xx	Department Level Optional Course I	TL	3	2	3	1	4
EC 3xx	Department Level Optional Course II	TL	3	2	3	1	4
Total			**18+1#**	**11**	**18**	**6**	**24**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
EC 301	Signals & Systems	40	40	40	60	2	25	-	125
EC 302	Computer Networks	40	40	40	60	2	25	25	150
EC 303	Professional Communication & Ethics II	-	-	-	-	-	50	-	50
EC 304	Software Engineering	40	40	40	60	2	25	25	150
EC 305	Programming Lab III (R-Programming)	-	-	-	-	-	25	25	50
EC 3xx	Department Level Optional Course I	40	40	40	60	2	25	25	150
EC 3xx	Department Level Optional Course II	40	40	40	60	2	25	25	150
Total									**875**

1# to be taken class wise

T- Theory , L- Lab , P-Programming, C- Communication

Course Code	Department Level Optional Course (DLOC) I	Group 1 Specializations
EC 306	Artificial Intelligence	AIML
EC 307	Advanced Database Management Systems + DWM	Data Analytics
EC 308	Advanced Operating System	High Performance Computing
EC 309	Embedded System Design & Basics of IOT	IOT

Course Code	Department Level Optional Course (DLOC) II	Group 2 Specializations
EC 310	Foundations of Robotics	Robotics
EC 311	Cryptography and System Security	System Security
EC 312	Mobile & Distributed Computing	Cloud Computing
EC 313	Integrated Circuit Technology	VLSI Design

Program Structure for
Bachelor of Technology in Electronics & Computer Science

Semester VI

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract/ Tuts	Theory	Pract/ Tuts	Total
EC 314	Image Processing & Machine Vision	TLP	3	2	3	1	4
EC 315	Computer Organization & Architecture	T	3	-	3	-	3
EC 316	Instrumentation & Control System	T	3	-	3	-	3
EC 3xx	Department Level Optional Course III	TL	3	2	3	1	4
EC 3xx	Department Level Optional Course IV	TL	3	2	3	1	4
IL 3xx	Institute Level Optional Course I	T	3	-	3	-	3
EC 392	Project A (Literature Survey & Problem Formulation)	LPC	-	6	-	3	3
Total			**16**	**14**	**16**	**7**	**23**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
EC 314	Image Processing & Machine Vision	40	40	40	60	2	25	25	150
EC 315	Computer Organization & Architecture	40	40	40	60	2	-	-	100
EC 316	Instrumentation & Control System	40	40	40	60	2	-	-	100
EC 3xx	Department Level Optional Course III	40	40	40	60	2	25	25	150
EC 3xx	Department Level Optional Course IV	40	40	40	60	2	25	25	150
IL 3xx	Institute Level Optional Course I	40	40	40	60	2	-	-	100
EC 392	Project A (Literature Survey & Problem Formulation)	-	-	-	-	-	50	50	100
Total									**800**

T- Theory , L- Lab , P-Programming, C- Communication

Course Code	Department Level Optional Course (DLOC) III	Group 1 Specializations
EC 317	Machine Learning	AIML
EC 318	Big Data Analytics	Data Analytics
EC 319	Parallel Computing Architecture	High Performance Computing
EC 320	Wireless Networks	IOT
Course Code	**Department Level Optional Course (DLOC) IV**	**Group 2 Specializations**
EC 321	Advanced Robotics	Robotics
EC 322	Advanced Network Theory	System Security
EC 323	Cloud Computing	Cloud Computing
EC 324	Advanced VLSI Design	VLSI Design
Course Code	**Institute Level Optional Course (ILOC) I**	**Specializations**
IL 360	Entrepreneurship	Entrepreneurship Development and Management
IL 361	E- Commerce and E-Business	Business Management
IL 362	Research Methodology	IP Management
IL 363	Introduction to Bioengineering	Bioengineering
IL 364	Biomedical Instrumentation	Bio Instrumentation
IL 365	Design of Experiments	Engineering Design
IL 366	Design for Sustainability	Sustainable Technologies
IL 367	Political Science	Contemporary Studies
IL 368	Visual Art	Art and Journalism
IL 369	Modern Day Sensor Physics	Applied Science
IL 370	Energy Audit and Management	Green Technologies
IL 371	Maintenance of Electronics Equipment	Maintenance Engineering
IL 372	Cooking and Nutrition	Life Skills
IL 373	Environmental Management	Environment & Safety

Program Structure for
Bachelor of Technology in Electronics & Computer Science

Semester VII

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract/ Tuts	Theory	Pract/Tuts	Total
EC 401	Personal Finance Management	T	2	-	2	-	2
EC 4xx	Department Level Optional Course V	TL	3	2	3	1	4
EC 4xx	Department Level Optional Course VI	TL	3	2	3	1	4
IL 4xx	Institute Level Optional Course II	T	3	-	3	-	3
EC 491	Project B	LPC	-	8	-	4	4
Total			**11**	**12**	**11**	**6**	**17**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
EC 401	Personal Finance Management	20	20	20	40	2	-	-	60
EC 4xx	Department Level Optional Course V	40	40	40	60	2	25	25	150
EC 4xx	Department Level Optional Course VI	40	40	40	60	2	25	25	150
IL 4xx	Institute Level Optional Course II	40	40	40	60	2	-	-	100
EC 491	Project B	-	-	-	-	-	50	100	150
Total									**610**

T- Theory , L- Lab , P-Programming, C- Communication

Course Code	Department Level Optional Course (DLOC) V	Group 1 Specializations
EC 402	Deep Learning	AIML
EC 403	Data Science	Data Analytics
EC 404	High Performance Computing	High Performance Computing
EC 405	Internet of Everything	IOT
Course Code	**Department Level Optional Course (DLOC) VI**	**Group 2 Specializations**
EC 406	Intelligent Robotics	Robotics
EC 407	Cyber Security & Digital Forensic	System Security
EC 408	Blockchain Technology	Cloud Computing
EC 409	Analog and Mixed Signal VLSI Design	VLSI Design
Course Code	**Institute Level Optional Course (ILOC) II**	**Specializations**
IL 470	Digital Business Management and Digital Marketing	Entrepreneurship Development and Management
IL 471	Business Analytics	Business Management
IL 472	IPR and Patenting	IP Management
IL 473	Biomechanics	Bioengineering
IL 474	Medical Image Processing	Bio Instrumentation
IL 475	Product Design	Engineering Design
IL 476	Technologies for Rural Development	Sustainable Technologies
IL 477	Economics	Contemporary Studies
IL 478	Journalism, Media and Communication studies	Art and Journalism
IL 479	Operation Research for Management	Applied Science
IL 480	Weather and Climate Informatics	Green Technologies
IL 481	Maintenance of Mechanical Equipment	Maintenance Engineering
IL 482	Physical Education	Life Skills
IL 483	Vehicle Safety	Environment & Safety

Program Structure for
Bachelor of Technology in Electronics & Computer Science

Semester VIII

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract	Theory	Pract	Total
EC 492	Project C	LPC	-	6	-	3	3
EC 493	Internship	LPC	-	16	-	8	8
Total			**3**	**22**	**-**	**11**	**11**

Course Code	Course Name	Examination Scheme							
		Theory							
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		1	2	Avg					
EC 492	Project C	-	-	-	-	-	50	50	100
EC 493	Internship	50	50	50	-	-	50	100	200
Total									**300**

T- Theory , L- Lab , P-Programming, C- Communication

*** - Six months internship to be undertaken by the student during the semester**

Program Structure for
Bachelor of Technology in Electronics & Computer Science

Semester III

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract /Tuts	Theory	Pract /Tuts	Total
EC 201	Engineering Mathematics III	T	3	1	3	1	4
EC 202	Communication Engineering	TL	3	2	3	1	4
EC 203	Analog Electronics Circuits	TL	3	2	3	1	4
EC 204	Digital Circuits & System Design	TL	3	2	3	1	4
EC 205	Data Structures & Algorithms	TLP	3	2	3	1	4
EC 206	Human Values and Social Ethics	T	2	-	2	-	2
EC 291	Programming Lab I (Java Programming)	LPC	-	1#+2	-	1	1
Total			**17+1#**	**11**	**17**	**6**	**23**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
EC 201	Engineering Mathematics III	40	40	40	60	2	25	-	125
EC 202	Communication Engineering	40	40	40	60	2	25	-	125
EC 203	Analog Electronics Circuits	40	40	40	60	2	25	25	150
EC 204	Digital Circuits & System Design	40	40	40	60	2	25	25	150
EC 205	Data Structures & Algorithms	40	40	40	60	2	25	25	150
EC 206	Human Values and Social Ethics	-	-	-	-	-	50	-	50
EC 291	Programming Lab I (Java Programming)	-	-	-	-	-	25	25	50
Total									**800**

1# to be taken class wise **T- Theory , L- Lab , P-Programming, C- Communication**

Program Structure for
Bachelor of Technology in Electronics & Computer Science

Semester IV

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract/ Tuts	Theory	Pract/ Tuts	Total
EC 208	Engineering Mathematics IV	T	3	1	3	1	4
EC 209	Basics of VLSI Design	T	3	2	3	1	4
EC 210	Database Management System	TLP	3	2	3	1	4
EC 211	Microprocessor and Microcontrollers	TL	3	2	3	1	4
EC 212	Analysis of Algorithms	TLP	3	2	3	1	4
EC 213	System Software & Operating Systems	TLP	3	2	3	1	4
EC 292	Programming Lab II(Web Programming)	LPC	-	1#+2	-	1	1
Total			**18+1#**	**13**	**18**	**7**	**25**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
EC 208	Engineering Mathematics IV	40	40	40	60	2	25	-	125
EC 209	Basics of VLSI Design	40	40	40	60	2	25	25	150
EC 210	Database Management System	40	40	40	60	2	25	25	150
EC 211	Microprocessor and Microcontrollers	40	40	40	60	2	25	25	150
EC 212	Analysis of Algorithms	40	40	40	60	2	25	25	150
EC 213	System Software & Operating Systems	40	40	40	60	2	25	-	125
EC 292	Programming Lab II (Web Programming)	-	-	-	-	-	25	25	50
Total									**900**

1# to be taken class wise

T- Theory , L- Lab , P-Programming, C- Communication

Bachelor of Technology
In
Electronics & Computer Science

(Semester III)

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 201	Engineering Mathematics III	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 201	Engineering Mathematics-III	40	40	40	60	25	-	-	125

Prerequisite: Engineering Mathematics-I and Engineering Mathematics-2

Course Objectives:

1. Learn the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2. Understand the concept of Fourier Series, its complex form and enhance the problem solving skills.
3. Understand Matrix algebra for engineering problems.
4. Understand the concept of complex variables, C-R equations with applications.
5. Understand the concept of Relation and function.
6. Understand the concept of coding theory

Course Outcomes:

After successful completion of the course students will be able to

1. Apply the concept of Laplace transform and its application to solve the real integrals in engineering problems.
2. Expand the periodic function by using the Fourier series for real-life problems and complex engineering problems.
3. Apply the concepts of Eigen values and eigenvectors in engineering problems.
4. Apply complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic functions.
5. Apply the concept of relation and function.
6. Use groups and codes in Encoding-Decoding.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs.
1.	**Laplace Transform**	Definition of Laplace transform and Laplace transform of standard functions, Properties of Laplace Transform: Linearity, First Shifting Theorem, change of scale Property, multiplication by t, Division by t, (Properties without proof). Inverse of Laplace Transform by partial fraction and convolution theorem.	07

2.	**Fourier Series , Fourier Transform**	Dirichlet's conditions, Fourier series of periodic functions with period 2π and 2L, Fourier series for even and odd functions, Half range sine and cosine Fourier series, Orthogonal and Ortho-normal functions, Fourier Integral Representation, Fourier Transform and Inverse Fourier transform of constant and exponential function.	06
3.	**Linear Algebra Matrix Theory, Quadratic Forms**	Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Quadratic forms over real field, Linear Transformation of Quadratic form, Reduction of Quadratic form to diagonal form using congruent transformation. Rank, Index and Signature of quadratic form, Sylvester's law of inertia, Value- class of a quadratic form-Definite, Semidefinite and Indefinite. Reduction of Quadratic form to a canonical form using congruent transformations.	07
4.	**Complex Variables and conformal mappings**	Function f(z)of complex variable, Introduction to Limit, Continuity and Differentiability of (z), Analytic function: Necessary and sufficient conditions for f(z) to be analytic, Cauchy-Riemann equations in Cartesian coordinates, Milne-Thomson method: Determine analytic function f(z)when real part(u), imaginary part (v) or its combination (u+v / u-v) is given, Conformal mapping, Linear and Bilinear mappings, cross ratio	06
5.	**Relation and Function**	Partition of A Set, Relation, Diagram of A Relation, Matrix of A Relation, Digraph of A Relation, Types of Relation, Number of Binary Relations, Number of Reflexive Relations, Equivalance Relation, Relation of the Path, Operations on Relations, Closures, Warshall's Algorithm,	07
6.	**Algebraic Structures, coding theory**	Properties of Binary Operations, Semi-Group. Monoid, Group, Ring, Isomorphism, Homomorphism, Group Code, Decoding and Error Correction, Maximum Likelihood Technique	06

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessment:

1. Term work Assessment:

Term work should consist of all the work done in tutorials and assignments. The final certification and acceptance of term work ensures satisfactory performance throughout in all the assigned work.

Text Books & References:

1. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education.
2. Advanced engineering mathematics H.K. Das, S . Chand, Publications.
3. Higher Engineering Mathematics B. V. Ramana, Tata Mc-Graw Hill Publication
4. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
5. Advanced Engineering Mathematics Wylie and Barret, Tata Mc-Graw Hill.
6. Beginning Linear Algebra Seymour Lipschutz Schaum's outline series, Mc-Graw Hill Publication
7. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
8. Discrete Mathematical Structures Bernard Kolman, Robert C. Busby ,Sharon Cutler Ross, Nadeem-ur-Rehman, " Pearson Education".
9. Discrete Mathematical Structures: Theory and Applications, D.S. Malik and M.K. Sen: Cengage Learning, 2004.
10. Discrete Mathematics with Applications, Thomas Koshy: Elsevier, 2005, Reprint 2008.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 202	Communication Engineering	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 202	Communication Engineering	40	40	40	60	25	--	--	125

Prerequisite: Basic Electrical Engineering

Course Objectives:

1. Gain the core idea of electromagnetic Spectrum.
2. To introduce students to various Communication Methods and Introduction to Noise and its effect on the Communication System.
3. To analyze different parameters of analog communication techniques.
4. Study the Sampling theorem and Pulse Analog and digital modulation techniques.
5. Learn the concept of multiplexing and digital bandpass modulation techniques.
6. To understand the fundamental concepts of electronic communication and their use in computer applications.

Course Outcomes:

After successful completion of the course students will be able to

1. Use different modulation and demodulation techniques used in analog communication
2. Identify and solve basic communication problems
3. Analyze transmitter and receiver circuits
4. Compare and contrast design issues, advantages, disadvantages and limitations of analog communication systems
5. To understand the fundamental concepts of electronic communication
6. To study basic concepts of information theory.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs.
1.	**Basics of Communication System**	Block diagram, electromagnetic spectrum, signal bandwidth and power, types of communication channels, Introduction to time and frequency domain. Types of noise, signal to noise ratio, noise figure and noise temperature, Friss transmission formula.	06
2.	**Communication Fundamentals: Analog Communication (Amplitude Modulation)**	Block diagram and elements of analog communication systems, Theory of amplitude modulation, mathematical Derivation Of AM and types of AM. Block diagram of AM transmitter (HLM and LLM). Generation of DSB-SC using diode Ring balanced modulator. Generation of SSB using phase shift method. **AM Receivers:** Receiver Characteristics (Selectivity, Sensitivity, Fedility) TRF Receiver and its disadvantages Superheterodyne Receiver. (Numerical's on Transmitter and Receiver).	09

3.	**Communication Fundamentals: Angle Modulation**	Frequency modulation (FM): Basic concept, mathematical analysis, spectrum of FM wave, sensitivity, phase deviation and modulation index, deviation ratio, narrowband FM and wideband FM. Varactor diode modulator, Direct FM transmitter, indirect FM Transmitter, pre-emphasis and de-emphasis. **FM demodulation:** Balance slope detector, Foster-Seely discriminator, ratio detector, comparison between AM, FM and PM Applications of AM, FM and PM	08
4.	**Pulse Modulation Techniques**	Statement of Sampling Theorem, Generation and detection of PAM, PWM, PPM, PCM, DM and ADM. Quantization process, Pulse code modulation, Delta modulation, Adaptive delta modulation. Introduction to Line Codes and ISI.	06
5.	**Multiplexing Techniques**	Principles of FDM. FDM Hierarchy. FDM Transmitter and Receiver. Principles of TDM. TDM Transmitter and Receiver. TDM – PCM system. TDM –PAM system. (Numericals)	06
6.	**Communication Fundamentals**: **Information theory**	Amount of information, average information, information rate, Statement of Shannon's theorem, channel capacity (Numericals)	04

DETAILED LAB SYLLABUS:
Hardware Requirements: Demonstrative kits

Sr. No.	Detailed Lab/Tutorial Description
1	Study of Electronic Component and measuring instruments
2	Modulation and Demodulation of AM.
3	Modulation and demodulation of FM
4	Study of super heterodyne receiver
5	Modulation and Demodulation PAM.
6	Modulation and Demodulation PWM.
7	Modulation and Demodulation PPM.
8	Modulation and Demodulation PCM.
9	FDM
10	TDM

Theory Assessments:
1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.
2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessment:
1. Term work Assessment :
Minimum 8 experiments to be performed based on the entire syllabus. Term work of 25 Marks will be based on the assessment on the overall performance of the student in every experiment and assignments graded from time to time.

Books:

1. George Kennedy, Bernard Davis, SRM Prasanna, Electronic Communication Systems, Tata McGraw Hill, 5th Ed
2. Simon Haykin, Michael Moher, Introduction to Analog & Digital Communications, Wiley India Pvt. Ltd., 2nd Ed.
3. Wireless Communication and Networking, Vijay Garg

References:

1. Wayne Tomasi, Electronic Communications Systems, Pearson Publication, 5th Ed.
2. B P Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University
3. Herbert Taub, Donald L Schilling, Goutam Saha, Principles of Communication Systems, Tata McGraw Hill, 3rdEd.
4. K Sam Shanmugam, Digital and Analog Communication Systems, Wiley India Pvt. Ltd, 1st Ed.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 203	Analog Electronics Circuits	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 203	Analog Electronics Circuits	40	40	40	60	25	25	--	150

Prerequisite: Basic Electrical Engineering

Course Objectives:

1. To enhance comprehension capabilities of students through understanding of electronic circuits.
2. To perform DC and AC analysis of BJT and MOSFET amplifier circuits.
3. To teach fundamental principles of operational amplifiers.
4. To develop an overall approach for students from selection of integrated circuit, specification, functionality and applications.

Course Outcomes:

After successful completion of the course students will be able to

1. Understand construction, characteristics and working of semiconductor devices such as BJT, MOSFET.
2. Derive expressions for performance parameters of BJT and MOSFET based Electronic circuits
3. Select and Design electronic circuits (using BJT and MOSFET) for given specifications
4. Derive and determine various performances-based parameters and their significance for Op-Amp.
5. Analyze and identify the closed loop stability considerations, linear and nonlinear applications of operational amplifiers.
6. Design an application with the use of integrated circuits.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs.
1.	**Semiconductor devices**	1.1Bipolar Junction Transistor - BJT operations, voltages and current equations, BJT characteristics (CE, CB, CC configurations), early effect. 1.2 Field Effect Devices- JFET: Construction, operation and characteristics. MOSFET: Construction, operation and characteristics of D-MOSFET and EMOSFET.	06

2.	**Biasing Circuits of BJTs and MOSFETs**	2.1 Concept of DC load line, Q point and regions of operations, Analysis and design of biasing circuits for BJT (Voltage divider Bias ONLY) 2.2 DC load line and region of operation for MOSFETs. Analysis and design of biasing circuits for E-MOSFET (voltage divider bias ONLY).	06
3.	**Small Signal Amplifiers**	3.1Concept of AC load line and Amplification, Small signal analysis (Zi, Zo, Av and Ai) of CE amplifiers using hybrid pi model ONLY. 3.2 Small signal analysis (Zi, Zo, Av) of CS (for EMOSFET) amplifiers. Introduction to multistage amplifiers. Cascade and cascode only.(Concept, advantages & disadvantages)	07
4.	**Operational Amplifiers**	4.1The ideal operational amplifier (op-amp), internal block diagram of op-amp, characteristics of op-amp, ideal & practical op-amp parameters / specifications (no detailed description or any analysis), mathematical model of op-amp, IC 741 op-amp with pin diagram & description 4.2 Operational amplifier open loop & closed loop configurations (theoretical description only), the concept of virtual ground & virtual short	06
5.	**Applications of Operational Amplifier**	5.1 The op-amp inverting amplifier & op-amp non-inverting amplifier (mathematical analysis for derivation of output voltage only,numerical examples & designing) 5.2 Adder, summing amplifier, averaging circuit, subtractor, integrator (ideal), differentiator (ideal), op-amp instrumentation amplifier (only mathematical analysis for derivation of output voltage)	07
6.	**Special Purpose Integrated Circuits**	6.1 IC 555 timer internal block diagram & pin configuration, operation in astable & monostable multivibrator with mathematical analysis & numerical examples, design problems on astable & monostable multivibrator, applications in astable & monostable configuration 6.2 Functional block diagram, working and design of general purpose IC 723 (HVLC and HVHC).(theoretical description only). working of the switching regulator. (theoretical description only)	07

DETAILED LAB SYLLABUS:

Hardware Requirements: Breadboard, Transistors, Resistors, Diodes, Connecting wires,Op-amp IC 741, timer IC555

Software Requirements: LTSpice

Sr. No.	Detailed Lab/Tutorial Description
1	To study input and output characteristics of CE configuration
2	Analyze Integrator using op-amp IC 741
3	Design Monostable Multivibrator using IC 555.
4	To study EMOSFET biasing circuits..
5	To study BJT as CE amplifier.and calculate its voltage gain
6	To study frequency response of a multistage amplifier.
7	Design inverting, non-inverting amplifier and buffer using IC 741
8	Design Wein bridge and RC phase shift Oscillator using op-amp IC 741
9	Simulation experiment on drain and transfer characteristics of JFET
10	Simulation experiment on multistage amplifier.
11	Design High Voltage High Current voltage regulator using IC 723.

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to the number of hours assigned to each module.

Lab Assessment:

1. **Term work Assessment :**

At least 8 experiments covering the entire syllabus of AEC should be set to have well predefined inference and conclusion. Simulation experiments are also encouraged. Minimum 3 Simulation Experiments covering the entire syllabus must be performed during the "Laboratory session batch wise". The experiments should be student centric and attempt to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment and assignments are graded from time to time.

2. Oral/Viva Assessment:

The oral examination will be based on the entire syllabus.(10 marks for performance and 15 marks for oral)

Books:

1. Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, 2nd Edition.
2. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Pearson Prentice Hall, 4th Edition.

References:

1. Robert Boylestad," Electronic Devices and Circuit Theory", Pearson.
2. George Clayton and Steve Winder, "Operational Amplifiers", NewnesBali, "Linear Integrated Circuits", Mc Graw Hill
3. Gray, Hurst, Lewise, Meyer, "Analysis & Design of Analog Integrated Circuits, Wiley Publications.
4. K. R. Botkar, "Integrated Circuits", Khanna Publishers (2004)
5. S. Salivahanan, N. Suresh Kumar,"Electronic Devices and Circuits", Tata McGraw Hill.
6. D. Roy Choudhury and S. B. Jain, "Linear Integrated Circuits", New Age International Publishers, 4th Edition.
7. Sergio Franco, "Design with operational amplifiers &analog integrated circuits", Tata McGraw Hill, 3rd edition
8. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", Pearson, 4th Edition

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 204	Digital Circuits & System Design	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 204	Digital Circuits & System Design	40	40	40	60	25	--	25	150

Prerequisite: Physics of Std 11th, 12th and FE - Basic Electrical & Electronics Engineering

Course Objectives:

1. To understand various number systems & codes and to introduce students to various logic gates, SOP, POS form and their minimization techniques.
2. To teach the working of combinational circuits, their applications and implementation of combinational logic circuits using MSI chips.
3. To teach the elements of sequential logic design, analysis and design of sequential circuits.
4. To understand various counters and shift registers and its design using MSI chips.
5. To explain and describe various logic families, their interfacing and Programmable Logic Devices.
6. To train students in writing programs with VHDL hardware description languages.

Course Outcomes:

After successful completion of the course students will be able to

1. Perform code conversion and able to apply Boolean algebra for the implementation and minimization of logic functions.
2. Analyze, design and implement Combinational logic circuits.
3. Analyze, design and implement Sequential logic circuits.
4. Design and implement various counter using flip flops and MSI chips.
5. Understand TTL & CMOS logic families, PLDs, CPLD and FPGA.
6. Understand basics of VHDL Hardware Description Language and its programming with combinational and sequential logic circuits.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs.
1.	**Logic Gates and Boolean Algebra**	Digital logic gates, Realization using NAND, NOR gates, Boolean Algebra, De Morgan's Theorem, SOP and POS representation, K Map up to four variables.	04
2.	**Combinational Circuits using basic gates as well as MSI devices**	Arithmetic Circuits: Half adder, Full adder, Ripple carry adder, Carry Look ahead adder, Half Subtractor, Full Subtractor, multiplexer, cascading of Multiplexer, demultiplexer, decoder, Comparator (Multiplexer and demultiplexer gate level upto 4:1). MSI devices: IC7483, IC74151, IC74138, IC7485.	07

3.	**Elements of Sequential Logic Design**	Sequential Logic: Latches and Flip-Flops. RS, JK, Master slave flip flops, T & D flip flops with various triggering methods, Conversion of flip flops Counters: Asynchronous, Synchronous Counters, Up Down Counters, Mod Counters, Ring Counter, Twisted ring counter, Shift Registers, Universal Shift Register.	07
4.	**Sequential Logic Design**	Sequential Logic Design: Mealy and Moore Machines, Clocked synchronous state machine analysis, State reduction techniques (inspection, partition and implication chart method) and state assignment, sequence detector, Clocked synchronous state machine design. Sequential logic design practices: MSI counters (7490, 7492, 7493,74163, 74169) and applications, MSI Shift registers (74194) and their applications.	07
5.	**Logic Families and Programmable Logic Devices**	Logic Families: Types of logic families (TTL and CMOS), characteristic parameters (propagation delays, power dissipation, Noise Margin, Fan-out and Fan-in), transfer characteristics of TTL NAND (Operation of TTL NAND gate),CMOS Logic: CMOS inverter, CMOS NAND and CMOS NOR, Interfacing CMOS to TTL and TTL to CMOS. Programmable Logic Devices: Concepts of PAL and PLA. Simple logic implementation using PAL and PLA, Introduction to CPLD and FPGA architectures.	07
6.	**Introduction to VHDL**	Design of Combinational circuits using VHDL: Introduction to Hardware Description Language, Core features of VHDL, data types, concurrent and sequential statements, data flow, behavioral, structural architectures, subprograms, Examples like Adder, subtractor, Multiplexers, De-multiplexers, decoder. Design of Sequential circuits using VHDL: VHDL code for flip flop, counters.	07

DETAILED LAB SYLLABUS:

Hardware Requirements: Hardware Kits

Software Requirements: VHDL simulation software

Sr. No.	Detailed Lab/Tutorial Description
1	Implementation of Asynchronous counter using MSI counter IC and flip flops
2	Implementation of synchronous counter using MSI counter IC and flip flops
3	Conversion of Flip flops.
4	Application of Universal Shift Register.
5	Design and implement Mealy machine
6	Design and implement Moore machine
7	Design sequence detector using Flip Flop
8	VHDL program for Combinational circuits
9	VHDL program for sequential circuits
10	VHDL program for Mealy and Moore machines.

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to the number of hours assigned to each module.

Lab Assessment:

1.Term work Assessment:

At least 6 experiments covering the entire syllabus of DCSD should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiments must be graded from time to time. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus. Equal weightage should be given to laboratory experiments and while assigning term work marks.

2.Oral/Viva Assessment:

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Oral exam will be based on the entire syllabus.

Books:

1. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill Education, Third Edition 2003.
2. Morris Mano, Digital Design, Pearson Education, Asia 2002.
3. J Bhaskar, VHDL Primer, Prentice Hall, Third Edition (1999).

References:

1. Digital Logic Applications and Design – John M. Yarbrough, Thomson Publications, 2006
2. John F. Warkerly, Digital Design Principles and Practices, Pearson Education, Fourth Edition, 2008.
3. Stephen Brown and Zvonko Vranesic, Fundamentals of digital logic design with VHDL, McGraw Hill, 2nd Edition.
4. Volnei A. Pedroni, “Circuit Design with VHDL” MIT Press (2004)
5. Digital Circuits and Logic Design – Samuel C. Lee , PHI
6. William I.Flectcher, “An Engineering Approach to Digital Design”, Prentice Hall of India.
7. Parag K Lala, “Digital System design using PLD”, BS Publications, 2003.
8. Charles H. Roth Jr., “Fundamentals of Logic design”, Thomson Learning, 2004.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 205	Data Structures and Algorithms	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 205	Data Structures and Algorithms	40	40	40	60	25	--	25	150

Prerequisite: C Programming

Course Objectives:

1. To teach concept and implementation of linear and nonlinear data structures.
2. To analyze various data structures and select the appropriate one to solve a specific real-world problem.
3. To introduce various techniques for representation of the data in the real world.

Course Outcomes:

After successful completion of the course students will be able to

1. Students will be able to implement linear and Non-Linear data structures.
2. Students will be able to handle various operations like searching, insertion, deletion and traversals on various data structures.
3. Students will be able to explain various data structures, related terminologies and its types.
4. Students will be able to choose appropriate data structure and apply it to solve problems in various domains.
5. Students will be able to analyze and Implement appropriate sorting and searching techniques for a given problem.
6. Students will be able to demonstrate the ability to analyze, design, apply and use data structures to solve engineering problems and evaluate their solutions.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs.
1.	**Introduction to Data Structures**	Introduction to Data Structures, Types of Data Structures – Linear and Nonlinear, Operations on Data Structures, Concept of array, Static arrays vs Dynamic Arrays, structures, Array Data Type:- Single and Multidimensional Arrays. Introduction to Analysis of Algorithms, characteristics of algorithms, Time and Space complexities, Asymptotic notations.	04
2.	**Stack and Queue**	**Stack:** Basic Stack Operations, Representation of a Stack using Array, Applications of Stack – Well form-ness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation.	07

		Queue: Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, Dequeue, queue-Round Robin Algorithm, Applications of Queue:- Interrupt handling	
3.	**Linked List**	Representation of Linked List, Linked List v*/s* Array, Types of Linked List - Singly Linked List (SLL), Doubly Linked List, Circular Linked List, Operations on Singly Linked List: Insertion, Deletion, reversal of SLL, Print SLL. Implementation of Stack and Queue using Singly Linked List. Singly Linked List Application-Documenting a sequence of heterogeneous records.	08
4.	**Tree**	Tree Terminologies, Binary Tree, Types of Binary Tree, Binary Tree Representation: Array and Linked Representation of Binary trees, Binary Tree Traversals algorithms: In-order, Pre-order, Post-order, Binary Search Tree Operations on Binary Search Tree, Applications of Binary Tree - Expression Tree, Huffman Encoding.	07
5.	**Graph**	Graph Terminologies, Representation of graph (Adjacency matrix and adjacency list), Graph Traversals – Depth First Search (DFS) and Breadth First Search (BFS), Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal's algorithm, Application of Graph – Topological Sorting.	06
6.	**Sorting and Searching**	**Searching:** Linear search, Random search, Binary search, Hashing, Applications:- Finding a root of a general quadratic polynomial over a finite interval. **Sorting:** Bubble, Insertion, selection, Quick Sort, Merge Sort, Two Way Merge Sort, Counting sort, Comparison of sorting Techniques based on their complexity, A few practical considerations for in-memory sorting	07

DETAILED LAB SYLLABUS:

Software Requirements: Turbo C/Code Blocks, Windows/Linux

Sr. No.	Detailed Lab/Tutorial Description
1	Program to reverse a list of given numbers using stack ADT.
2	Program to Check whether parentheses are balanced or not.
3	Convert an Infix expression to Postfix expression using stack ADT.
4	Program to evaluate Postfix Expression using Stack ADT.
4	Program to implement Linear Queue ADT using array.
5	Program to implement Stack/Queue using linked list.
6	Program to implement Circular Queue ADT using array.
7	Program to implement Priority Queue ADT using array.
8	Program to implement Binary Search Tree ADT using Linked List.
9	Program to implement searching algorithms -Linear search, Binary search.
10	Implement Depth First Search and Breadth First Search Graph Traversal technique.
11	Program to implement sorting algorithms (any 2)- bubble, selection, insertion, merge, quick.
12	Implementation of Prim's and Kruskal's algorithms for finding out Minimum Cost Spanning Tree of a given input graph. For eg. Finding out electricity distribution cable network with minimum overall cable length.

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessment:

1. Term work Assessment :

The experiments should be student centric and attempt to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment and assignments are graded from time to time.

2. Oral/Viva Assessment:

The oral examination will be based on the entire syllabus.

Text Books:

1. Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, "Data Structures Using C", Pearson Publication.
2. Jean Paul Tremblay, P. G. Sorenson, "Introduction to Data Structure and Its Applications", McGraw-Hill Higher Education
3. Thomas H. Cormen, Charles E. Leiserson, Ronald Rivest, Clifford Stein, "Introduction to Algorithms", PHI Learning Pvt. Ltd. (Originally MIT Press); Third edition, 2010
4. Mark A.Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education India; 2nd edition, 2002.
5. Data Structures using C and C++, Rajesh K Shukla, Wiley - India
6. Data Structures Using C, Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, Pearson.
7. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg & Behrouz A., Forouzan, Second Edition, CENGAGE Learning.
8. Introduction to Data Structure and Its Applications, Jean Paul Tremblay, P. G. Sorenson.

Reference Books:

1. C & Data Structures, Prof. P.S. Deshpande, Prof. O.G. Kakde, DreamTech press
2. E. Balagurusamy, "Data Structure Using C", Tata McGraw-Hill Education India
3. Rajesh K Shukla, "Data Structures using C and C++", Wiley-India

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 206	Human Values and Social Ethics	02	--	--	02	--	--	02

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 206	Human Values and Social Ethics	--	--	--	--	50	--	--	50

Prerequisite: Should have respect for justice and be able to reflect on one's personal beliefs and values.

Course Objectives:

1. To enable learners to understand the core values that shape the ethical behaviour of a professional.
2. To develop an awareness on the different ethical dilemmas at the work place and society.
3. To inculcate the ethical code of conduct in writing technical article and technology development.
4. To internalize ethical principles and code of conduct of a good human being at home, society and at work place.

Course Outcomes:

After successful completion of the course students will be able to

1. Learners will be able to recognize the relation between ethics and values pertinent for an engineering professional.
2. Learners will be able to exercise the responsibility for establishing fair and just processes for participation and group decision making
3. Learners will be able to demonstrate an awareness of self-held beliefs and values and how they are altered in interactions with others.
4. Learners will be able to acquire the writing skills necessary to analyse data from research and attribute the source with proper citation.
5. Learners will be competent to incorporate values and ethical principles in social and professional situations.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs.
1.	**Ethics and Values**	Meaning & Concept of Ethics Difference between Ethics and Values Ethical code of conduct	03
2.	**Professional Ethics**	Professional Ethics vs Personal ethics Components of professional ethics	05

		Professional values and its importance	
3.	**Ethics and Society**	Relevance of values and ethics in social work Ethical dilemmas Values and ethical principles of social work ● Service ● Dignity and worth of a person ● Importance of Human relationships ● Integrity ● Competence ● Social Justice	04
4.	**Ethics in Technical writing**	Documenting sources Presentation of Information Ethics & Plagiarism	07
5.	**Ethics and Technology Development**	Risk management and Individual rights Moral issues in development and application of technology Privacy/confidentiality of information Managing Technology to ensure fair practices	07

Assessments:

Termwork : 50 marks (Continuous evaluation)

Books/References:

1. Martin Cohen, *101 Ethical Dilemmas* Routledge, 2nd edition, 2007.
2. M. Govindarajan, S. Natarajan & V.S. Senthilkumar, *Professional Ethics and Human Values,* Prentice Hall India Learning Private Limited, 2013.
3. Mike W. Martin, *Ethics in Engineering*, McGraw Hill Education; Fourth edition, 2017.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 291	Programming Lab I (Java Programming)		$1^{\#}$+2	--	-	1	--	1

$1^{\#}$ to be taken class wise

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment (Review)			End Sem. Exam				
		1(10)	2(10)	Average					
EC 291	Programming Lab I (Java Programming)	-	-	-	-	25	–	25	50

Course Objectives:

1. To write programs using abstract classes.
2. To write programs for solving real world problems using the java collection framework.
3. To write Exception Handling & multithreaded programs.
4. To write GUI programs using swing controls in Java.
5. To introduce java compiler and eclipse platform.
6. To impart hands-on experience with java programming

Course Outcomes:

After successful completion of the course students will be able to

1. Understand Java Programming.
2. Develop a program that efficiently implements the features and packaging concept of java.
3. Implement Exception handling and Applets using Java.
4. Identify problems based on societal /research needs , write code using java and demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Lab/Tutorial Description	No of Hours
1	Introduction to Java	Java History, Java Features, Java Virtual Machine, Data Types and Size (Signed vs. Unsigned, User Defined vs. Primitive Data Types, Explicit Pointer type)Installing Java, Java Program Development, Java Source File Structure, Compilation, Executions.	3
2	Object-Oriented Programming	Class Fundamentals, Object & Object reference, Creating and Operating Objects, Constructor &	5

		initialization code block, Access Control, Modifiers, Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism.	
3	Classes, and Inheritance	Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods, Role of Constructors in inheritance	5
4	Package	Organizing Classes and Interfaces in Packages, Package as Access Protection, Defining Package, Classpath, Setting for Packages, Making JAR Files for Library Packages Import and Static Import Naming Convention For Packages.	4
5	Exception Handling & Multithreading	The Idea behind Exception, Exceptions & Errors, Types of Exception, Control Flow In Exceptions, JVM reaction to Exceptions, Use of try, catch, finally, throw, throws in Exception Handling, In-built and User Defined Exceptions. Multithreaded programming, Create thread, Life cycle, Thread methodsThread exception,	5
6	Applet and Graphics Programming	Applet: Applet Fundamental, Applet Architecture, Applet Life-Cycle, Applet Skeleton, Applet, and Application Program.Graphics Programming, Graphics classes, Functions and methods	4

DETAILED LAB SYLLABUS:

Software Requirements: Netbeans:https://netbeans.org/downloads/ J-Edit/J-Editor/Blue J

Sr. No.	Detailed Lab/Tutorial Description
1	Introduction to Java programming language.
2	Creating Classes and their Objects in Java.
3	Using constructors to create objects.
4	To understand the inheritance in Java
4	Learning of abstraction through Interface.
5	Learning of Encapsulation through Package.
6	Handling Exceptions in Java
7	Understanding Life cycle of a Thread
8	Develop an applet in Java that displays a simple message
9	Mini Project

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do surveys and identify needs, which shall be converted into problem statements for mini projects in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini projects.
- A log book to be prepared by each group, wherein the group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand the problem effectively, propose multiple solutions and select the best possible solution in consultation with the guide/ supervisor. Students shall convert the best solution into a working model using various components of their domain areas and demonstrate. The solution to be validated with proper justification and report to be compiled in standard format.

Lab Assessment:

1.Term work Assessment:

For performance experiments	: 15 Marks
Attendance	: 05 Marks
Quality of Project report	: 05 Marks

2.Oral/Practical Assessment:

Practical and Oral exam will be based on the experiments and project implemented in the semester.

Bachelor of Technology
In
Electronics & Computer Science

(Semester IV)

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 208	Engineering Mathematics IV	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 208	Engineering Mathematics IV	40	40	40	60	25	--	--	125

Prerequisite: Engineering Mathematics I, Engineering Mathematics II and Engineering Mathematics III.

Course Objectives:

1. Understand the basic techniques of statistics like correlation, regression, and curve fitting for data analysis, Machine learning, and AI.
2. Acquaint with the concepts of probability, random variables with their distributions and expectations.
3. Understand the concepts of vector spaces used in the field of machine learning and engineering problems.
4. Introduce students to equivalence relations, recurrence relations, Introduce students to graphs, and trees.
5. Understand the concepts of complex integration.
6. Use concepts of vector calculus to analyze and model engineering problems.

Course Outcomes:

After successful completion of the course students will be able to

1. Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning, and AI.
2. Illustrate understanding of the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.
3. Apply the concept of vector spaces and orthogonalization process in Engineering Problems.
4. Express recursive functions of other subjects like Data Structures as recurrence relation, Ability to understand use of functions, graphs and trees in programming applications.
5. Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals
6. Apply the concepts of vector calculus in real life problems.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs.
1.	**Correlation, Regression and Curve Fitting,**	Karl Pearson's Coefficient of correlation (r),Spearman's Rank correlation coefficient (R) ,Lines of regression ,Fitting of first and second degree curves.	06
2.	**Probability, Probability Distributions**	Conditional probability, Total Probability and Baye's Theorem, Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, Expectation, Variance, Binomial distribution ,Poisson distribution, Normal distribution	06
3.	**Linear Algebra : Vector Spaces**	Vectors in n-dimensional vector space, norm, dot product, The Cauchy Schwarz inequality, Unit vector ; Linear combinations, linear Dependence and Independence, QR decomposition ; Orthogonal projection, Orthonormal basis, Gram-Schmidt process for vectors ; Vector spaces over real field, subspaces.	06
4.	**Graphs and Trees**	Types of Graphs, Homomorphism And Isomorphism Of Graphs, Subgraphs, Types of Graphs, Complement of Graph, Connected Graphs, Eulerian And Hamiltonian Graphs, Trees, Binary Trees, Minimum Spanning Tree, Kruskal's Algorithm	08
5.	**Lattice Theory & Recurrence relation**	Poset, Hasse Digram, Isomorphism, Extremal Elements of Posets, Lattices, Special Types of Lattices, Solving Recurrence relation, Linear Homogenous Recurrence relation with constant coefficients, Non-Homogenous Recurrence relation	06
6.	**Complex Integration and Vector Integration**	Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof). Taylor's and Laurent's series (without proof). Definition of Singularity, Zeroes, poles of f(z), Residues, Cauchy's Residue Theorem (without proof) Vector integral: Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation. Gauss' divergence	07

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.

Weightage of marks should be proportional to the number of hours assigned to each module.

Lab Assessment:

Term work Assessment:

Term work should consist of all the work done in tutorials and assignments. The final certification and acceptance of term work ensures satisfactory performance throughout in all the assigned work.

Books/References:

1. Probability, Statistics and Random Processes, T. Veerarajan, Mc. Graw Hill education.
2. Vector Analysis, Murray R. Spiegel, Schaum Series.
3. Beginning Linear Algebra Seymour Lipschutz Schaum's outline series, Mc-Graw Hill Publication.
4. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication.
5. Discrete Mathematical Structures"Bernard Kolman, Robert C. Busby ,Sharon Cutler Ross, Nadeem-ur-Rehman, " Pearson Education.
6. Discrete Mathematical Structures: Theory and Applications, D.S. Malik and M.K. Sen: Cengage Learning, 2004.
7. Higher Engineering Mathematics B. V. Ramana, Tata Mc-Graw Hill Publication.
8. Advanced Engineering Mathematics Wylie and Barret, Tata Mc-Graw Hill.
9. Advanced engineering mathematics H.K. Das, S . Chand, Publications.
10. Discrete Mathematics with Applications, Thomas Koshy, Elsevier, 2005, Reprint 2008.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 209	Basics of VLSI Design	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 209	Basics of VLSI Design	40	40	40	60	25	--	25	150

Course Objectives:

1. To teach fundamental principles of VLSI circuit design and layout techniques.
2. To highlight the circuit design issues in the context of VLSI technology
3. To explain different scaling effects.
4. To study CMOS gates and effect of W/L ratio.
5. To study dynamic gates and circuit realization using pass transistors.
6. To design semiconductor memories and its importance.

Course Outcomes: Upon successful completion of the course students will be able to

1. Apply the knowledge to demonstrate a clear understanding of choice of technology and technology scaling.
2. Explain the design of MOSFET Inverters.
3. Analyze and design MOS based circuits design styles.
4. Understand CMOS gates and effect of W/L ratio.
5. Understand dynamic gates and circuit realization using pass transistors.
6. Understand the design of Semiconductor Memories.

Prerequisite: Analog Electronics Circuits, Digital Circuits and System Design(DCSD)

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs
1.	**Technology Comparison, MOSFET Scaling**	Comparison of BJT, NMOS and CMOS technology Types of scaling, MOSFET Models, MOSFET capacitances	05

2.	**MOSFET Inverters**	**Circuit Analysis:** Static and dynamic analysis (Noise, propagation delay and power dissipation) of resistive load, E mode MOSFET load, D mode MOSFET load inverter and CMOS inverter, comparison of all types of MOS inverters, design of CMOS inverters	07
3.	**Universal gates, Complex circuits using MOSFETs**	**Logic Circuit Design**: Analysis and design of 2-I/P NAND and NOR using equivalent CMOS inverter, W/L ratio, Complex circuits.	07
4.	**MOS Circuit Design Styles**	**Design Styles:** Static CMOS, pass transistor logic, transmission gate, Pseudo NMOS, Domino, NORA, Zipper, C2MOS, sizing using logical effort	08
5.	**Circuit Realization using MOSFETs**	**Circuit Realization:** SR Latch, JK FF, D FF, 1 Bit Shift Register, MUX, decoder using above design styles	06
6.	**Semiconductor Memories**	**SRAM:** ROM Array, SRAM (operation, design strategy, leakage currents, read/write circuits), DRAM (Operation, leakage currents, refresh operation), Flash memory- NOR flash, NAND flash.	06

DETAILED LAB SYLLABUS:

Software Requirements: TINA**,** NGSpice, Microwind

Sr. No.	Detailed Lab Description
1	Effect of parasitic capacitance and threshold voltage on output of NMOS inverter with resistive load.
2	Circuit characteristics and performance estimation of NMOS inverter with resistive load. 1) Verification of V_{OH} level for different values of load resistance. 2) Find rise time for different values of load resistance.
3	Circuit characteristics and performance estimation of NMOS inverter with Enhancement mode MOSFET load.
4	Circuit characteristics and performance estimation of NMOS inverter with Depletion mode N channel MOSFET as a load.
5	Circuit characteristics and performance estimation of CMOS inverter. 1) Verification of V_{OH} and V_{OL} levels. 2) Comparison of rise and fall times for different values of W/L ratio of pull up and pull down devices.
6	Circuit characteristics and performance estimation of CMOS Dynamic 2 Input NAND Gate. 1) Verification of V_{OH} and V_{OL} levels for various input possibilities. 2) Verification of precharge and evaluate condition for different inputs. 3) Verification of charge leakage problem.
7	Design of 4:1 MUX using pass transistor logic and transmission gates.

8	Design of 6T SRAM using Microwind dsch3.1.

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

- Term work should consist of 8 experiments.
- Journal must include at least 3 assignments.

1. **Term work Assessment:**

Total 25 Marks (Experiments: 10-marks, Assignments: 10-marks, Attendance Theory & Practical: 05-marks)

2. **Oral/Viva Assessment**:

Based on the above contents and entire syllabus.

Text Books:

1. Sung-Mo Kang and Yusuf Leblebici, “CMOS Digital Integrated Circuits Analysis and Design”, Tata McGraw Hill, 3rd Edition.
2. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, “Digital Integrated Circuits: A Design Perspective”, Pearson Education, 2nd Edition.

References:

1. Etienne Sicard and Sonia Delmas Bendhia, “Basics of CMOS Cell Design”, Tata McGraw Hill, First Edition. 2. Neil H. E. Weste, David Harris and Ayan Banerjee, “CMOS VLSI Design: A Circuits and Systems Perspective”, Pearson Education, 3rd Edition.
2. Debaprasad Das, “VLSI Design”, Oxford, 1st Edition. 6. Kaushik Roy and Sharat C. Prasad, “Low-Power CMOS VLSI Circuit Design”, Wiley, Student Edition.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 210	Database Management System	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 210	Database Management System	40	40	40	60	25	25	--	150

Prerequisite: Data Structures

Course Objectives:

1. Develop entity relationship data model and its mapping to relational model
2. Learn relational algebra and Formulate SQL queries
3. Apply normalization techniques to normalize the database
4. Understand the concept of transaction, concurrency control and recovery techniques.

Course Outcomes:

After successful completion of the course students will be able to

1. Recognize the need of database management system
2. Design ER and EER diagram for real life applications
3. Construct relational models and write relational algebra queries.
4. Formulate SQL queries.
5. Apply the concept of normalization to relational database design.
6. Describe the concept of transaction, concurrency and recovery.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs.
1.	**Introduction Database Concepts**	Introduction, Characteristics of databases, File system v/s Database system, Data abstraction and data Independence, DBMS system architecture, Database Administrator	04
2.	**Entity–Relationship Data Model**	The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Relationship constraints: Cardinality and Participation,	06
3.	**Relational Model and relational Algebra**	Introduction to the Relational Model, relational schema and concept of keys. Relational Algebra-operators, Relational Algebra Queries.	07
4.	**Structured Query Language (SQL)**	Overview of SQL, Data Definition Commands, Integrity constraints: key constraints, Domain Constraints, Referential integrity , check constraints, Data Manipulation commands, Data Control commands, Set and string operations, aggregate	08

		functions, group by, having, Views in SQL, joins, Nested and complex queries, Triggers.	
5.	**Relational-Database Design**	Concept of normalization, Function Dependencies, First Normal Form, 2NF, 3NF, BCNF.	06
6.	**Transactions Management and Concurrency and Recovery**	Transaction concept, Transaction states, ACID properties, Transaction Control Commands, Concurrent Executions, Serializability-Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols, Recovery System: Log based recovery, Deadlock handling.	07

DETAILED LAB SYLLABUS:

Hardware Requirements: 2GB RAM

Software Requirements: SQL server (Oracle/MySQL/PostGreSQL)

Sr. No.	Detailed Lab/Tutorial Description
1	Identify the case study and detail statement of the problem. Design an Entity-Relationship(ER) / Extended Entity-Relationship (EER) Model.
2	Mapping ER/EER to Relational schema model.
3	Create a database using Data Definition Language (DDL) and apply integrity constraints for the specified System.
4	Apply DML Commands for the specified system.
5	Perform Simple queries, string manipulation operations and aggregate functions.
6	Implement Views and Join operations.
7	Perform Nested and Complex queries
8	Perform DCL and TCL commands.
9	Implement function and trigger.
10	Demonstrate Database connectivity
11	Implementation and demonstration of Transaction and Concurrency control techniques using locks.

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.

Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessment:

1.Term work Assessment:

Term work should have min. 8 experiments. Journal must include at least 2 assignments on content of theory and practical of "Database Management System". The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks).

2.Oral/ Practical Assessment:

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Books:

1. Korth, Slberchatz, Sudarshan, Database System Concepts, 6thEdition, McGraw Hill.
2. Elmasri and Navathe, Fundamentals of Database Systems, 5thEdition, Pearson Education.
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH.

References:

1. Microsoft SQL Server Black Book By Patrick Dalton.
2. https://www.w3schools.com/sql/
3. https://www.postgresqltutorial.com/

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 211	Microprocessor & Microcontrollers	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 211	Microprocessor & Microcontrollers	40	40	40	60	25	25	--	150

Prerequisite: Digital System Design

Course Objectives:

1. To understand the basic concepts of Microprocessor based systems.
2. To understand the architecture and instruction set of 8-bit Microcontroller 8051.
3. To write assembly / C programs for 8051 Microcontroller.
4. To understand peripheral devices and their interfacing with 8051 Microcontroller.
5. To understand various applications of 8051microcontroller.
6. To understand architecture of 32-bit Microcontroller ARM Cortex M3.

Course Outcomes:

After successful completion of the course students will be able to

1. Identify the features of microcontrollers (8051 & ARM Cortex M3)
2. Understand the architecture and aspects of 8051& Cortex M3 microcontroller.
3. Interface microcontroller with hardware for given application
4. Write and execute assembly or C language programs for given application.
5. Explain the Interrupt system, operation of Timers/Counters and Serial port of 8051
6. Develop small microcontroller based applications.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs.
1.	**Introduction to Microprocessor System.**	1.1 Microprocessor based system: CPU, I/O Devices, Clock, Memory, Concept of Address, Data and Control Bus. 1.2 Features of 8086 Microprocessor. 1.3 Comparison between Microprocessor and Microcontroller. 1.4 Concept of Harvard & Von Neumann Architecture. 1.5 pipelined operation.	04

2	**8051 Microcontroller Architecture**	2.1 8051 Features & its architecture (ALU, PC, DPTR, PSW, Internal RAM, Internal ROM, Latch, SFRs, General purpose registers, Timer/Counter, Interrupt, Ports). 2.2 Pin configuration of 8051 Microcontroller. 2.3 Memory organization (Program and Data memory Map)	04
3.	**8051 Microcontroller assembly language programming**	3.1 Addressing modes of 8051. 3.2 Assembler directives of 8051. 3.3 Instruction Set: Data transfer, Arithmetic, Logical, Branching. 3.4 Programming concepts: Looping , Counting, sorting and Indexing, Data manipulation, Masking. 3.5 Programs related to: arithmetic, logical, Branch & delay.	08
4.	**Internal Hardware of 8051 Microcontroller & Programming**	4.1 I/O port structure and programming. 4.2 Timer/Counter and programming.. 4.3 Serial port and programming. 4.4 Interrupts and programming. 4.5 Power saving modes of 8051: Power down and idle mode.	08
5.	**8051 Interfacing & Applications**	6.1 Display interfacing: 7-segment LED display, 16x2 generic alphanumeric LCD display. 6.2 Analog devices interfacing: 8-bit ADC and DAC 6.3 Motor interfacing: Dc motor & Stepper motor. 6.4 Waveform (Ramp, triangular & Sine wave) generation program using DAC.	08
6.	**Advanced Microcontroller Architecture (ARM CORTEX-M3)**	6.1 Comparison of CISC & RISC architectures. 6.2 Overview of ARM family. 6.3 ARM Cortex-M3 architecture,. 6.4 Programmer's model: Operation Modes and States, registers, special registers, Application Program Status Register- Integer status flags, Q status flag, GE bits. 6.5 Memory system: Features and memory map 6.6 Exceptions and Interrupts - Nested vectored interrupt controller.	07

DETAILED LAB SYLLABUS:
Lab Prerequisite: Digital System Design
Hardware Requirements: Experiments can be conducted on Assembler, Emulator
Software Requirements: Hardware kits

Sr. No.	Detailed Lab/Tutorial Description
1	Introduction to 8086 microprocessor kit and assembler.
2	To write an assembly language program to perform Arithmetic and Logical Operations using 8051 microcontroller.
3	To write an assembly language program to transfer of data bytes between Internal and External Memory using 8051 microcontroller.
4	To write an assembly language program to perform experiments based on General Purpose Input-Output & Timers.
5	Program for Serial communication of 8051 using UART.

6	Programs for Interfacing of Stepper Motor/DC motor with 8051 microcontroller.
7	Programs for generating waveform (Square, Triangular, Sine wave) with 8051 microcontroller.
8	Programs for Interfacing of LCD with 8051
9	Mini project based on any application related to 8051 microcontroller.

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to the number of hours assigned to each module.

Lab Assessment:

1. Term work Assessment:

08 Experiments covering the entire syllabus must be given during the "Laboratory session batch wise". Computation/simulation based experiments are also encouraged. The experiments should be student centric and attempts should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for a maximum batch of at least 04 students.

Text Books:

1. Microprocessor and Interfacing: By Douglas Hall (TMH Publication)
2. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, "The 8051 Microcontroller & Embedded systems", Pearson Publications, Second Edition 2006.
3. C. Kenneth J. Ayala and D. V. Gadre, "The 8051 Microcontroller & Embedded system using assembly & 'C' ", Cengage Learning, Edition 2010.
4. Joseph Yiu,"The Definitive Guide to ARM CORTEX-M3 & CORTEX-M4 Processors", Elsevier, 2014, 3rd Edition.

Reference Books:

1. 8086 Microprocessor Programming and Interfacing the PC: By Kenneth Ayala (West Publication).
2. Microcomputer Systems: 8086/8088 family Architecture, Programming and Design: By Liu & Gibson (PHI Publication).
3. Satish Shah, "The 8051 Microcontrollers", Oxford publication first edition 2010.
4. "MCS@51 Microcontroller, Family users Manual" Intel.
5. David Seal, "ARM Architecture", Reference Manual (2nd Edition), Publisher Addison Wesley.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical/ Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 212	Analysis of Algorithms	03	02	-	03	01	-	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 212	Analysis of Algorithms	40	40	40	60	25	25	--	150

Prerequisite: Data Structure

Course Objectives:

1. To conceptualize learners with mathematical models for analysis of algorithm
2. To understand and solve problems using various algorithmic design strategies
3. To apply algorithm strategies to real life problems

Course Outcomes:

After successful completion of the course students will be able to

1. Analyse space and time complexity of various algorithms
2. Describe, Apply and Analyse design strategy and complexity for optimization problems
3. Describe, Apply and Analyse design and complexity of Backtracking
4. Describe, Apply and Analyse design and complexity of Branch and Bound
5. Describe, Apply and Analyse divide and conquer approach
6. Define and give examples complexity classes P and NP

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs.
1.	**Introduction to algorithms and analysis of algorithm**	Notion of an Algorithm, Brief introduction:-algorithm design paradigms, Algorithm analysis :- Asymptotic notations $O, \Omega, \theta, \omega, o$ $O, \Omega, \theta, \omega, o$ and their properties, notions of time and space complexity, best case, worst case and average case analysis of algorithms, Brief introduction:- randomized algorithms and notion of expected time complexity	07
2.	**Divide and Conquer Approach**	Recurrence equations, Solution of recurrence equations:-Recurrence Tree method, Master Theorem, General structure of a Divide and Conquer algorithm, Finding closest pair of points in 2D plane, Merge/Quick sort.	06
3.	**Dynamic Programming Approach**	General method, applications-Matrix chain multiplication, Optimal binary search trees, Single Source Shortest Path:- Bellman-Ford algorithm, All pairs shortest path problem:-Floyd-Warshall, Travelling salesperson problem.	08
4.	**Greedy Method Approach**	General method, Applications-Job sequencing with deadlines, fractional knapsack problem, Minimum cost spanning trees, Single source shortest path problem:- Dijkstra's algorithm	08
5.	**Backtracking and**	Backtracking: General method, graph coloring	05

	Branch-and-bound	Branch and Bound: General method, applications - 0/1 knapsack problem- LC Branch and Bound solution, FIFO Branch and Bound solution.	
6.	**Selected algorithms and Non-deterministic polynomial time algorithms**	Number Theoretic:- Euclid's algorithm for GCD and it's time complexity analysis, Graph Theoretic:- Johnson's algorithm for All pair Shortest Path problem Computational Complexity classification of problem: Brief introduction:- non deterministic algorithms, Complexity classes:- P, NP.	05

DETAILED LAB SYLLABUS:

Lab Prerequisite:

Hardware Requirements:

Software Requirements: C/Python/C++

Sr. No.	Detailed Lab/Tutorial Description
1	Implement Merge and Quick sort algorithms.
2	Implement Bellman-Ford algorithm.
3	Implement Floyd-Warshall algorithm.
4	Implement Dijkstra's algorithm for the single source shortest path problem on a given weighted graph.
5	Implement Prim/Kruskal algorithm for finding a minimum cost spanning tree of a given input graph.
6	Implement a backtracking based algorithm for vertex coloring of a given graph.
7	Implement Johnson's algorithm for shortest paths, for a given graph.
8	Implement a randomized algorithm for searching an element in an unsorted array and derive its expected time complexity.
9	Implement Euclid's algorithm to calculate GCD of a given set of n>2 natural numbers.

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessment:

1.Termwork Assessment:

Term work should consist of all the work done in tutorials and assignments. The final certification and acceptance of term work ensures satisfactory performance throughout all the assigned work.

2. Oral/Practical Assessment: Practical & Oral Exams should be conducted based on syllabus and practicals conducted.

Text Books:

1. Ellis Horowitz,Satraj Sahni and Rajasekharam, Fundamentals of Computer Algorithms, Galgotia publications pvt. Ltd.
2. Parag Himanshu Dave, Himanshu Bhalchandra Dave, Design and Analysis Algorithms - Publisher: Pearson

Reference Books:

1. T.H.Cormen, C.E.Leiserson, R.L.Rivest, C. Stein, Introduction to Algorithms, 2nd edition, Prentice-Hall India, 2001.
2. J. Kleinberg and E. Tardos, Algorithm Design, Pearson International Edition, 2005.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 213	System Software & Operating Systems	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 213	System Software & Operating Systems	40	40	40	60	25	--	--	125

Prerequisite: Basic knowledge of Data structures and Computer architecture, Any programming language

Course Objectives:

1. To understand the role and functioning of various system programs over application programs.
2. To understand basic concepts and designing of assembler and Macro processor
3. To understand the role of loaders, linkers and Compilers.
4. To introduce basic concepts and functions of operating systems.
5. To understand the concepts and implementation of Process Management, IPC, memory management policies, File and I/O Management.

Course Outcomes:

After successful completion of the course students will be able to

1. Identify the relevance of different system programs.
2. Identify the need of assembler and macro processor design.
3. Understand the functions of linkers, loaders and compilers.
4. Understand the role of Operating System in terms of process, memory, file and I/O management.
5. Apply and analyse the concept of a process,process scheduling and synchronization
6. Apply and analyze different techniques of memory management, file and I/O management.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs.
1.	**Introduction to System Software**	Concept of System Software, Introduction to various system programs such as Assembler, Macro processor, Loader, Linker, Compiler, Interpreter, Device Drivers, Operating system, Editors, Debuggers.	03

2.	**Assemblers and Macro Processors**	Elements of Assembly Language programming, Assembler Design: Introduction to single pass Assembler Design for Hypothetical machines, data structures used. Macro definition and call, parameterized, conditional Macro, Design of Two pass macro processor for Hypothetical machines, data structures used.	08
3.	**Linkers, Loaders and Compilers**	Functions of loaders, Absolute loader/Compile and Go loader, Phases of compilers: Lexical Analysis, Syntax analysis, SR Parser, Introduction to semantic analysis, Intermediate Code Generation: Types of Intermediate codes, Code optimization techniques, Introduction to Code Generation.	08
4.	**Overview of operating System**	Introduction, Objectives, Functions and Types of Operating System, Operating System Services and Interface; Operating system structures: Layered, Monolithic and Microkernel.	04
5.	**Process Management**	Concept of a Process, Process States, Operation on Process Uniprocessor Scheduling-Types: Preemptive and Non-preemptive, scheduling algorithms Threads: Definition and Types, Concept of Multithreading, Inter-Process Communication, Process Synchronization, Mutual Exclusion: ,Semaphores, Producer Consumer problem, Principles of Deadlock: Conditions Deadlock Handling Mechanism.	08
6.	**Memory Management and I/O Management**	Basic Concepts of Memory Management; Memory Allocation Techniques, Paging, TLB, Segmentation, Virtual Memory; Demand Paging, Page Replacement Algorithms, I/O Devices, Disk Scheduling algorithm: FCFS, SSTF, SCAN, CSCAN, LOOK, C- LOOK, Linux I/O.	08

DETAILED LAB SYLLABUS:

Lab Prerequisite: Any programming language, Knowledge on Operating system principles

Hardware Requirements: 2GB RAM,PC i3 processor and above

Software Requirements: C, IDE/Compiler (Geany). Linux Operating System

Sr. No.	Detailed Lab/Tutorial Description
1	Implementation of File handling program to check whether entered input is Mnemonic or Pseudo opcode or symbol.
2	Design and Development of Simple Macro Processor
3	Implementation of Lexical analysis phase of compilers
4	Implementation of Intermediate code generation phase of compilers
5	Implementation of code generation phase of compilers
6	Explore usage of basic and advanced Linux Commands
7	Explore the file and process management system calls.
8	Create a child process in Linux using the fork system call. From the child process obtain the process ID of both child and parent by using getpid and getppid system call.
9	Write a program to demonstrate the concept of non-preemptive and preemptive scheduling algorithms.
10	Write a program in C demonstrate the concept of page replacement policies

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to the number of hours assigned to each module.

Lab Assessment:

1.Term work Assessment:

Term work should consist of 10 experiments. Journal must include at least 2 assignments on content of theory and practical of "System Software & Operating Systems".The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks).

Text Books:

1. D. M Dhamdhere: Systems programming, Tata McGraw Hill.
2. A. V. Aho, R. Shethi, Monica Lam , J.D. Ulman : Compilers Principles, Techniques and Tools, Pearson Education , Second Edition.
3. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014, ISBN-10: 0133805913 • ISBN-13: 9780133805918 .
4. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons , Inc., 9th Edition, 2016, ISBN 978-81-265-5427-0

References:

1. Compiler construction : principles and practices , Kenneth C.Louden ,CENGAGE Learning.
2. System software : An introduction to system programming , Leland L. Beck, Pearson.
3. Principles of Operating Systems, Naresh Chauhan, First Edition , Oxford university press.
4. Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rd Edition.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 292	Programming Lab II(Web Programming)	-	$1^{\#}$+2	--	-	--	--	01

$1^{\#}$ to be taken class wise

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment (Review)			End Sem. Exam				
		1(10)	2(10)	Average					
EC 292	Programming Lab II(Web Programming)	-	-	-	-	25	--	25	50

Course Objectives:

1. To make students familiar with Web Fundamentals, Programming Languages for the Web.
2. To make students familiar with HTML Basics, the working environment.
3. To develop the ability to logically plan and develop web pages.
4. To learn to write, test, and debug web pages using HTML and JavaScript.

Course Outcomes: Upon successful completion of the course students will be able to

1. Understand Basics of JavaScript.
2. Support the development of web pages.
3. Programming the browser and forms with JavaScript.
4. Create forms and check for data accuracy.
5. Use JavaScript system objects.
6. Analyse the impact of solutions in societal and environmental context for sustainable development.
7. Use standard norms of engineering practices.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
I	HTML, CSS and JavaScript	Basic of HTML: Web System architecture-1,2,3 and n tier architecture, URL, domain name system, overview of HTTP and FTP, Cross browser compatibility issues, W3C Validators.	8

		Formatting and Fonts, Anchors, images, lists, tables, frames and forms. Introduction to CSS: Evolution of CSS, Syntax of CSS, Exploring CSS Selectors, Inserting CSS in an HTML Document, Defining Inheritance in CSS. Introduction to JavaScript: JavaScript language constructs, Objects in JavaScript- Built in, Browser objects and DOM objects, event handling, form validation and cookies.	
II	Responsive Web Design with CSS3	Native Audio and Video, Geo-location, CSS3 and Responsive Web Design: Media Queries, Selectors, Typography and color Modes, CSS3 Transitions, Transformations and Animations.	4
III	Rich Internet Application (RIA)	Characteristics of RIA, Introduction to AJAX :AJAX design basics, AJAX vs Traditional Approach, , Rich User Interface using Ajax. Working with JavaScript Object Notation(JSON): Create data in JSON format, JSON Parser .	4
IV	Server Side Programming: PHP	Introduction to PHP- Data types, control structures, built in functions, Building web applications using PHP- tracking users, PHP and Mysql database connectivity with example. Introduction to PHP Framework: Laravel.	5
V	Python Web Framework: Flask	Introduction, Web Frameworks, Introduction to Flask, Creating flask application, “Hello World” Application.	2
VI	Web Extensions	Introduction to XML, Introducing XSL, XSLT.	3

Text Books:

1. HTML 5 Black Book: Kogent Learning solutions
2. “Learning PHP 5”, David Sklar, O’Reilly Publication
3. Rich Internet Application AJAX and Beyond WROX press
4. Responsive Web Design with HTML5 and CSS3, Ben Frain, PACKT Publication

References:

1. “Web Technologies: Black Book”, Dreamtech publication
2. HTML5 Cookbook, By Christopher Schmitt, Kyle Simpson, O'Reilly Media

Web Links:

HTML

- https://www.w3schools.com/html/default.asp
- https://developer.mozilla.org/en-US/docs/Learn/HTML

CSS ● https://www.w3schools.com/css/default.asp ● https://developer.mozilla.org/en-US/docs/Learn/CSS
JavaScript ● https://www.w3schools.com/js/default.asp ● https://developer.mozilla.org/en-US/docs/Web/JavaScript

Detailed Lab Syllabus:

Prerequisite: Basic programming skills.

Hardware Requirements:

PC With following Configuration

1. Intel Core i3/i5/i7 Processor
2. 4 GB RAM
3. 500 GB Hard Disk

Software Requirements:

1. Windows or Linux Desktop OS
2. HTML5 compatible web browsers(Chrome, Opera, Firefox, Safari etc)
3. HTML, CSS editors like Dreamweaver, Notepad++ etc.
4. Netbeans or Eclipse IDE
5. XAMPP

Suggested list of Experiments		
I	HTML	Write five HTML programs showing use of: Links, images, table, lists, forms.
II	CSS and JavaScript	Create a HTML document and style it using three ways of applying CSS. Create a HTML document applying following CSS styles: color, background, border, margins, padding, text alignment, font, Write a program for form validation using JavaScript.
III	Responsive web design and RIA	Create a HTML document to display audio and video files. Create a HTML showing use of canvas. Create a HTML showing use of media queries. Write a program using geolocation api. Write a program showing use of AJAX.
IV	PHP	Write five PHP programs showing use of: server side form validation, session tracking, MySQL connection.
V	Flask	Any two programs creating basic flask applications.
VI	XML	Write a program to create any XML document. Write a program to display a XML document using XSLT.

Text Books:

1. Responsive Web Design by Example Beginner's Guide by Thoriq Firdaus, PACKT
2. Responsive Web Design with HTML5 and CSS3 PACKT
3. Professional Rich Internet Application : AJAX and Beyond WROX press

References:

1. Laravel: Up and Running, By Matt Stauffer O'Reilly Media.
2. Advanced Internet Technologies (includes practicals) ,Deven Shah ,Dreamtech publication
3. Flask Web Development: Developing Web Applications with Python, O′Reilly; 2nd edition (16 March 2018).

Practical Assessment: A Practical / Oral exam will be held based on the above syllabus. The final certification and acceptance of TW ensures the satisfactory performance of laboratory work and minimum passing in the TW.

● **Term Work:** The Term work shall consist of at least 08 experiments based on the above list.The term work Journal must include Mini Project based on the content of the syllabus (Group of 3-4 students).

Distribution of Term work marks shall be as below:

● Term Work Marks - Total 25-Marks: Experiments: 10 Marks, Attendance: 05 Marks, Mini Project: 10 Marks

Program Structure for
Bachelor of Technology in Electronics & Computer Science

Semester V

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract/ Tuts	Theory	Pract/ Tuts	Total
EC 301	Signals & Systems	TL	3	1	3	1	4
EC 302	Computer Networks	TL	3	2	3	1	4
EC 303	Professional Communication & Ethics II	TC	1	2	1	1	2
EC 304	Software Engineering	TL	3	2	3	1	4
EC 305	Programming Lab III (R-Programming)	TP	-	1#+2	-	1	1
EC 3xx	Department Level Optional Course I	TL	3	2	3	1	4
EC 3xx	Department Level Optional Course II	TL	3	2	3	1	4
Total			**18+1#**	**11**	**18**	**6**	**24**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
EC 301	Signals & Systems	40	40	40	60	2	25	-	125
EC 302	Computer Networks	40	40	40	60	2	25	25	150
EC 303	Professional Communication & Ethics II	-	-	-	-	-	50	-	50
EC 304	Software Engineering	40	40	40	60	2	25	25	150
EC 305	Programming Lab III (R-Programming)	-	-	-	-	-	25	25	50
EC 3xx	Department Level Optional Course I	40	40	40	60	2	25	25	150
EC 3xx	Department Level Optional Course II	40	40	40	60	2	25	25	150
Total									**875**

1# to be taken class wise

T- Theory , L- Lab , P-Programming, C- Communication

Course Code	Department Level Optional Course (DLOC) I	Group 1 Specializations
EC 306	Artificial Intelligence	AIML
EC 307	Advanced Database Management Systems + DWM	Data Analytics
EC 308	Advanced Operating System	High Performance Computing
EC 309	Embedded System Design & Basics of IOT	IOT

Course Code	Department Level Optional Course (DLOC) II	Group 2 Specializations
EC 310	Foundations of Robotics	Robotics
EC 311	Cryptography and System Security	System Security
EC 312	Mobile & Distributed Computing	Cloud Computing
EC 313	Integrated Circuit Technology	VLSI Design

Program Structure for
Bachelor of Technology in Electronics & Computer Science

Semester VI

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Pract/ Tuts	Theory	Pract/ Tuts	Total
EC 314	Image Processing & Machine Vision	TLP	3	2	3	1	4
EC 315	Computer Organization & Architecture	T	3	-	3	-	3
EC 316	Instrumentation & Control System	T	3	-	3	-	3
EC 3xx	Department Level Optional Course III	TL	3	2	3	1	4
EC 3xx	Department Level Optional Course IV	TL	3	2	3	1	4
IL 3xx	Institute Level Optional Course I	T	3	-	3	-	3
EC 392	Project A (Literature Survey & Problem Formulation)	LPC	-	6	-	3	3
Total			**16**	**14**	**16**	**7**	**23**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
EC 314	Image Processing & Machine Vision	40	40	40	60	2	25	25	150
EC 315	Computer Organization & Architecture	40	40	40	60	2	-	-	100
EC 316	Instrumentation & Control System	40	40	40	60	2	-	-	100
EC 3xx	Department Level Optional Course III	40	40	40	60	2	25	25	150
EC 3xx	Department Level Optional Course IV	40	40	40	60	2	25	25	150
IL 3xx	Institute Level Optional Course I	40	40	40	60	2	-	-	100
EC 392	Project A (Literature Survey & Problem Formulation)	-	-	-	-	-	50	50	100
Total									**800**

T- Theory , L- Lab , P-Programming, C- Communication

Course Code	Department Level Optional Course (DLOC) III	Group 1 Specializations
EC 317	Machine Learning	AIML
EC 318	Big Data Analytics	Data Analytics
EC 319	Parallel Computing Architecture	High Performance Computing
EC 320	Wireless Networks	IOT
Course Code	**Department Level Optional Course (DLOC) IV**	**Group 2 Specializations**
EC 321	Advanced Robotics	Robotics
EC 322	Advanced Network Theory	System Security
EC 323	Cloud Computing	Cloud Computing
EC 324	Advanced VLSI Design	VLSI Design

Course Code	Institute Level Optional Course (ILOC) I	Specializations
IL 360	Entrepreneurship	Entrepreneurship Development and Management
IL 361	E- Commerce and E-Business	Business Management
IL 362	Research Methodology	IP Management
IL 363	Introduction to Bioengineering	Bioengineering
IL 364	Biomedical Instrumentation	Bio Instrumentation
IL 365	Design of Experiments	Engineering Design
IL 366	Design for Sustainability	Sustainable Technologies
IL 367	Political Science	Contemporary Studies
IL 368	Visual Art	Art and Journalism
IL 369	Modern Day Sensor Physics	Applied Science
IL 370	Energy Audit and Management	Green Technologies
IL 371	Maintenance of Electronics Equipment	Maintenance Engineering
IL 372	Cooking and Nutrition	Life Skills
IL 373	Environmental Management	Environment & Safety

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(Semester V)

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 301	Signals and Systems	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 301	Signals and Systems	40	40	40	60	25	--	--	125

Course Objectives:

1. To identify, classify and analyze various types of signals and systems.
2. To analyze time Domain analysis of continuous and discrete time signals and systems.
3. To Analyze the continuous and discrete time LTI signals and systems in frequency domain using Fourier Transform.
4. To analyze, formulate and solve problems on frequency domain analysis of continuous time systems using Laplace Transform.
5. To analyze, formulate and solve problems on frequency domain analysis of discrete time systems using Z- Transform.
6. To provide foundation of signal and system concepts to areas like communication, control and comprehend applications of signal processing in communication systems.

Course Outcomes: Upon successful completion students will be able to

1. Classify and analyze various types of signals and systems.
2. Apply the concept of convolution integral and convolution sum in signals and systems.
3. Analyze the continuous and discrete time signals and systems in frequency domain using Fourier Transform
4. Analyze, formulate and solve problems on frequency domain analysis of continuous time systems using Laplace Transform.
5. Analyze, formulate and solve problems on frequency domain analysis of continuous time systems using Z Transform.
6. Understand and apply the concept of FIR and IIR systems.

Prerequisite: Engineering Mathematics III

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs
1.	**Introduction of Continuous and Discrete Time Signals and systems:**	Introduction to Signals: Definition of Signals , Representation of continuous time signals and discrete time signals, Sampling theorem, sampling of continuous time signals Basic Elementary signals , Arithmetic operations on the signals- Time Shifting, Time scaling,	07

		Time Reversal of signals Classification of Continuous time signals and Discrete time signal Introduction to Systems: Definition of Systems , Classification of Continuous time systems and Discrete time systems, Applications of Signals and Systems	
2.	**Time domain analysis of continuous time and discrete time systems**	Linear Time Invariant (LTI) systems, impulse response, step response, Convolution integral and Convolution sum for analysis of LTI systems, properties of convolution integral/sum, Correlation of Signals: Auto-correlation and Cross correlation of Continuous time signals (Numericals not expected) and Discrete time signal.	06
3.	**Fourier Analysis of Continuous and Discrete Time Signals and Systems**	Fourier transform of periodic and non-periodic functions, Properties of Fourier Transform, Inverse Fourier Transform, Frequency Response: computation of Magnitude and Phase Response, Limitations of Fourier Transform	07
4.	**Frequency domain analysis of continuous time system using Laplace transform**	Definition of Laplace Transform (LT), Region of Convergence (ROC), Properties of Laplace transform, Inverse Laplace transform. Analysis of continuous time LTI systems using Laplace Transform: Causality and stability of systems in s-domain, Total Response of the system, Relation between LT and FT	07
5.	**Frequency domain analysis of discrete time system using Z-transform**	Definition of unilateral and bilateral Z Transform, Region of Convergence (ROC),Properties of Z-Transform, Inverse Z-Transform. Analysis and characterization of the LTI system using Z transform: Transfer Function and difference equation, plotting Poles and Zeros of a transfer function, impulse and step response, causality, stability, Total response of a system. Relation between Laplace Transform and Z–Transform, Relation between ZT and FT	08
6.	**FIR and IIR systems**	Concept of finite impulse response systems and infinite impulse response systems, Linear Phase FIR systems. IIR Realization structures of LTI Discrete time system: Direct form –I and direct form II.	04

SR NO	List of Tutorials
01	Tutorial No 1 : Mathematical Operations on Continuous and Discrete time signals
02	Tutorial No 2 : Classifications of Continuous and Discrete time signals and systems
03	Tutorial No 3 : Convolution and Correlation of Continuous and Discrete time signals
04	Tutorial No 4 : Sums on properties of Continuous time and Discrete time Fourier Transform
05	Tutorial No 5 : Magnitude and Phase Response Sums of Fourier transform
06	Tutorial No 6 : ROC , properties of Laplace transform

07	Tutorial No 7 : Inverse Laplace transform and total response
08	Tutorial No 8 : ROC and properties of Z transform
09	Tutorial No 9 : Inverse Z transform and total response
10	Tutorial No 10 : FIR Realization structures 1. Direct form –I 2. Direct form II

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

Term Work Assessment:

- At least 08 tutorials covering the entire syllabus must be conducted.
- The tutorials should include easy, medium and high level thinking questions. Term work assessment must be based on the overall performance of the student with every tutorial graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme.

Text Books:

1. NagoorKani, “Signals and Systems”, Tata McGraw Hill, Third Edition, 2011.
2. Tarun Kumar Rawat, “Signals and Systems”, Oxford University Press 2016.
3. Simon Haykin and Barry Van Veen, “Signals and Systems”, John Wiley and Sons, Second Edition, 2004.

References:

1. Hwei. P Hsu, “Signals and Systems”, Tata McGraw Hill, Third edition, 2010
2. Rodger E Ziemer, William H. Tranter and D. Ronald Fannin, “Signals and Systems”, Pearson Education, Fourth Edition 2009.
3. Alan V. Oppenheim, Alan S. Willsky and S. Hamid Nawab, “Signals and Systems”, Prentice-Hall of India, Second Edition, 2002.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 302	Computer Networks	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 302	Computer Networks	40	40	40	60	25	--	25	150

Course Objectives:

1. To introduce networking architecture and protocols.
2. To understand the various layers and protocols in the TCP/IP model.
3. To recognize different addressing schemes, connecting devices and routing protocols.
4. To select the required protocol from the application layer protocols.

Course Outcomes: Upon successful completion students will be able to

1. Demonstrate knowledge of networking concepts and necessary protocols.
2. Analyze the various layering structures of Physical Layer.
3. Evaluate various addressing schemes and connecting devices of Data Link Layer.
4. Analyze the various layering structures and routing protocols of Network Layer.
5. Understand the networking concepts and required protocols of Transport Layer.
6. Appreciate the various protocols in application layer.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs
1.	**Introduction to Network Architectures, Protocol Layers, and Service models**	Uses of computer networks. Topologies, LAN, MAN, WAN, Network topologies, Addressing : Physical / Logical /Port addressing, Protocols and Standards. Protocol Architecture: Need of layered protocol architecture, Layers details of OSI, , Protocol Layers and Their Service Models TCP/IP Model: Protocol suite, Comparison of OSI and TCP/IP	06

2.	**Physical Layer**	Transmission Media: Guided media like Coaxial, fiber, twisted pair, and Wireless media, Transmission Impairments. Interconnecting Devices: Hub, Bridges, Switches, Router, Gateway Data communication model : DTE, DCE, RS-232D Interface , Null Modem , Multiplexing : FDM , Synchronous TDM , Statistical TDM, ADSL , xDSL, Cable modem	09
3.	**Data Link Control**	Data link services: Framing, Flow control, Error control, ARQ methods, Piggybacking High Level Data Link Control (HDLC): HDLC configurations, Frame formats, Typical frame exchanges. Medium Access Control Protocols: ALOHA, Slotted ALOHA, CSMA, CSMA/CD	08
4.	**Network Layer**	Switching: Switched Communication networks, Circuit switching Networks, , Circuit switching Concepts, Packet switching Principles: Virtual circuit switching and Datagram switching Routing in Packet Switching Networks: Characteristics, Routing strategies, Link state Routing versus Distance vector Routing. Least-Cost Routing Algorithms: Dijkstra's Algorithm, Bellman Ford Algorithm. Internet Protocol: Principles of Internetworking: Requirements, Connectionless Operation Internet Protocol Operation: IP packet, IP addressing, subnet addressing , IPv4, ICMP, ARP, RARP IPv6 (IPv6 Datagram format, comparison with IPv4, and transition from IPv4 to IPv6)	04
5.	**Transport Layer**	Connection –oriented Transport Protocol Mechanisms: Transmission Control Protocol (TCP): TCP Services, TCP Header format, TCP three way handshake, TCP state transition diagram. User datagram Protocol (UDP) Congestion: Effects of congestion, Congestion control methods, Traffic management, Congestion control in Packet switching Networks	08
6.	**Application Layer**	Application layer Protocols : HTTP, FTP, DNS,SMTP, SSH	04

DETAILED LAB SYLLABUS:

Hardware Requirements: Switches Routers, Cables Crimping Tools

Software Requirements: Cisco PacketTRacer, NS 2

Sr. No.	Detailed Lab Description
1	To study basic networking commands.
2	To perform crimping and set up a LAN connection.
3	To configure a network using Distance Vector Routing Protocol-RIP using Cisco Packet Tracer.
4	Configure a network using Path Vector Routing Protocol- BGP using Cisco Packet Tracer
5	To perform subnetting using Cisco Packet Tracer.
6	To study about NS2 simulator in detail.
7	Creating two nodes and set up a LAN connection using NSG 2.1
8	To Simulate and to study stop and Wait protocol using NS 2.1
9	To Simulate Sliding Window protocol using NS 2.1

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

1. Term Work Assessment:

- At least 08 experiments covering entire syllabus and one mini project should be set to have well predefined inference and conclusion.
- The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme.

2. Oral/Viva Assessment:

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus. Students are encouraged to share their experiments/mini project codes on online repository.

Text Books:

1. Data Communications and Networking – Behrouz A. Forouzan, Fourth Edition TMH,2006.
2. Computer Networks -Andrew S Tanenbaum, 4th Edition, Pearson Education..
3. Alberto Leon Garcia, “Communication Networks” , McGraw Hill Education, Second Edition.
4. J. F. Kurose and K. W. Ross ,”Computer Networking: A Top-Down Approach”, Addison Wesley, 5th Edition

References:

1. An Engineering Approach to Computer Networks-S.Keshav,2nd Edition, Pearson Education.
2. Understanding communications and Networks,3rd Edition, W. A. Shay, Cengage Learning T L Singal “wireless communications”, Mc Graw Hill Education
3. Computer and Communication Networks, Nader F. Mir, Pearson Education.
4. Computer Networking: A Top-Down Approach Featuring the Internet, James F.Kurose,K.W.Ross,3rd Edition, Pearson Education.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 303	Professional Communication & Ethics II	01	--	02	01	--	01	02

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 303	Professional Communication & Ethics II	--	--	--	--	50	--	--	50

Course Objectives:

1. To enable learners to formulate professional documents in a structured manner that meets the corporate requirements.
2. To provide an appropriate environment, opportunity and scope to the learners to acquire skills such as collaboration, leadership qualities, assertiveness etc. necessary for group discussion and team building.
3. Train learners in effective presentation, research, organisational, creative and critical thinking skills necessary for global and industrial set up.
4. To promote the importance of having an impressive personality that will enhance self-esteem, build self-confidence and sensitize the learners in appropriate behaviour.
5. To prepare the learners for campus placement, employability and competitive examination required for lifelong learning.
6. Fostering skills in technology-mediated social and professional communications and collaborative learning.

Course Outcomes: Upon successful completion of the course students will be able to

1. Acquire the writing skills necessary for professional documents to meet the corporate requirement.
2. Demonstrate the skills required for self-improvement and effective communication.
3. Develop self-confidence and behave professionally.
4. Perform successfully in competitive exams like GRE, CET and TOEFL
5. Illustrate effective presentation, research, organisational, creative and critical skills necessary for lifelong learning.
6. Acquire the skills necessary to communicate using blogs, LinkedIn, You Tube, Facebook and Twitter.

Prerequisite: Possess the necessary language skills.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs
1.	**Structure, Style and Language of Report Writing**	1.1 Introducing the purpose, aim, objective and format of report 1.2 Literature review-ability to gather and analyse information from different sources and summarize. Specific emphasis on plagiarism, use of quotation marks appropriately. 1.3 Research Methodology 1.4 Presenting data-figures, diagrams and labelling 1.5 How and why to write discussion 1.6 Citing and referencing- IEEE format 1.7 Writing an abstract	06
2.	**Practicing Critical Thinking**	2.1 Framing the situation 2.2 Gathering information from different sources and comparing them 2.3 Create/write an autonomous research paper	04
3.	**Oral Skills for Employability**	3.1 Group Discussion- with special reference to leadership qualities, assertiveness, analysing the topic, developing different perspectives, introducing and concluding the discussion. 3.2 Interview-with special reference to introducing oneself and answering questions with confidence. 3.3 Presentation Skills-with special reference to preparing slides, dress code, non-verbal communication including paralinguistic features, introduction and conclusion.	06
4.	**Personality Development And Social Etiquettes**	4.1. Personality Development ● Improving self-awareness- analysing our own experiences, looking at ourselves through the eyes of others ● Knowing and Building our own identity ● Discovering and Developing our talents ● Teamwork/collaboration 4.2. Social Etiquettes ● Formal Dining Etiquettes ● Cubicle Etiquettes ● Learning Accountability and Accepting Criticism ● Demonstrating Flexibility and Cooperation ● Selecting Effective Communication Channels	03
5.	**Content writing**	5.1Writing Resume and statement of purpose 5.2 Research Skills 5.3 Organisational skills 5.4 Creative Writing- Blog posts, Web pages etc.	04
6.	**Communication through Social Media**	6.1 Introduction to Social Media and its relevance in communication 6.2 Benefits of social media in communication	03

		6.3 Impact of social media in human communication (positive and negative) 6.4 Responsibility in Using Social Media Showing Empathy and Respect	

DETAILED LAB SYLLABUS:

Sr. No.	Details of Assignments	Details of Activities	Hrs
I	Written assignment on Literature Review 20 page report on technical topic-(to be included as part of term work)	Sample IEEE papers to be shared with students and train them to identify contributions of each author. These contributions can then be written in the format required in journals.	4
II	Written assignment on summarizing a technical proposal 4 page technical proposal (to be included as part of term work)	Example of summarizing techniques to be demonstrated.	4
III	Oral Skills for Employability to be included in term work.	Role play and mock interviews Mock group discussion Mock presentation	2 2 2
IV	Written Assignment on Documentation of Business Meeting	Mock meetings	2
V	Written Assignment on Resume writing/Statement of Purpose.	NA	2
VI	Written Assignment on Blog Posts	NA	2

Term work Assessment:

Term work will consist of-

1. Assignments-10 marks
2. Group Discussion-10 marks
3. Interviews-5marks

4. Report- 5 marks
5. Technical Proposal- 5 marks
6. Attendance -5 marks
7. Presentation- 10 mark
8. The final certification and acceptance of term work ensures that satisfactory performance in class activities and assignments is met by the student.

Text Books:

1. Virendra Singh Nirban, Krishna Mohan, RC Sharma, Business Correspondence and Report
   Writing.
2. Raman Meenakshi & Sharma Sangeeta, Technical Communication Principles and Practice,
   Second edition, Oxford University Press.
3. Ann Handley Everybody Writes: Your Go-To Guide to Creating Ridiculously Good Content, Wiley.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical/ Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 304	Software Engineering	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 304	Software Engineering	40	40	40	60	25	--	25	150

Course Objectives:

1. To demonstrate and evaluate real time projects with respect to software engineering principles.
2. To provide the knowledge of software engineering discipline.
3. To apply analysis, design and testing principles to software project development.
4. To design and develop different software projects.
5. To provide knowledge about gathering requirements, analysing them and to develop prototypes.

Course Outcomes: Upon successful completion of the course students will be able to

1. Understand and demonstrate basic knowledge in software engineering.
2. Identify requirements, analyze and prepare models.
3. Plan, schedule and track the progress of the projects.
4. Design & develop the software projects.
5. Identify risks, manage the change to assure quality in software projects.
6. Apply testing principles on software project and understand the maintenance concepts.

Prerequisite:

1. Concepts of Object Oriented Programming & Methodology
2. Knowledge of developing applications with front end & back end connectivity.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs
1.	**Introduction to software Engineering process paradigms**	● "Generic view of Process, Software Process, Capability Maturity Model (CMM)" ● Prescriptive Models: Waterfall Model, Incremental-RAD Model	06

	and Agile methodology	● "Evolutionary Process Model Prototyping, Spiral and Concurrent Development Model" ● Specialized Models: Component based, Aspect Oriented Development ● Agile Methodology, Agility Principles, Scrum and Extreme Programming & Kanban model	
2.	**Requirement Elicitation and Software Project estimation.**	● Requirement, Types of Requirements, Requirement gathering, Requirement Engineering Task ● Identifying Stakeholders, Multiple viewpoints, SRS (Software Requirement Specification) ● Project Estimation, LOC based, FP based and Use case based estimation ● Management Spectrum, 4Ps (people, product and process), Process &Project metrics.	08
3.	**Project Scheduling ,Monitoring & Risk Management**	● Project scheduling: Defining a Task Set for the Software Project ● Timeline charts, Tracking the Schedule, Earned Value Analysis ● Risk Identification, Risk Assessment, ● Risk Projection, RMMM	06
4.	**Software Analysis and design**	● "Introduction of Analysis elements, Scenario based, Flow based, ● behavior and class based Design Concepts" ● Classification of UML ● Developing UML Diagrams ● Requirement Model – Scenario-based model, Class-based model, Behavioral model. ● Principles, Architecture Design, .Coupling vs. Cohesion ● Post Development models- Component Level Design, System Level Design, ● Types of User Interface Design & develop an UI Design	07
5.	**Software Configuration management and quality Assurance**	● SCM Process ● Version control management ● Re- engineering & Reverse Engineering ● SCM repositories ● Software Quality Assurance Task and Plan, ● Software Reliability, Formal Technical Review (FTR), Walkthrough ● McCall's Quality Factor	05
6.	**Software testing and Web Engineering**	● Purpose of STLC ● Strategic Approach of Testing , White-Box, Grey-Box and Black Box testing and their types, Boundary-value Analusis, Path Testing- Calculate	07

		Cyclomatic Complexity, Equivalence class partitioning ● Types of Software Testing – Manual Testing, Automated Testing, Object-oriented Testing approach, Derive a Test case ● Importance of Web Engineering ● Web project planning and management ● Web-based System ,Major Differences between Web Applications and Conventional Software ● Elements of Web Site Construction	

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Text Books:

1. Roger Pressman, ―Software Engineering: A Practitioner‘s Approach", McGraw-Hill Publications (7th edition)
2. Ian Sommerville, ―Software Engineering‖, Pearson Education (9th edition)
3. Ali Behfrooz and Fredeick J. Hudson, "Software Engineering Fundamentals", Oxford University Press

References:

1. Pankaj Jalote, "An integrated approach to Software Engineering", Springer/Narosa
2. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India
3. Ugrasen Suman, ―Software Engineering – Concepts and Practices‖, Cengage Learning
4. Jibitesh Mishra and Ashok Mohanty, ―Software Engineering‖, Pearson

DETAILED LAB SYLLABUS:

Lab Prerequisite: Object Oriented Programming with Java , Python Programming

Suggested List of Experiments - Assign the case study/project as detail statement of problem to a group of two/three students. Laboratory work will be based on course syllabus with minimum 08 experiments. Open source computer-aided software engineering (CASE) tools can be used for performing the experiment.

Sr. No.	Title of Experiment
1	Application of at least two traditional process models.

2	Application of the Agile process models.
3	Preparation of software requirement specification (SRS) document in IEEE format.
4	Structured data flow analysis.
5	Use of metrics to estimate the cost.
6	Scheduling & tracking of the project.
7	Write test cases for black box testing.
8	Write test cases for white box testing.
9	Preparation of Risk Mitigation, Monitoring and Management Plan (RMMM).
10	Version controlling of the project.

Term Work:

1.Term work should consist of 08 experiments.

2.Journal must include at least 2 assignments on content of theory and practical of "Software Engineering".

3.The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.

Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)

Oral/Viva Assessment:**:-** Oral Exams should be conducted based on syllabus and practicals conducted.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical/ Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 305	Programming Lab III (R-Programming)	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
EC 305	Programming Lab III (R-Programming)	--	--	--	--	25	--	25	50

Lab Prerequisite:
Basic statistics

Lab Objectives:
1: Install and configure R and RStudio for data analysis tasks.
2: Identify and use basic data types and perform operations in R.
3: Utilize various data structures such as vectors, matrices, lists, and data frames.
4: Apply programming concepts in R including loops, conditionals, and functions.
5: Create visualizations using base R graphics and ggplot2 for data exploration.
6: Execute a mini project involving data extraction, analysis, and visualization using R.

Lab Outcomes:
CO1: Demonstrate the installation and basic functionality of R and RStudio.
CO2: Use various data types and perform basic operations in R.
CO3: Implement data structures such as vectors, matrices, lists, and data frames.
CO4: Develop R scripts using grouping, loops, conditionals, and custom functions.
CO5: Generate graphical representations of data using base R and ggplot2.
CO6: Conduct a comprehensive data analysis project, including data extraction, EDA, and visualization.

SN	Detailed Lab/Tutorial Description	Hrs.
1	Introduction: Installing R on personal machines. installing R and RStudio. The basic functionality of R will be demonstrated , Variable types in R. Numeric variables, strings and factors.,Accessing the help system. Retrieving R packages.,Basic data types and operations: numbers, characters and composites.Data entry and exporting dat	3
2	Data structures: vectors, matrices, lists and data frames	4
3	R as a programming language: Grouping, loops and conditional execution, Functions Exploratory data analysisRange, summary, mean, variance, median, standard deviation, histogram, box plot, scatterplot	5
4	Graphics in R: Graphics and tables Working with larger datasets Introduction to ggplot2 graphics	5
5	Regression and correlation: Simple regression and correlation,Multiple regression ,Tabular data and analysis of Categorical data	5
6	R for Data Science (Mini Project) Implementing a mini project using any data mining or big data analytics algorithm in R Extracting data from a large Dataset,Exploratory analysis,Visualizations and interpretation of results	4

Laboratory Assessment:

Term Work:

Term Work shall consist of experiments on above guidelines/syllabus. Also Term work Journal
must include at least 2 assignments.
25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5Marks (Attendance)

End Semester Practical/Oral Examination:

Pair of Internal and External Examiner should conduct practical/viva based on contents.
Distribution of marks for practical/viva examination shall be as follows:
Practical Examination: 15 Marks Oral Examination: 10 Mark

Text Books:

1. URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf (Online Resources)
2. R Cookbook Paperback – 2011 by Teetor Paul O Reilly Publications
3. Beginning R: The Statistical Programming Language by Dr. Mark Gardener, Wiley Publications
4. R Programming For Dummies by Joris Meys Andrie De Vries, Wiley Publications

References:

1. Hands-On Programming with R by Grolemund, O Reilly Publications
2. R for Everyone: Advanced Analytics and Graphics, 1e by Lander, Pearson Ltd.
3. R for Data Science Learning Dan Toomey December 2014 Pack

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 306	Artificial Intelligence	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 306	Artificial Intelligence	40	40	40	60	25	--	25	150

Course Objectives:

1. To gain perspective of AI and its foundations.
2. To study different agent architectures and properties of the environment.
3. To understand the basic principles of AI towards problem solving, inference, perception, knowledge representation, and learning.
4. To investigate probabilistic reasoning under uncertain and incomplete information.
5. To explore the current scope, potential, limitations, and implications of intelligent systems.

Course Outcomes: Upon successful completion of the course students will be able to:

1. Identify the characteristics of the environment and differentiate between various agent architectures.
2. Apply the most suitable search strategy to design problem solving agents.
3. Represent a natural language description of statements in logic and apply the inference rules to design Knowledge Based agents.
4. Apply a probabilistic model for reasoning under uncertainty.
5. Comprehend various learning techniques.
6. Ability to design and develop AI applications in real world scenarios.

Prerequisite: Discrete Mathematics, Data Structures

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1.	**Introduction to Artificial Intelligence**	1.1: Introduction, History of Artificial Intelligence, Intelligent Systems: Categorization of Intelligent System,	4

		Components of AI Program, Foundations of AI, Sub-areas of AI, Applications of AI, Current trends in AI.	
2.	**Intelligent Agents**	2.1: Agents and Environments, The concept of rationality, The nature of environment, The structure of Agents, Types of Agents, Learning Agent. 2.2: Solving problem by Searching: Problem Solving Agent, Formulating Problems, Example Problems.	4
3.	**Problem solving**	3.1: Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Methods: Greedy best first Search, A* Search, Memory bounded heuristic Search. 3.2: Local Search Algorithms and Optimization Problems: Hill climbing search Simulated annealing, Genetic algorithms. 3.3: Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning	10
4.	**Knowledge and Reasoning**	4.1: Knowledge based Agents, Brief Overview of propositional logic, First Order Logic: Syntax and Semantic, Inference in FOL, Forward chaining, backward Chaining. 4.2: Knowledge Engineering in First-Order Logic, Unification, Resolution 4.3: Uncertain Knowledge and Reasoning: Uncertainty, Representing knowledge in an uncertain domain, The semantics of belief network, Simple Inference in belief network	12
5.	**Planning and Learning**	5.1: The planning problem, Planning with state space search, Partial order planning, Hierarchical planning, Conditional Planning. 5.2: Learning: Forms of Learning, Theory of Learning, PAC learning. Introduction to statistical learning (Introduction only) Introduction to reinforcement learning: Learning from Rewards, Passive Reinforcement Learning, Active reinforcement Learning	5
6.	**Applications of AI**	A. Introduction to NLP- Language models, Grammars, Parsing B. Robotics - Robots, Robot hardware C. AI applications in Healthcare, Retail, Banking	4

DETAILED LAB SYLLABUS:

Lab Prerequisite: Discrete Mathematics, Data Structure
Suggested List of Experiments:

Sr. No.	Title of the experiment
1	Provide the PEAS description and TASK Environment for a given AI problem.
2	Identify suitable Agent Architecture for the problem

3	Write simple programs using PROLOG as an AI programming Language
4	Implement any one of the Uninformed search techniques
5	Implement any one of the Informed search techniques e.g. A-Star algorithm for 8 puzzle problem
6	Implement adversarial search using min-max algorithm.
7	Implement any one of the Local Search techniques. e.g. Hill Climbing, Simulated Annealing, Genetic algorithm
8	Prove the goal sentence from the following set of statements in FOPL by applying forward, backward and resolution inference algorithms.
9	Create a Bayesian Network for the given Problem Statement and draw inferences from it. (You can use any Belief and Decision Networks Tool for modeling Bayesian Networks)
10	Implement a Planning Agent
11	Design a prototype of an expert system
12	Case study of any existing successful AI system

Theory Assessments:

1. **Internal Assessment:** Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.
2. **End Sem Theory Examination:**
   - Question paper will consist of 4 questions, each carrying 20 marks.
   - Total 3 questions need to be solved.
   - Q.1 will be compulsory, based on the entire syllabus.
   - Remaining questions will be randomly selected from all the modules.
   - Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessment:

1. **Termwork Assessment:** Term Work shall consist of at least 8 to 10 experiments based on the above list. Also Term work Journal must include at least 2 assignments. Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance). The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
2. **Oral/Viva Assessment:** An oral exam will be held based on the above syllabus.

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition" Pearson Education, 2020.
2. Saroj Kaushik, "Artificial Intelligence", Cengage Learning, First edition, 2011
3. George F Luger, "Artificial Intelligence" Low Price Edition, Fourth edition, Pearson Education.,2005

References:

1. Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.
2. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication
3. Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson Education.
4. Elaine Rich and Kevin Knight, "Artificial Intelligence", Third Edition, McGraw Hill Education,2017.
5. Ivan Bratko, ―PROLOG Programming for Artificial Intelligence‖, Pearson Education, Third Edition.
6. D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall.

Useful Links :

1. https://nptel.ac.in/courses/106105078
2. https://nptel.ac.in/courses/106105079

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 307	Advance Database Management System + Data Warehousing & Mining	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 307	Advance Database Management System + Data Warehousing & Mining	40	40	40	60	25	--	25	150

Course Objectives:

1. To provide insights into distributed database designing.
2. To specify the various approaches used for using XML and JSON technologies.
3. To apply the concepts behind the various types of NoSQL databases and utilize it for Mongodb.
4. To identify the significance of Data Warehousing and Mining.
5. To develop research interest towards advances in data mining.

Course Outcomes: Upon successful completion students will be able to

1. Design distributed database using the various techniques for query processing.
2. Organize the data using XML and JSON database for better interoperability.
3. Compare different types of NoSQL databases.
4. Formulate NoSQL queries using Mongodb.
5. Understand data warehouse fundamentals and design data warehouse with dimensional modelling and apply OLAP operations.
6. Understand data mining principles and perform Data preprocessing and Visualization.

Prerequisite: Database Management System (DBMS)

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs
1.	**Distributed Databases**	Introduction, Distributed DBMS Architecture, Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design, Distributed Transaction Management – Definition, properties, types, architecture. Distributed Query Processing - Characterization of Query Processors, Layers/ phases of query processing. Distributed Concurrency Control- Taxonomy, Locking based, Basic TO	08

		algorithm, Recovery in Distributed Databases: Failures in distributed database, 2PC and 3PC protocol.	
2.	**Data interoperability – XML and JSON**	XML Databases: Document Type Definition, XML Schema, Querying and Transformation: XPath and XQuery. Basic JSON syntax, (Java Script Object Notation),JSON data types, Stringifying and parsing the JSON for sending & receiving, JSON Object retrieval using key-value pair and JQuery, XML Vs JSON.	05
3.	**NoSQL Distribution Model**	NoSQL database concepts: NoSQL data modeling, Benefits of NoSQL, comparison between SQL and NoSQL database system. Replication and sharding, Distribution Models Consistency in distributed data, CAP theorem, Notion of ACID Vs BASE, handling Transactions, consistency and eventual consistency. Types of NoSQL databases: Key-value data store, Document database and Column Family Data store, Comparison of NoSQL databases w.r.t CAP theorem and ACID properties.	07
4.	**NoSQL using MongoDB**	NoSQL using MongoDB: Introduction to MongoDB Shell, Running the MongoDB shell, MongoDB client, Basic operations with MongoDB shell, Basic Data Types, Arrays, Embedded Documents. Querying MongoDB using find() functions, advanced queries using logical operators and sorting, simple aggregate functions, saving and updating document. MongoDB Distributed environment: Concepts of replication and horizontal scaling through sharding in MongoDB.	05
5.	**Data Warehousing Fundamentals**	Introduction to Data Warehouse, Data warehouse architecture, Data warehouse versus Data Marts, E-R Modeling versus Dimensional Modeling, Information Package Diagram, Data Warehouse Schemas; Star Schema, Snowflake Schema, Factless Fact Table, Fact Constellation Schema. Update to the dimension tables. Major steps in ETL process, OLTP versus OLAP, OLAP operations: Slice, Dice, Rollup, Drilldown and Pivot.	07
6.	**Introduction to Data Mining, Data Exploration and Data Pre-processing**	Data Mining Task Primitives, Architecture, KDD process, Issues in Data Mining, Applications of Data Mining, Data Exploration: Types of Attributes, Statistical Description of Data, Data Visualization, Data Preprocessing: Descriptive data summarization, Cleaning, Integration & transformation, Data reduction, Data Discretization and Concept hierarchy generation.	07

DETAILED LAB SYLLABUS:

Software Requirements: SQL, Java/Python, WEKA

Sr. No.	Detailed Lab Description
1	Design of a distributed database for a real life application - Fragmentation, Query Processing.
2	Simulation of Recovery methods in distributed DB.
3	Design XML schema for real life application and write queries using XPath & XQuery.
4	Implement data transfer using JSON.
5	Design a database using NoSQL model and query it.

6	Implement different operations in MongoDB.
7	One case study on building Data warehouse/Data Mart -Write Detailed Problem statement and design dimensional modelling (creation of star and snowflake schema).
8	Implementation of all dimension table and fact table based on the case study.
9	Implementation of OLAP operations: Slice, Dice, Rollup, Drilldown and Pivot based on the case study.
10	Perform data Pre-processing task and demonstrate Classification, Clustering, Association algorithm on data sets using data mining tool (WEKA/R tool).

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

1.Term work Assessment:

Term work should consist of minimum 8-10 experiments. Journal must include at least 2 assignments on content of theory and practical. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Total 25 Marks (Experiments: 15-marks, Attendance (Theory & Practical): 05-marks, Assignments: 05-marks).

2. Oral/Viva Assessment: Oral exam to be conducted by Internal & External examiners.

Text Books:

1. Korth, Siberchatz,Sudarshan, “Database System Concepts”, 6thEdition, McGraw Hill.
2. Elmasri and Navathe, “Fundamentals of Database Systems”, 5thEdition, Pearson Education.
3. Ozsu, M. Tamer, Valduriez, Patrick, “Principles of distributed database systems”,3rd Edition, Pearson Education, Inc.
4. PramodSadalge, Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Addison Wesely/ Pearson.
5. Jeff Friesen , Java XML and JSON,Second Edition, 2019, après Inc.
6. Paulraj Ponniah, “ Data Warehousing: Fundamentals for IT Professionals”, Wiley India.
7. Han, Kamber, “Data Mining Concepts and Techniques”, Morgan Kaufmann 2nd edition.

References:

1. Peter Rob and Carlos Coronel,Database Systems Design, Implementation and Management, Thomson Learning, 5thEdition.
2. Adam Fowler, NoSQL for dummies, John Wiley & Sons, Inc.
3. Shashank Tiwari, Professional NOSQL, John Willy & Sons. Inc
4. MongoDB Manual : https://docs.mongodb.com/manual.
5. Reema Theraja, "Data warehousing", Oxford University Press 2009.
6. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson Publisher 2nd edition.
7. Ian H. Witten, Eibe Frank and Mark A. Hall, "Data Mining", Morgan Kaufmann 3rd edition.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical/ Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 308	Advanced Operating System	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 308	Advanced Operating System	40	40	40	60	25	--	25	150

Course Objectives:

1. To learn the architectural differences and issues related to Advanced Operating System.
2. To learn the Unix Operating System.
3. To get a comprehensive knowledge of the distributed systems.
4. To get a comprehensive knowledge of Real time operating system.
5. To get a thorough knowledge of database operating systems.
6. To get thorough knowledge of Mobile Os and cloud operating System.

Course Outcomes: Upon successful completion of the course students will be able to

1. Apply the principles and concepts in analyzing and designing Advance Operating System.
2. Learn the Unix Operating System.
3. Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system
4. Understand a comprehensive knowledge of Real time operating system.
5. Learn knowledge of database operating systems
6. Analyze the performance and reliability of different Advanced Operating Systems.

Prerequisite: Knowledge of Operating System

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs
1.	**Introduction to Advanced operating System**	Functions of operating systems, Design approaches: layered, kernel based and virtual machine approach, types of advanced operating systems (NOS, DOS, Multiprocessor OS, Mobile OS,RTOS, Cloud OS)	07
2.	**Unix Kernel and File Management**	System Structure, User Perspective, Architecture of Unix Operating System, Buffer cache: Header, Buffer Pool, Retrieving, Reading and Writing Buffer, File Representation:	07

		inodes: Structure of file Directories, Path conversion to inode, superblock, inode assignment, allocation of disk blocks	
3.	**Distributed Operating system concepts**	Goals, Distributed Computing Models, Hardware Concepts, Software Concepts, Architecture of DOS. Design Issues: Transparency, Flexibility, Scalability, Reliability, Performance, fault tolerance, Distributed Mutual Exclusion: Introduction, Classification of Mutual Exclusion algorithms, Mutual Exclusion Algorithms, Distributed Deadlock: Introduction, deadlock handling strategies, Deadlock detection: Issues and resolution	07
4.	**Real Time Operating Systems and Mobile OS**	Characteristics of Real Time operating Systems, Classification of Real Time Operating Systems, Scheduling in RTOS: Clock driven: cyclic, Event driven: EDF and rate monotonic scheduling, Resource Handling: Resource Sharing, Priority Inversion, PIP, PCP, HLP. Scheduling real time tasks in distributed systems	08
5.	**Database Operating systems**	Concurrency control : Database systems, Concurrency control model of database systems, Problem of Concurrency Control, serializability theory, Distributed Database Systems. Concurrency Control Algorithms : asic synchronization Algorithms, Lock based, Timestamp based and Optimistic Algorithms, Concurrency Control Algorithms : Data Replication	06
6.	**Mobile OS**	Architecture, Android OS, iOS, Virtual OS, Cloud OS and their design issues	04

DETAILED LAB SYLLABUS:
Software Requirements: Windows/linux

Sr. No.	Detailed Lab Description
1	Design and developed shell script that support Following Command ls, date, time, echo, cat, pwd, cp,
2	Write a multi-class multithreaded program that simulates multiple sleeping barbers, all in one barbershop that has a finite number of chairs in the waiting room. Each customer is instantiated from a single customer class; each barber is instantiated from a single Barber class
3	Implement the program for EDF
4	Implement the Program for Rate Monotonic algorithm
5	Implement a distributed share list among a group of mobile device users which is similar to Google document.
6	IOs, Android OS, Cloud OS

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.

Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

- Term work should consist of 10 experiments.
- Journal must include at least 2 assignments.
  1. **Term work Assessment:** Total 25 Marks (Experiments: 10-marks, Attendance Theory& Practical: 05-marks, Assignments: 10-marks)
  2. **Oral/Viva Assessment**:
     Based on the above contents and entire syllabus.

Text Books:

1. Mukesh Singhal and Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems" .MC Graw Hill education.
2. Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson education.

References:

1. Andrew S.Tanenbaum, "Modern Systems Principles and Paradigms". PHI.
2. Pradeep K.Sinha, "Distributed Operating System-Concepts and design", PHI.
3. Andrew S.Tanenbaum, "Distributed Operating System", Pearson Education.
4. Jane W. S. Liu, “Real Time Systems”, Pearson education.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 309	Embedded System Design and basics of IOT	03	02	---	03	01	---	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Avg.					
EC 309	Embedded System Design and basics of IOT	40	40	40	60	25	--	25	150

Course Objectives:

1. To develop background knowledge Embedded Systems.
2. To understand communication techniques.·
3. To write programs for embedded systems and real time operating systems
4. To understand fundamentals of IoT / M2M
5. To learn real world application scenarios of IoT along with its social and economic impact using case studies

Course Outcomes:

1. Analyze and identify various characteristic features and applications of embedded systems, and select appropriate hardware for implementation.
2. Evaluate detailed processor design techniques and methods of communication protocols.
3. Assess the concepts and benefits of low power embedded processors.
4. Develop programs for embedded systems and real-time operating systems (RTOS).
5. Examine the principles of IoT and its related issues.
6. Create embedded system applications using RTOS and explore basic applications of IoT development.

.**Prerequisite:** Basics of microprocessor and micro controller.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1.	**Introduction**	Definition of Embedded System, Embedded Systems Vs GeneralComputing Systems, Classification, Major Application Areas Characteristics and quality attributes (Design Metric) of embedded systems. Real time system‘s requirements, real time issues, interruptlatency. Embedded Product development life cycle and hardware software Codesign process	04
2.	**Embedded Hardware**	Embedded cores, Types of memories, Sensors (Optical encoders,Resistive) and Actuators (Solenoid valves, Relay/switch, Opto-couplers),Power supply considerations in Embedded systems: Low power featuresIdle& Power down mode, Sleep mode, Brown-out detection. Communication Interfaces: Comparative study of serial communicationinterfaces (RS-232, RS-485), I2C, CAN, USB (v2.0), Bluetooth, Zig-Bee.Selection criteria of above interfaces.	08
3.	**ARM CORTEX-M3 Architecture**	Comparison of CISC & RISC architectures, overview of ARM family. ARM Cortex-M3 architecture, Programmer’s model: Operation Modes and States, registers, special registers, Application Program Status RegisterInteger status flags, Q status flag, GE bits. Memory system: Features and memory map Exceptions and Interrupts-Nested vectored interrupt controller.	08
4.	**Embedded C-programming concepts**	Program Modelling concepts: DFG,FSM,UML Embedded C-programming concepts (from Embedded system point of view): Data types, Modifiers, Qualifiers, Functions, Macros, Interrupt service routine, Device drivers. Real-time Operating system: Need of RTOS in Embedded system softwareand comparison with GPOS, Foreground/Background processes, Interrupt latency, Task, Task states, Multi-tasking, Context switching, Task scheduling, Schedulingalgorithms-Rate Monotonic Scheduling, EarliestDeadline First (with numericals), Inter-process communication: Semaphore,Mailbox, Message queues, Event timers, Task synchronisation- Shareddata, Priority inversion, Deadlock. Memory Management.Introduction to µCOS II RTOS	08
5.	**IoT Introducton and Architecture**	History of IoT, M2M – Machine to Machine, Web of Things, IoT protocols Applications: Remote Monitoring & Sensing, Remote Controlling, Performance Analysis The Architecture The Layering concepts , IoT Communication Pattern, IoT protocol Architecture, Application Protocols MQTT, REST/HTTP, CoAP and 6LoWPAN in IoT.	06
6.	**Case Study & advanced IoT Applications**	Hard Real-time: Car Cruise-Control using µCOS II RTOS-Requirements study, specification study using UML, Hardware architecture, Software Architecture, Automatic Chocolate Vending Machine IoT	05

DETAILED LAB SYLLABUS:

Software Requirements:

Keil 5, Raspbian

Hardware Requirements:

ARM 7 kit, RPi, peripherals

Sr. No.	List of Experiments
1	Two or three programs for GPIO programming with ARM 7
2	Two Interfacing of communication protocols(I2C,CAN,SPI,zigbee etc) with ARM 7
3	Simulation of multitasking with ARM 7 using RTOS
4	Inter process communication using semaphore with ARM 7 in RTOS
5	Minimum two Experiments using any hardware platform (Arduino/Raspberry i/BeagleBone/Galileo) for data handling and storage.
6	Minimum three experiments using any hardware platform (Arduino/Raspberry Pi/BeagleBone/Galileo) for interfacing various sensors and communicating data using Internet using various Protocols.

Theory Assessments:

1. **Internal Assessment:** Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.
2. **End Sem Theory Examination:**

- Question paper will consist of 5 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessment:

1. **Term work Assessment:**

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Equal weightage should be given to laboratory experiments and while assigning term work marks.

2. **Oral/Viva Assessment:**

Practical and Oral exam will be based on the entire syllabus.

Text Books:

1. Raj Kamal,‖ Embedded Systems Architecture, Programming and design‖, Tata MCgrawHill Publication.
2. Shibu K.V,‖ Introduction to Embedded Systems‖, Mc Graw Hill, 2nd edition.
3. Raj Kamal, "Internet of Things Architecture & Design Principles" Mcgraw Hill
4. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.

References:

1. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers.
2. David Simon, ―Embedded systems software primer', Pearson
3. K.V.K.K. Prasad, ―Embedded Real Time Systems: Concepts, Design & Programming‖,Dreamtech Publication.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 310	Foundations of Robotics	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Avg.					
EC 310	Foundations of Robotics	40	40	40	60	25	25	–	150

Course Objectives:

1. To provide students with a foundational understanding of robotics concepts, including history, evolution, and applications.
2. To familiarize students with the basics of embedded systems, microcontrollers, sensors, and actuators used in robotics.
3. To introduce students to robot kinematics, dynamics, and programming for embedded systems.
4. To develop students' skills in interfacing sensors and actuators with microcontrollers.
5. Understanding and Exploring Robotic Vision Fundamentals
6. To introduce students to Robot Operating Systems (ROS) and its applications in robotics.

Course Outcomes: Upon successful completion of the course students will be able to

1. Comprehend the historical development and current applications of robotics technology.
2. Apply proficiency in programming microcontrollers using C/C++ for robotics applications.
3. Analyze simple robotic systems by applying the principles of robot kinematics and dynamics.
4. Implement basic control algorithms by interfacing various sensors and actuators with microcontrollers.
5. Create vision systems tailored for robotic applications, considering factors such as sensor selection, calibration, and system integration.
6. Develop simple robotic applications and simulate robot behavior using ROS.

Prerequisite: Digital Electronics, Microcontroller and Microprocessor, Programming language.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs
1	**Introduction to Robotics**	1.1 Definition and scope of robotics, 1.2 Brief history of robotics, 1.3 Type and Classification of Robots, 1.4 Asimov‘s laws of robotics 1.5 Robot Anatomy, and its Working, 1.6 Robotic System Architecture.	06
2	**Sensing and Perception**	2.1 Types of sensors and their principles Position sensors, Range sensors [LiDAR, UltraSonic sensors], Proximity sensing; Inertial Measurement Unit (IMU) sensor.	06
3	**Actuators and Motion**	3.1 Servo Motors 3.2 Grippers: Principles of Gripper Design, actuation methods, and Applications 3.3 Motor Drivers 3.4 Comparison of Different Drives in Robotics, 3.5 Selection Parameters of drive 3.6 Microactuators, 3.7 Determination of HP of motor,	07
4.	**Embedded systems and programming**	4.1 Introduction to embedded systems, Design metrics, 4.2 Introduction to embedded hardware platforms – STM Board & programming model 4.3 Programming and interfacing of sensors and actuators 4.4 Wired and wireless communication systems – CAN, Modbus, Bluetooth(BLE), Wi-Fi (802.11)	07
5.	**Introduction to Robot Operating Systems (ROS)**	5.1 Overview of ROS Architecture: nodes, topics, messages, services, and the ROS Master. 5.2 ROS Tools: roscore, roslaunch, rviz, rqt, and rosbag for system development, visualization, debugging, and data logging. 5.3 Exploring ROS Packages, 5.4 ROS Communication Mechanisms: publishing and subscribing to topics, calling and providing services, and sharing data using message types 5.5 ROS Configuration and Launch Files 5.6 Robot Control and Navigation: ROS control, robot modeling, simulation, motion planning, and path following.	07
6.	**ROS integration and case studies**	6.1 Integration with Sensor Systems: cameras, LiDAR, IMUs, and depth sensors 6.2 ROS Middleware and Ecosystem: ROS libraries, frameworks, and community resources for robotics development. 6.3 Autonomous Vehicles 6.4 Agricultural Robotics	06

DETAILED LAB SYLLABUS:

Hardware Requirements: STM microcontroller

Software Requirements: Matlab, Keil, ROS

Sr. No.	Detailed Lab Description
1	Study of Embedded C programming on STM32F767ZI MCU Development Board
2	Sensor Interfacing and Data Acquisition with STM32F767ZI MCU Development Board
3	PWM based Actuator Control using STM32F767ZI MCU Development Board
4	Introduction to ROS and Basic Commands
5	Basic simulations of robotic systems, including robot models, world environments on Gazebo simulation environment integrated with ROS.
6	Interface sensors with ROS for data acquisition (sensors such as cameras, or ultrasonic sensors)
7	Interface sensors with ROS for data acquisition (LiDAR)
8	Collecting sensor data, processing it with ROS nodes, and controlling actuators based on sensor feedback (controlling actuators such as motors)
9	Collecting sensor data, processing it with ROS nodes, and controlling actuators based on sensor feedback (controlling actuators such as grippers)
10	Mini Project

Theory Assessments:

1. **Internal Assessment:** Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.
2. **End Sem Theory Examination:**
   - Question paper will consist of 4 questions, each carrying 20 marks.
   - Total 3 questions need to be solved.
   - Q.1 will be compulsory, based on the entire syllabus.
   - Remaining questions will be randomly selected from all the modules.
   - Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

1.Term work Assessment:

At least 07 Experiments and 3 Assignments based on the entire syllabus and **one course mini project/seminar** must be submitted by a maximum batch of 2 to 3 students. Term work assessment must be based on the overall performance of the student with every experiment and Course-project is graded from time to time.

2.Oral/Viva Assessment: Based on the above contents and entire syllabus.

Text Books:

1. Saeed B. Niku, "Introduction to Robotics: Analysis, Systems,Applications",Pearson Education Inc.,New DELHI, 2006
2. "Programming Robots with ROS: A Practical Introduction to the Robot Operating System" by Morgan Quigley, Brian Gerkey, and William D. Smart, Publisher: O'Reilly Media

3. Ganesh S. Hedge A Text book on "Industrial Robotics", Laxmi Publications Pvt. Ltd.,New Delhi.
4. S.R. Deb & Sankha Deb, "Robotics Technology and FlexibleAutomation Robot", Tata McGrawHill, 2010.
5. Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata Mc Graw Hill,2004.

References:

1. "Robotics: Everything You Need to Know About Robotics from Beginner to Expert" by Peter Mckinnon.
2. "Introduction to Robotics: Mechanics and Control" by John J. Craig.
3. K.V.K.K.Prasad, “Embedded Real-Time Systems: Concepts, Design & Programming”, DreamTech Press, 2005
4. M.P. Groover "Industrial Robotics: Technology, Programming and Applications" Tata Mc Graw Hill Co,2001

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 311	Cryptography and System Security	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 311	Cryptography and System Security	40	40	40	60	25	--	25	150

Course Objectives:

1. To introduce the concepts of modular arithmetic and number theory and their application in Classical Encryption techniques.
2. To explore the working principles and utilities of various cryptographic algorithms including Secret Key Cryptography and Public Key Cryptography.
3. To explore various hashing and Message Digest Algorithms to achieve Confidentiality and Integrity.
4. To explore the design issues and working principles of various authentication protocols, PKI standards and different digital signature algorithms to achieve authentication.
5. To explore various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.
6. To develop the ability to use existing cryptographic utilities to build programs for secure communication.

Course Outcomes: Upon successful completion of the course students will be able to

1. Understand system security goals and concepts, classical encryption techniques and acquire fundamental knowledge on the concepts of modular arithmetic and number theory.
2. Understand, compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication
3. Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes.
4. Apply different digital signature algorithms to achieve authentication and design secure applications
5. Understand network security basics, analyze different attacks on networks and evaluate the performance of firewalls and security protocols like SSL, IPSec, and PGP.
6. Analyze and apply system security concepts to recognize malicious code.

Prerequisite: Computer Networks, ISO OSI Layered Protocols, TCP/IP protocol suite.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1.	**Introduction and Number Theory**	Security Goals, Attacks, Services and Mechanisms, Techniques. The OSI security architecture, Network Security Model, Classical Encryption Techniques, Symmetric cipher model, mono-alphabetic and poly-alphabetic substitution techniques: Vigenere cipher, playfair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers Modular Arithmetic and Number Theory:- Euclid‘s algorithm, Prime numbers, Fermat‘s & Euler‘s theorem - Testing for primality,	09
2.	**Symmetric and Asymmetric key Cryptography and key Management**	Block cipher principles, block cipher modes of operation, DES, Double DES, Triple DES, Advanced Encryption Standard (AES), Stream Ciphers: RC4 algorithm Public key cryptography: Principles of public key cryptosystems-The RSA algorithm, The knapsack algorithm,Symmetric Key Distribution techniques: KDC, Needham-schroeder protocol. Kerberos: Kerberos Authentication protocol, Diffie Hellman Key exchange algorithm. Public key Distribution: Digital Certificate: X.509, PKI	08
3.	**Hashes, Message Digests and Digital Certificates**	Cryptographic hash functions, Hash function requirements, Hash function uses, MD5, SHA-1, MAC, HMAC, CMAC	04
4.	**Authentication Protocols & Digital signature schemes**	Authentication Requirement and Functions, Types of Authentication, User Authentication and Entity Authentication: Password Based, Challenge Response Based Authentication Importance of Digital Signature, Attacks on Digital Signature, Digital Signature Schemes – RSA,	05
5.	**Network Security and Applications**	Network Security Basics,TCP/IP Vulnerabilities (Layer-wise): Application layer: HTTP, DHCP Transport layer: TCP syn flood, Port Scanning, Network layer: IP Spoofing, Packet sniffing, ARP Spoofing,DOS: Classic DOS attacks: Ping flood, ICMP flood, UDP flood, Distributed DOS, Defenses against DOS attacks Internet Security Protocols: SSL, IPSEC, Secure Email: PGP, Network Security: Firewall, IDS	09
6.	**System Security**	Software Vulnerabilities: Buffer Overflow,Malwares: Viruses, Worms, Trojans, SQL injection, cross-site scripting	04

DETAILED LAB SYLLABUS:

Hardware Requirements: PC With following Configuration

1. Intel Core i3/i5/i7 Processor
2. 4 GB RAM
3. 500 GB Hard Disk

Software Requirements:

1. Windows / Linux Desktop OS / Kali Linux
2. wireshark
3. ARPWATCH
4. Cppcheck
5. Hping, hping3

Sr. No.	Detailed Lab/Tutorial Description
1	Design and Implementation of a product cipher using Substitution and Transposition ciphers
2	1. Implementation and analysis of RSA cryptosystem and Digital signature scheme using RSA. 2. Implementation of Diffie Hellman Key exchange algorithm. 3. For varying message sizes, test integrity of message using MD-5, SHA-1, and analyse the performance of the two protocols.
3	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.
4	Study of packet sniffer tools :wireshark, : 1. Download and install wireshark and capture icmp, tcp, and http packets in promiscuous mode. 2. Explore how the packets can be traced based on different filters. 3. Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, xmas scan etc. 4. Detect ARP spoofing using nmap and/or open source tool ARPWATCH and wireshark.
5	1. Setting up personal Firewall using iptables. 2. Explore the GPG tool of linux to implement email security. 3. Set up Snort and study the logs.
6	1. Simulate buffer overflow attack using Ollydbg, Splint, Cppcheck etc. 2. Simulate DOS attack using Hping, hping3.

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 5 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.

- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessment:

1. Term work Assessment:
The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

2. Oral/Viva Assessment: Practical and Oral exam will be based on the entire syllabus.

Text Books:

1. William Stallings, Cryptography and Network Security, Principles and Practice, 6th Edition, Pearson Education, March 2013
2. Behrouz A. Ferouzan, ―Cryptography & Network Security‖, Tata Mc Graw Hill
3. Bernard Menezes, ―Cryptography & Network Security‖, Cengage Learning.
4. Network Security Bible, Eric Cole, Second Edition, Wiley.

References:

1. Applied Cryptography, Protocols Algorithms and Source Code in C, Bruce Schneier, Wiley.
2. Cryptography and Network Security, Atul Kahate, Tata Mc Graw Hill

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Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 312	Mobile & Distributed Computing	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Avg.					
EC 312	Mobile & Distributed Computing	40	40	40	60	25	--	25	150

Course Objectives:

1. To introduce the basic concepts and principles in mobile computing. This includes major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications
2. To provide an opportunity for students to understand the key components and technologies involved and to gain hands-on experiences in building mobile applications.
3. Key concepts of virtualization.
4. To introduce basic concepts, goals, issues of distributed systems.
5. To understand the concept of Inter process communications, Message oriented communication, stream oriented communications.
6. To provide master skills to measure the performance of distributed synchronization algorithms.

Course Outcomes: Upon successful completion of the course students will be able to

1. Identify basic concepts and principles in mobile communication & computing.
2. Describe the components and functioning of mobile networking.
3. Describe the importance of virtualization along with their technologies.
4. Understand the basic elements and concepts related to distributed systems and illustrate the middleware technologies that supports distributed applications such as RPC, RMI and object based middleware.
5. Understand the concepts of resource and process management.
6. Analyse various techniques used for clock synchronization, election of coordinators and distributed mutual exclusion.

Prerequisite: Computer Networks

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs
1.	**Networking Infrastructures & Mobility Management**	Overview of the Internet Protocol (IP) and its importance in networking. Different versions of IP addresses: IPv4 and IPv6. Format and structure of IPv4 and IPv6 addresses. Public vs. private IP addresses. Sub netting and CIDR notation. Mobility Management: Introduction, IP Mobility, Optimization, Overview of IPv6 addressing and its advantages over IPv4. IPv6 address types: unicast, multicast, and anycast. IPv6 address notation and representation. Macro Mobility: MIPv6, Micro Mobility: Cellular .	06
2.	**Network Services**	Defining the Internet, Defining Intranets and Extranets. Mobile IP: overview, Desirable features, Key Mechanism. Packet Delivery, Route Optimization. Dynamic Host Configuration Protocol (DHCP). Introducing Remote Administration, Enable Remote Desktop, Access Remote Desktop. Defining Name Resolution Techniques, Defining DNS, Defining WINS.	07
3.	**Network Security & Virtualization**	Overview of IP security mechanisms and protocols. - IPsec (Internet Protocol Security) and its components: Authentication Header (AH) and Encapsulating Security Payload (ESP). -Information Security: Security Techniques and Algorithms, Security Protocols, Models & Frameworks for Mobile Computing. Characteristics of virtualized environment, Understanding the importance of Hypervisors, Type I & Type II Hypervisors,. Case Study of KVM & Xen Vmware Architecture,	07
4.	**Distributed Computing Systems**	Characterization of Distributed Systems: Types of distributed systems (Difference between tightly coupled and loosely coupled multiprocessor systems), Issues (Transparency, Performance Transparency, Scaling Transparency, Reliability, Fault Avoidance, Fault Tolerance, Fault Detection and Recovery, Flexibility, Performance, Scalability), Goals, and Distributed Computing System Models. Distributed Share Memory.	06
5.	**Distributed Computing Communication**	Introduction to message passing, Remote communication: Remote Procedure Call (RPC): Transparency of RPC, Implementing RPC mechanism, Stub Generation, RPC Messages, Marshaling Arguments and Results, Server Management.	07

		Remote Object Invocation (ROI): Remote Method Invocation (RMI): RMI Architecture, Four Layered Operation, RMI Components.	
6.	**Synchronization**	Clock Synchronization, Physical clock synchronization algorithm, Logical (lamport) Clock, Election Algorithms.	06

DETAILED LAB SYLLABUS:

Software Requirements: J2ME, Android Studio, NS2

Sr. No.	Detailed Lab Description
1	1) To implement Remote Procedure Call/Remote Method Invocation. 2) To implement deadlock management in distributed systems.
2	1) To implement Logical Clock Synchronization algorithm (Lamport clock) 2) To implement an election algorithm.
3	1) To implement OBEX protocol using bluetooth.
4	1) Explore and install Android studio 2) Develop an application that uses GUI components in Android. 3) Write an application that draws basic graphical primitives on the screen in Android
5	1) To implement a mutual exclusion algorithm.
6	MINI PROJECT Develop an android application for social needs.

Theory Assessments:

1. **Internal Assessment:** Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.
2. **End Sem Theory Examination:**

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.

Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

1.Term work Assessment:

At least 08 Experiments and 2 Assignments based on the entire syllabus and **one mini project** must be submitted by a maximum batch of 3 to 4 students. Term work assessment must be based on the overall performance of the student with every experiment and mini project is graded from time to time.The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

2.Oral/Viva Assessment: Based on the above contents and entire syllabus.

Text Books:

1. Jochen Schilller,‖Mobile Communication ―, Addision wisely,Pearson Education, 2nd Edition.

2. Wireless Communications & Networks,‖ By William Stallings, Second Edition, Pearson Education .

3. Raj Kamal, Mobile Computing, 2/e , Oxford University Press-New Delhi

References:

1. LTE Self-Organizing Networks (SON): Network Management Automation for Operational
   Efficiency, Seppo Hamalainen, Henning Sanneck , Cinzia Sartori, Wiley publications .
2. Christopher Cox, ―An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications,‖ Wiley publications .
3. Mobility Protocols and Handover Optimization: Design, Evaluation and Application By Ashutosh Dutta, Henning Schulzrinne, IEEE Press, Wiley Publication.
4. Michael Gregg, ―Build your own security lab,‖ Wiley India edition .
5. Emerging Wireless Technologies and the Future Mobile Internet, Dipankar Raychaudhuri, Mario Gerla, Cambridge.
6. Andreas F.Molisch, ―Wireless Communications,‖ Second Edition, Wiley Publications.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 313	Integrated Circuit Technology	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
EC 313	Integrated Circuit Technology	40	40	40	60	25	--	25	150

Course Objectives:

1. To provide knowledge of Wafer preparation and fabrication for VLSI Technology
2. To provide knowledge of IC fabrication processes and advanced IC technologies.
3. To provide knowledge of IC fabrication processes and design rules.
4. To disseminate knowledge about novel semiconductor measurement.
5. To provide knowledge about different VLSI Technology.
6. To disseminate knowledge about novel VLSI devices and materials.

Course Outcomes: Upon successful completion of the course students will be able to

1. Analyze and demonstrate a clear understanding of various MOS fabrication processes & CMOS fabrication flow.
2. Analyze and design layout of MOS based Circuits.
3. Demonstrate a clear understanding of Semiconductor Measurements & Testing.
4. Analyze SOI and GaAs technology.
5. Develop different fabrication process.
6. Understand advanced technologies, Novel Devices and materials in Modern VLSI Technology.

Prerequisite: Electronic Devices and Circuits I, Digital Circuit Design, VLSI Design

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1.	**Crystal Growth, Wafer preparation and fabrication for VLSI Technology**	Semiconductor Manufacturing: Semiconductor technology trend, Clean rooms, Wafer cleaning and Gettering. Semiconductor Substrate: Crystal structure, Crystal defects, Czochralski growth, Float Zone growth, Bridgman growth of GaAs, Wafer Preparation and specifications	08

2.	**Fabrication Processes Part 1**	Epitaxy: Classification, Molecular Beam Epitaxy Silicon Oxidation: Thermal oxidation process, Kinetics of growth, Properties of Silicon Dioxide, Oxide Quality. Device Isolation: LOCOS, Shallow Trench Isolation (STI). Deposition: Physical Vapor Deposition-Evaporation and Sputtering, Chemical Vapor Deposition: APCVD, LPCVD,PECVD Diffusion: Nature of diffusion, Diffusion in a concentration gradient, diffusion Equation, diffusion systems, problems in diffusion. Ion Implantation: Penetration range-Nuclear& Electronic stopping and Range, implantation damage, Annealing-Rapid thermal annealing, ion implantation systems.	07
3.	**Fabrication Process Part 2**	Etching & Lithography: Etching: Basic concepts and Classification Lithography: Introduction to Lithography process, Types of Photoresist, Types of Lithography: Electron beam, Ion beam and X-ray lithography. Metallization and Contacts: Introduction to Metallization, Schottky contacts and Ohmic contacts. CMOS Process Flow: N well, P-well and Twin tub, CMOS Latch Up Design rules, Layout of MOS based circuits (gates and combinational logic), Buried and Butting Contact.	07
4.	**Measurement and Testing**	Semiconductor Measurements: Conductivity type, Resistivity, Hall Effect Measurements, Drift Mobility. Testing: Technology trends affecting testing, VLSI testing process and test equipment, test economics and product quality.	06
5.	**VLSI Technologies**	SOI Technology: SOI fabrication using SIMOX, Bonded SOI and Smart Cut ,PD ,SOI and FD SOI Device structure and their features. Advanced Technologies: low κ and high κ, BiCMOS, HκMG Stack, Strained Silicon. GaAs Technologies: MESFET Technology, MMIC technologies, MODFET	06
6.	**Novel Devices and Materials**	Multigate Devices:Various multigate device configurations-double gate, triple gate (FinFET) and Gate All Around (Nanowire). Nanowire: Concept, VLS method of fabrication, Nanowire FET, Types: Horizontal and Vertical Nanowires, III-V compound Materials in Nanowires. 2-D Materials and FET:Graphene& CNT FET, MOS2 and Black Phosphorous.	05

DETAILED LAB SYLLABUS:

Software Requirements: NANOHUB, MICROWIND

Sr. No.	Detailed Lab Description
1	To study the CZ process for Silicon Crystallization.
2	Implement NMOS inverter with resistive load using NANOHUB and study its characteristics.
3	Various effects of Temperature on Thermal Oxidation using NANOHUB.
4	Design of CMOS Inverter using Microwind.
5	Design of CMOS NAND using Microwind.
6	Design of CMOS NOR using Microwind.
7	Design of CMOS EXOR using Microwind.
8	To implement the given function Y=A+BC using Microwind.
9	Design of 6T SRAM using Microwind.
10	Case Study IEEE paper.

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

1.Term work Assessment:

- Term work should consist of 10 experiments.
- Journal must include at least 2 assignments
- Mini Project to be performed

Total 25 Marks (Experiments: 10-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks, Mini Project: 5-marks)

2.Oral/Viva Assessment:

Based on the above contents and entire syllabus.

Text Books:

1. James D. Plummer, Michael D. Deal and Peter B. Griffin, “Silicon VLSI Technology”, Pearson, Indian Edition.
2. Stephen A. Campbell, “The Science and Engineering of Microelectronic Fabrication”, Oxford University Press, 2nd Edition.
3. Sorab K. Gandhi, “VLSI Fabrication Principles”, Wiley, Student Edition.
4. G. S. May and S. M. Sze, “Fundamentals of Semiconductor Fabrication”, Wiley, First Edition.
5. Kerry Bernstein and N. J. Rohrer, “SOI Circuit Design Concepts”, Kluwer Academic Publishers, 1st edition.

References:

1. Jean-Pierre Colinge, “FinFETs and Other Multigate Transistors”, Springer, 1st edition
2. M. S. Tyagi, “Introduction to Semiconductor Materials and Devices”, John Wiley and Sons,1st edition.
3. James E. Morris and KrzysztolIniewski, “Nanoelectronic Device ApplicationsHandbook”, CRC Press.
4. Glenn R. Blackwell, “The electronic packaging”, CRC Press.
5. Michael L. Bushnell and Vishwani D. Agrawal, “Essentials of Electronic Testing for digital, memory and mixed-signal VLSI circuits”, Springer.
6. G.S.May and S. M. Sze, “Fundamentals of Semiconductor Fabrication”, Wiley, First Edition.

Bachelor of Technology
In
Electronics & Computer Science

(Semester VI)

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 314	Image Processing & Machine Vision	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 314	Image Processing & Machine Vision	40	40	40	60	25	--	25	150

Course Objectives:

1. To cover the fundamentals and mathematical models in digital image processing and Machine Vision
2. To understand basic image segmentation techniques.
3. To develop time and frequency domain techniques for image enhancement.
4. To expose the students to classification techniques in Machine Vision
5. To develop Applications using image processing and Machine Vision

Course Outcomes: Upon successful completion of the course students will be able to

1. Understand theory and models in image processing.
2. Interpret and analyze 2D signals in Spatial and frequency domain through image transforms.
3. Apply quantitative models of image processing for segmentation and restoration for various applications
4. Find shape using various representation techniques and classify the object using different classification methods
5. Develop innovative design for practical applications in various fields.

Prerequisite:

- Signals and Systems
- Discrete Time Signal Processing

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1	**Digital Image Fundamentals**	Introduction – Origin – Steps in Digital Image Processing , Components, Elements of Visual Perception – Image Sensing and Acquisition, Image	04

		Sampling and Quantization – Relationships between pixels, Transformation: Orthogonal, Euclidean, Affine Color Image Processing: Color Fundamentals Color models.	
2	**Image Transforms**	1-D DFT, 2-D Discrete Fourier Transform and Its Inverse, Some Properties of 2D DFT ,Walsh –Hadamard Transform, Discrete Cosine Transform, Haar Transform	04
3	**Image Enhancement**	Digital Negative, contrast stretching, thresholding, graylevel slicing, bit plane slicing, log transform and power law transform. Histogram equalization and Histogram Specification Spatial Domain: Averaging filters, order statistics filters, high pass filters and high boost filters Frequency Domain: The Basics of Filtering in the Frequency Domain, Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Laplacian, Unsharp Masking and Homomorphic filters	08
4	**Image Segmentation and Representation**	Detection of Discontinuities, Edge Linking using Hough Transform, Thresholding, Region based Segmentation, Split and Merge Technique, Image Representation and Description, Chain Code, Polygonal, Representation, Shape Number, Moments.	06
5	**Morphology & Image Restoration**	Morphology: Erosion and Dilation, Opening and Closing, The Hit- or-Miss Transformation. Restoration: Degradation model, noise models, estimation of degradation function by modeling, restoration using Weiner filters and Inverse filters	08
6	**Boundary Description & Object Recognition**	Texture: Statistical Texture Description Methods-Methods based on spatial frequencies, co-occurrence matrices, edge frequency, primitive length, Law‘s texture energy measures Object Recognition Knowledge representation, Classification Principles, Classifier setting, Classifier Learning, Support vector machine, cluster analysis	09

DETAILED LAB SYLLABUS:

Sr. No.	Detailed Lab/Tutorial Description
1	Point Processing Methods - Negative, Log, Power law, Contrast stretching, Bit plane slicing
2	Histogram calculation and equalization

3	Spatial Domain Filtering: 1. Smoothening filters 2. Sharpening with Laplacian 3. Unsharp masking & high boost filtering 4. Edge detection using 1st and 2nd order derivatives
4	Frequency Domain Filtering : Ideal, Butterworth and Gaussian
5	Image segmentation using global Thresholding Algorithm
6	Canny edge detection
7	Shape representation using chain code
8	Morphological operation – Erosion, dilation, opening, closing, hit-miss transform, Boundary extraction
9	Feature extraction using co-occurrence matrix
10	Classification using k-means algorithm
11	Classification using Basiyan classifier
12	Basic binary classification of any data or pattern using Support Vector Machine.
13	Case Study : 1. Face recognition 2. Finger print identification 3. License plate recognition

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessment:

1. Term work Assessment:

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Equal weightage should be given to laboratory experiments and while assigning term work marks.

2. Oral/Viva Assessment:

Practical and Oral exam will be based on the entire syllabus.

Text Books:

1. Gonzalesand Woods, ―Digital Image Processing‖, Pearson Education, India, Third Edition,
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, ―Image Processing, Analysis, and Machine Vision‖, Cengage Engineering, 3rd Edition, 2013

References:

1. AnilK.Jain,―FundamentalsofImageProcessing‖,PrenticeHallofIndia,FirstEdition, 1989.
2. W Pratt, ―Digital Image Processing‖, Wiley Publication, 3rdEdition, 2002
3. S. Jayaraman, E.Esakkirajan and T.Veerkumar, "Digital Image Processing" TataMcGraw Hill Education Private Ltd, 2009.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 315	Computer Organization & Architecture	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 315	Computer Organization & Architecture	40	40	40	60	--	--	--	100

Course Objectives:

1. To conceptualize the basics of organizational and architectural issues of a digital computer.
2. To analyze performance issues in processor and memory design of a digital computer.
3. To understand various data transfer techniques in digital computers.
4. To analyze processor performance improvement using instruction level parallelism

Course Outcomes: Upon successful completion of the course students will be able to

1. Explain the basic structure of a computer.
2. Do computer arithmetic operations.
3. Elaborate control unit operations.
4. Able to perform the concept of cache mapping techniques.
5. Explain the concept of I/O organization and conceptualize instruction level parallelism.
6. Able to explain the advance computer architectures

Prerequisite: Microprocessor and Microcontroller

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs
1.	**Introduction to Computer Organization**	1.1 Introduction to Computer Organization & Architecture, Basic functional blocks of a computer: CPU, memory, input-output subsystems, control unit. 1.2 Instruction set architecture of a CPU - registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. 1.3 Evolution of computers, Von Neumann model, 1.4 Performance measure of computer architecture.	06

2.	**Data presentation and Arithmetic algorithm**	2.1 Signed number representation, fixed and floating point representations, character representation. 2.2 Computer arithmetic - integer addition and subtraction, ripple carry adder, carry look-ahead adder. 2.3 Multiplication - shift-and-add, Booth multiplier, carry save multiplier. 2.4 Division - non-restoring and restoring techniques. 2.5 Floating point arithmetic : Addition, Subtraction	08
3.	**Processor Organization and Architecture**	3.1 CPU Architecture, register organization, instruction formats, basic instruction cycle, instruction interpretation and sequencing 3.2 Control unit: soft wired (micro-programmed) and hardwired control unit design methods 3.3 Introduction to RISC and CISC architectures	06
4.	**Memory Organization**	4.1 Semiconductor memory technologies : SRAM,DRAM. Interleaved and associative memory, 4.2 Cache memory concept, mapping techniques, cache coherency, cache performance. 4.3 Virtual memory concept, segmentation and paging-	08
5.	**Input / Output Organization**	5.1 IO fundamentals: handshaking, buffering, programmed controlled IO, interrupt driven IO; Interrupt handling mechanism, 5.2 Buses: protocols, arbitration, direct memory access (DMA).	04
6.	**Fundamentals of Advanced Computer Architecture**	6.1 Parallel Architecture: Classification of Parallel Systems, Flynn's Taxonomy, Array Processors, Clusters, and NUMA Computers. 6.2 Multiprocessor Systems : Structure & interconnection Networks 6.3 Multi-Core Computers: Introduction,Organization and Performance.	07

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Text Books:

1. Computer Organization and Design, 5th Ed., D. A. Patterson and J. L. Hennessy
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Fifth Edition, Tata McGraw-Hill.
3. John P. Hayes, "Computer Architecture and Organization", Third Edition

References:

1. William Stallings, “Computer Organization and Architecture: Designing for Performance”, Eighth Edition, Pearson.
2. Govindarajulu, “Computer Architecture and Organization: Design Principles and Applications”, Second Edition, Tata McGraw-Hill.
3. Dr. M. Usha and T. S. Srikanth, “Computer System Architecture and Organization”, First Edition, Wiley-India.
4. Ramesh Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, Fifth Edition, Penram.
5. Microprocessor Architecture, Jean Loup Baer

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 316	Instrumentation & Control System	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 316	Instrumentation & Control System	40	40	40	60	--	---	----	100

Prerequisite: Applied Mathematics(Laplace Transform, Ordinary differential equations), Applied Physics, Basic Electrical Engineering

Course Objectives:

1. To develop the ability to model control systems and determine their time response and frequency response.
2. To develop the ability to analyze stability of control systems.
3. To develop the ability to understand various types of sensors, transducers and data acquisition systems.

Course Outcomes: After successful completion of the course students will be able to

1.Derive the transfer functions for any given control systems.
2.Analyze the performance of control systems based on the time domain and frequency domain specifications.
3. Evaluate the stability of the control systems in time domain and frequency domain.
4.Understand the working principle of sensors and transducers.
5. Explain various parameters of data acquisition systems.
6. Describe instrument communication standards.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs.
1.	**Introduction to Control System**	Examples of control systems; open and closed loop systems; Servomechanism. Mathematical modeling of Electrical & Mechanical Systems; Transfer function model. Block diagram and Signal Flow Graph (SFG) representation of control systems; Block diagram reductions; Mason's gain formula.	**08**
2.	**Time Response Analysis**	Standard test input signals; time response of first and second order systems for standard test inputs; Transient response specification for second order system; Error constants and type of the system. Concept of stability; Routh-Hurwitz Criteria; Relative stability analysis; Root-Locus technique and construction of root-loci.	**08**

3.	**Frequency Response Analysis**	Introduction to frequency response; Frequency response plots: Polar plot and Bode plot; Stability margins in frequency domain, Nyquist stability criterion and stability analysis using Nyquist plot (Numericals not expected).	**06**
4.	**Sensor and Transducers**	Introduction to sensors and transducers. Various types of sensors. Various types of transducers and their principle of operation. Selection criteria of transducers. Displacement and pressure transducers: potentiometers, pressure gauges, Linear variable differential transducer (LVDT), strain gauges. Temperature transducers: working principle, ranges and applications of resistance temperature detectors (RTD), thermocouple and thermistor temperature transducers.	**07**
5.	**Signal conditioning DAS and SCADA**	Introduction to instrumentation systems, data acquisition system (DAS), use of DAS in Intelligent instrumentation system. Data logger, its types and applications. SCADA communication architecture, types, applications, open SCADA protocols. Introduction to Distributed Control system [D.C.S] and fibre optic instrumentation.	**06**
6.	**Telemetry and Instrument communication standards**	Introduction to telemetry, landline telemetry, radio telemetry and types of multiplexing. Instrument interfacing, Current loop, RS232/485, Field bus, Modbus GPIB, USB Protocol, and HART communication Protocol.	**04**

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.

Weightage of marks should be proportional to the number of hours assigned to each module.

Books:

1. K. Ogata, “Modern Control Engineering”, PHI, New Delhi
2. I. J. Nagrath, M. Gopal, “Control System Engineering”, 5th edition, New Age International Publishers
3. A.K. Sawhney, “Electrical & Electronic Measurement & Instrumentation” – DRS. India
4. D. Patranabis, “Principle of Industrial Instrumentation”, Tata McGraw Hill.
5. H.S.Kalsi, “Electronic Instrumentation”-TMH, 2nd Edition.

References:

1. Kuo B.C., Automatic Control Systems, Prentice Hall of India Ltd., New Delhi, 1995.
2. Norman S. Nise, “Control System Engineering”, John Wiley and Sons
3. C. S. Rangan, G. R. Sharma and V. S. Mani, ‘Instrumentation Devices and Systems’, Tata McGraw-Hill Publishing Company Ltd.
4. Helfrick& Cooper, “Modern Electronic Instrumentation & Measuring Techniques” – PHI

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 317	Machine Learning	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 317	Machine Learning	40	40	40	60	25	--	25	150

Course Objectives:

1. To introduce the basic concepts and techniques of Machine Learning.
2. To acquire in depth understanding of various supervised and unsupervised algorithms
3. To be able to apply various ensemble techniques for combining ML models.
4. To demonstrate dimensionality reduction techniques.

Course Outcomes: Upon successful completion of the course students will be able to:

1. Acquire fundamental knowledge of developing machine learning models.
2. Comprehend regression, classification that are used in machine learning.
3. To demonstrate ensemble techniques to combine predictions from different models.
4. Identify and apply classification models to real world problems.
5. Apply different clustering methods that are used in machine learning.
6. To demonstrate the dimensionality reduction techniques.

Prerequisite: Data Structures, Algorithms, Linear algebra, multivariate calculus, and probability theory

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1.	**Introduction to Machine Learning**	1.1: Machine Learning, Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps in developing a Machine Learning Application. 1.2: Training Error, Generalization error, Overfitting, Underfitting, BiasVariance trade-off.	04
2.	**Learning with Regression and Trees**	2.1: Learning with Regression: Linear Regression, Multivariate Linear Regression, Logistic Regression. 2.2: Learning with Trees: Decision Trees, Constructing Decision Trees using Gini Index (Regression), Classification and Regression Trees (CART) 2.3: Performance Metrics: Confusion Matrix, [Kappa Statistics], Sensitivity, Specificity, Precision, Recall, F-measure, ROC curve	09
3.	**Ensemble Learning**	3.1: Understanding Ensembles, K-fold cross validation, Boosting, Stumping, XGBoost 3.2: Bagging, Subagging, Random Forest, Comparison with Boosting, Different ways to combine classifiers	06
4.	**Learning with Classification**	4.1: Support Vector Machine Constrained Optimization, Optimal decision boundary, Margins and support vectors, SVM as constrained optimization problem, Quadratic Programming, SVM for linear and nonlinear classification, Basics of Kernel trick. 4.2: Support Vector Regression, Multiclass Classification	08
5.	**Learning with Clustering**	5.1: Introduction to clustering with overview of distance metrics and major clustering approaches. 5.2: Graph Based Clustering: Clustering with minimal spanning tree Model based Clustering: Expectation Maximization Algorithm, Density Based Clustering: DBSCAN	07
6.	**Dimensionality Reduction**	6.1: Dimensionality Reduction Techniques, Principal Component Analysis, Linear Discriminant Analysis, Singular Value Decomposition.	05

DETAILED LAB SYLLABUS:

Lab Prerequisite: Data Structures, Analysis of Algorithms
Suggested List of Experiments:

Sr. No	Title of Experiment
1	To implement Linear Regression.
2	To implement Logistic Regression
3	To implement Ensemble learning (bagging/boosting)
4	To implement multivariate Linear Regression.
5	To implement Naive Bayes Classifier with sample dataset and evaluate it using various performance measure
6	To implement CART.
7	To implement K-Means clustering using sample dataset
8	To implement agglomerative clustering using sample dataset
9	To implement SVM.
10	To implement PCA/SVD/LDA.
11	To implement Graph Based Clustering.
12	To implement DB Scan.
13	To implement LDA.

Theory Assessments:

1. **Internal Assessment:** Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.
2. **End Sem Theory Examination:**
   - Question paper will consist of 4 questions, each carrying 20 marks.
   - Total 3 questions need to be solved.
   - Q.1 will be compulsory, based on the entire syllabus.
   - Remaining questions will be randomly selected from all the modules.
   - Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessment:

1. **Termwork Assessment:** Term Work shall consist of at least 8 to 10 experiments based on the above list. Also Term work Journal must include at least 2 assignments. Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance). The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
2. **Oral/Viva Assessment:** An oral exam will be held based on the above syllabus.

Text Books:

1. Peter Harrington, ―Machine Learning n Action‖, DreamTech Press
2. Ethem Alpaydın, ―Introduction to Machine Learning‖, MIT Press
3. Tom M. Mitchell, ―Machine Learning‖ McGraw Hill
4. Stephen Marsland, ―Machine Learning An Algorithmic Perspective‖, CRC Press

References:

1. Han Kamber, ―Data Mining Concepts and Techniques‖, Morgan Kaufmann Publishers
2. Margaret. H. Dunham, ―Data Mining Introductory and Advanced Topics, Pearson Education
3. Kevin P. Murphy , Machine Learning ― A Probabilistic Perspective‖
4. Samir Roy and Chakraborty, ―Introduction to soft computing‖, Pearson Edition.
5. Richard Duda, Peter Hart, David G. Stork, ―Pattern Classification‖, Second Edition, Wiley Publications.

Useful Digital Links :

1. Data sets for Machine Learning algorithms: https://www.kaggle.com/datasets
2. Machine Learning repository- https://archive.ics.uci.edu/ml/index.php
3. Machine Learning from Coursera
4. https://towardsdatascience.com/machine-learning/home
5. Introduction to Machine Learning - IITKGP - Course (nptel.ac.in)

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 318	Big Data Analytics	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 318	Big Data Analytics	40	40	40	60	25	--	25	150

Course Objectives:

1. To provide an overview of an exciting growing field of Big Data analytics.
2. To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
3. To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce.
4. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
5. To introduce to the students several types of big data like social media, web graphs and data streams.
6. To enable students to have skills that will help them to solve complex real-world problems in decision support.

Course Outcomes: Upon successful completion of the course students will be able to

1. Explain the motivation for big data systems and identify the main sources of Big Data in the real world.
2. Demonstrate an ability to use frameworks like Hadoop, NOSQL to efficiently store, retrieve and process Big Data for Analytics.
3. Implement several Data Intensive tasks using the Map Reduce Paradigm
4. Apply several newer algorithms for Clustering Classifying and finding associations in Big Data
5. Design algorithms to analyze Big data like streams, Web Graphs and Social Media data.
6. Design and implement successful Recommendation engines for enterprises.

Prerequisite: Database Management System.

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1.	**Introduction to Big Data**	Data Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Big Data Challenges, Examples of Big Data in Real Life, Big Data Applications	03
2.	**Introduction to Big Data Frameworks: Hadoop, NOSQL**	What is Hadoop? Core Hadoop Components; Hadoop Ecosystem; Overview of : Apache Spark, Pig, Hive, Hbase, Sqoop What is NoSQL? NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, MongoDB	07
3.	**MapReduce Paradigm**	MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures. Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce , Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Grouping and Aggregation by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce Step . Illustrating use of MapReduce with use of real life databases and applications.	06
4.	**Mining Big Data Streams**	The Stream Data Model: A DataStream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing. Sampling Data in a Stream : Sampling Techniques. Filtering Streams: The Bloom Filter Counting Distinct Elements in a Stream : The Count-Distinct Problem, The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements . Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-IndykMotwani Algorithm, Query	06
5.	**Big Data Mining Algorithms**	Frequent Pattern Mining : Handling Larger Datasets in Main Memory Basic Algorithm of Park, Chen, and Yu. The SON Algorithm and MapReduce. Clustering Algorithms: CURE Algorithm. Canopy Clustering, Clustering with MapReduce Classification Algorithms: Parallel Decision trees, Overview SVM classifiers, Parallel SVM, KNearest Neighbor classifications for Big Data, One Nearest Neighbour.	08
6.	**Big Data Analytics Applications**	Link Analysis : PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: PageRank Iteration Using MapReduce, Topic sensitive Page Rank, link Spam, Hubs and Authorities, HITS Algorithm. Mining Social- Network Graphs : Social Networks as Graphs, Types , Clustering of	09

		Social Network Graphs, Direct Discovery of Communities, Counting triangles using Map-Reduce. Recommendation Engines: A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering.	

DETAILED LAB SYLLABUS:

Software Requirements: Virtual Machine, Hadoop Frame work, NOSQL and MongoDb Compilers

Hardware Requirements: PC i3 or above, 8 GB RAM

Sr. No.	Detailed Lab Description
1	Assignment on Study of Hadoop ecosystem
2	Programming exercises on Hadoop Using Hive, Pig, Hbase Sqoop NOSQL, MongoDB
3	Implementing simple algorithms in MapReduce Matrix multiplication, Aggregates, joins, sorting, searching etc.
4	● Implementing Algorithms using MapReduce (Any 2) ● Implementing Frequent Item set Mining Implementing Clustering algorithms Implementing Classification Algorithms
5	Big Data Applications (Any 2) ● Implementing Analytics on data streams ● Implementing Social Network Analysis Algorithms Implementing Web Graph Algorithms Implementing recommendation Engines
6	Mini Project: One real life large data application to be implemented (Use standard Datasets available on the web) a) Twitter data analysis b) Fraud Detection c) Text Mining d) Recommendation Engines (list of datsets also given in the text book)

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

1. **Termwork Assessment:** Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments. Journal must include at least 2 assignments. Term Work Marks: 25 Marks (Total marks) = 15 Marks

(Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance) Oral Examination will be based on the above syllabus.

2. **Oral/Viva Assessment**: An oral exam will be held based on the above syllabus.

Text Books:

1. Radha Shankarmani, M Vijayalakshmi, ”Big Data Analytics”, Wiley Publications
2. Anand Rajaraman and Jeff Ullman “Mining of Massive Datasets”, Cambridge University Press.
3. Alex Holmes “Hadoop in Practice”, Manning Press, Dreamtech Press.
4. Professional NoSQL Paperback, by Shashank Tiwari, Dreamtech Press.
5. MongoDB: The Definitive Guide Paperback, Kristina Chodorow (Author), Michael Dirolf, O'Reilly Publications.

References:

1. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Bart Baesens , WILEY Big Data Series.
2. Big Data Analytics with R and Hadoop by Vignesh Prajapati Paperback, Packt Publishing Limited
3. Hadoop: The Definitive Guide by Tom White, O'Reilly Publications
4. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services
5. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence by Pramod J. Sadalage, Addison Wesley

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 319	Parallel Computing Architecture	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
EC 319	Parallel Computing Architecture	40	40	40	60	25	--	25	150

Course Objectives:

1. To understand the principles of parallel computer architecture.
2. To understand the design of parallel computer systems including modern parallel architectures.
3. To assess the communication and computing possibilities of parallel system architecture and to predict the performance of parallel applications.

Course Outcomes: Upon successful completion of the course students will be able to

1. Students get accustomed with the representation of data, addressing modes, and instruction sets.
2. Students are able to understand parallelism both in terms of a single processor and multiple processors.
3. Technical knowhow of parallel hardware constructs to include instruction-level parallelism for multi core processor design.

Prerequisite: Computer Organization & Architecture

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1.	**Fundamentals of Computer Design**	Defining Computer Architecture – Trends in Technology – Trends in Power in Integrated Circuits – Trends in Cost – Dependability – Measuring, Reporting and Summarizing Performance – Quantitative Principles of Computer Design – Basic and Intermediate concepts of pipelining – Pipeline Hazards.	04
2.	**Introduction to Parallel Processing**	Parallel computing structure, scope of parallel computing, architectures classification schemes, applications of parallel processing.	06

3.	**Memory and Input output subsystems**	Memory structure Hierarchy, Addressing scheme for main memory, Virtual Memory systems, Memory allocation and management strategies, Virtual Memory, Cache Memory, Management and Design criteria, I/O subsystems, Interrupt mechanisms, Vector processing requirements.	08
4.	**Pipelining**	Principles of pipelining, vector processing: Pipelining, Instruction and Arithmetic pipelines, principles of designing pipelined processors, vector processing requirements Pipeline computers and Vectorization methods: Vectorization and Optimization methods.	07
5.	**SIMD and MIMD**	SIMD computers and Performance enhancement: Study of SIMD array processor and associative processor, Scientific attached processor. MIMD: Architecture and memory organization of MIMD and Interconnection N/W. Data Driven computing, Data Flow Computer Architecture.	08
6.	**Parallel Software Environment**	Parallel Algorithm, features of Parallel Languages, Parallel compiler and OS.	06

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

1. The distribution of marks for term work shall be as follows:
    - Lab Performance (Experiments /case studies): 15
    - Assignment 05
    - Attendance (Theory & Practical) 05

2. Oral/Viva Assessment: Based on the above contents and entire syllabus.

Text Books:

1. David.A.Patterson, John L.Hennessy, "Computer Architecture: A Quantitative approach", Elsevier, 5th Edition 2012.
2. K.Hwang, Naresh Jotwani, “Advanced Computer Architecture, Parallelism, Scalability, Programmability”, Tata McGraw Hill, 2nd Edition 2010
3. D.Culler and J. Singh, Parallel Computer Architecture: A Hardware/Software Approach, Morgan Kaufmann, 1999.

4. J. L. Hennessy and D. A. Patterson. Computer Architecture: A Quantitative Approach. Morgan-Kaufmann publishers.
5. A.Grama, A. Gupta, G. Karypis, and V. Kumar, Introduction to Parallel Computing, 2nd Edition, Pearson: Addison-Wesley, 2003. Errata is available by John Kirk.
6. P.Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann, 2011.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 320	Wireless Networks	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Avg.					
EC 320	Wireless Networks	40	40	40	60	25	--	25	150

Course Objectives:

1. To get familiar with basic of wireless system.
2. To understand planning and design of various mobile and wireless networks.
3. To study various WPAN technologies like Bluetooth, Zigbee etc.
4. To explore basics of WAP.
5. To study basic fundamental of WLAN technologies.
6. To discuss introduction of 5G technology.

Course Outcomes: Upon successful completion of the course students will be able to

1. Get familiar with basic of wireless system.
2. Understand planning and design of various mobile and wireless networks.
3. Study various WPAN technologies like Bluetooth, Zigbee etc..
4. Explore basics of WAP.
5. Study basic fundamental of WLAN technologies.
6. Discuss introduction of 5G technology

Prerequisite: Wireless and mobile communication.

Detailed Theory Syllabus:

Sr. No.	Module	Detailed Content	Hours
1	**Overview of Wireless System**	Advantages, limitations and application wireless media, Infrared Modulation Techniques, DSSS and FHSS, Frequency Spectrum: Radio and Infrared, Wireless generations: 1G: Cellular,2G: Mobile Radio, 3G: UMTS- Security related Encryption Algorithm	05
2	**Planning and design of WWANs**	Basics of fundamental of WWANs, Planning and design of wireless networks, Receiver sensitivity and link budget, Pole capacity of CDMA cell, Uplink and downlink radio link budget for CDMA system	09

3	**WPANs (Low rate and high rate)**	Introduction to wireless PAN, Need of Wireless PAN, Bluetooth Technology: History & Applications, Technical Overview, Bluetooth Specifications, Piconet Synchronization, master-slave switch, Bluetooth security, Enhancements to Bluetooth: Bluetooth Interface issues, Intra & Inter Piconet Scheduling, Scatternet Formation, QoS Assignment, IEEE 802.15 Working group for WPAN, IEEE 802.15.3 & IEEE 802.15.4, Comparison between WPAN System & Comparison between WLAN & WPAN	08
4	**Basics of WAP**	Introduction to WAP, WML basics, Forms and user input, Data base driven WAP	04
5	**Fundamentals of WLANs**	Introduction to wireless LAN, Transmission Techniques, Medium Access Control Protocol Issues: Hidden Terminal Problem, Reliability, Collision Avoidance, Congestion Avoidance, Congestion Control, Energy Efficiency, IEEE 802.11 Standard for Wireless LAN: Network Architecture, Physical Layer, MAC Layer, Security, System design and considerations, Enhancements to IEEE 802.11 MAC: Power Control, Spatial Reusability & QoS Provisioning	09
6	**Introduction to 5G**	Salient features of 5G , 5G technology, 5G Architecture, Advantages and disadvantages, Applications, 5G Advancements, 5G Challenges, 5G future scope	04

DETAILED LAB SYLLABUS:

Software Requirements:

1. Ns-2: http://www.isi.edu/nsnam/ns/
2. Virtual Lab : http://vlab.amrita.edu/index.php?sub=78&brch=256
3. Scilab Experiments Book:
https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjgwcelodTTAhVJrI8KHTQUC9AQFggqMAA&url=http%3A%2F%2Fscilab.in%2Ftextbook_companion%2Fenerate_book%2F3446&usg=AFQjCNGDs2a6AHGKL93l3_j8Ra1UN-5SQQ&sig2=yT9ep5_ZlhfRDVsv-GmsWw&cad=rja

Online Repository Sites:

1. Google Drive
2. GitHub
3. Code Guru

Sr. No.	Detailed Lab Description
1	Study of Hardware and Software aspects of Wireless Network.
2	Study, discussion and installation of different network simulation tools such as NS2/NS3,Netstumbler, Wireshark etc.
3	Analysis of Zigbee Network to compute the energy efficiency of the network.
4	Simulation of a simple wireless network (IEEE802.11) using NS2 or any other simulator.
5	Configuration of WPAN using Xbee S2 series modules and XCTU software.
6	Use of wireshark to capture WiFi or Bluetooth packets.
7	Configuration of WLAN.

8	Analysis of WiFi network to compute average end to end delay and packet delivery ratio.
9	Link budget analysis of a GSM Network using Scilab / Matlab.
10	Link budget analysis of a WCDMA Network using Scilab / Matlab.
11	Simulation of Wireless Sensor Network (IEEE802.15.4)in NS2 or any other simulator.

Theory Assessments:

1. **Internal Assessment**: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.
2. **End Sem Theory Examination:**

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.

Weightage of marks should be proportional to number of hours assigned to each module

Lab Assessments:

1.Term work Assessment:

- Term work should consist of 10 experiments.
- Journal must include at least 2 assignments

Total 25 Marks (Experiments: 10-marks, Attendance Theory& Practical: 05-marks, Assignments: 10-marks)

2.Oral/Viva Assessment:

Based on the above contents and entire syllabus.

Text Books:

1. Vijay K. Garg, “Wireless Communication and Networking”, Morgan -Kaufmann
2. Series in Networking—Elsevier
3. Theodore S. Rappaport, “wireless communications - principles and practice”, PEARSON, Second edition.
4. T L Singal ,“Wireless Communications”, Mc Graw Hill Education.
5. Fundamentals of 5G Mobile Networks: Jonathan Rodriguez (Ist Edition), Wiley Publication

References:

1. WAP Development with WML and WML Script: Ben Forta and Keith
2. Dr SunilkumarS. Manvi, Mahabaleshwar S. Kakkasageri, “Wireless and Mobile
3. Networks Concepts and Protocol”, Wiley India Pvt Ltd.
4. Raj Kamal, “Internet of Things Architecture & Design Principles” Mcgraw Hill
5. Kazem Sohraby, Daniel Minoli, and Taieb Znati, “Wireless Sensor Networks:
6. Technology, Protocols, and Applications”, Wiley Student Edition.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 321	Advanced Robotics	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
EC 321	Advanced Robotics	40	40	40	60	25	–	25	150

Prerequisite: Robotics fundamentals

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs
1	**Basics of Robotic Technology**	3.1 Robot Specifications: Axes, Capacity & Speed, Reach & Stroke, Tool Orientation, Resolution, accuracy and precision of Robot. 3.2 Robot Degrees of Freedom, 3.3 Robot Links, Joints and Symbols, Robot Coordinates, Robot Reference Frames 3.4 Robot Classification	06
2	**Mathematical Modeling of a Robot**	2.1 Homogeneous transformation matrices, 2.2 Inverse transformation matrices, 2.3 Forward and inverse kinematic equations - position and orientation 2.4 Denavit-Hartenberg representation of forward kinematics,	06
3.	**Kinematics & Dynamics of Robot**	3.1 Direct (Forward) Kinematics: Homogeneous coordinates, Link coordinates, Coordinate frame, coordinate transform, Arm equations, An example – Four Axis SCARA. 3.2 Inverse Kinematics: Inverse kinematics problem, Tool Configuration, An example – Four Axis SCARA.	06
4	**Velocity Kinematics & Dynamics**	4.1 Differential motions and velocities: Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian, Singularities. 4.2 Dynamic Analysis of Forces: Lagrangian mechanics, Newton Euler formulation, 4.3 Dynamic equations of two-axis robot	07

5	**Trajectory planning**	5.1 Path vs. Trajectory 5.2 Joint-Space vs. Cartesian-Space Descriptions 5.3 Basics of Trajectory Planning 5.4 Joint-Space Trajectory Planning: Third-Order Polynomial Trajectory Planning, Fifth-Order Polynomial Trajectory Planning, Linear Segments with Parabolic Blends, Linear Segments with Parabolic Blends and Via Points, Higher-Order Trajectories, Other Trajectories 5.5 Cartesian-Space Trajectories 5.6 Continuous Trajectory Recording	07
6	**Robotic Control**	6.1 Basics of control systems for one-axis robots. 6.2 State-Space Control Methodology(one-axis robot). 6.3 Introduction to Controllers. 6.4 Design of Controllers (P, PI, PD, PID). 6.5 Study of LQR Controller for One Axis Robot.	07

DETAILED LAB SYLLABUS:

Hardware Requirements: STM microcontroller

Software Requirements: Scilab, Matlab

Sr. No.	Detailed Lab Description
1	Forward Kinematics of Cylindrical Robot Coordinates.
2	Forward Kinematics of 3 DOF Robots using D-H algorithm.
3	Inverse Kinematics of 2 DOF Robots
4	Inverse Kinematics of 3 DOF Robots
5	Inverse Kinematics of 3 DOF Robot Arm.
6	Trajectory using Third Order Polynomial.
7	PID Controller Tuning for Motor Control
8	Inverted Pendulum Control
9	Modeling of Mobile Robot and Manipulator
10	Mini Project

Theory Assessments:

Internal Assessment: Two Internal assessments will be conducted for 40 marks each with the average marks of both assessments as final score.

End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.

- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

1.Term work Assessment:

At least 07 Experiments and 3 Assignments based on the entire syllabus and **one course mini project/seminar** must be submitted by a maximum batch of 2 to 3 students. Term work assessment must be based on the overall performance of the student with every experiment and Course-project is graded from time to time.

2. Practical/Oral/Viva Assessment: Based on the above contents and entire syllabus.

Text Books:

1 Saeed B. Niku, "Introduction to Robotics: Analysis, Systems,Applications",Pearson Education Inc., New DELHI, 2006

2. Schilling, Robert J. Fundamentals of robotics: analysis and control. Simon & Schuster Trade, 1996.

3. Corke, Peter I., Witold Jachimczyk, and Remo Pillat. Robotics, vision and control: fundamental algorithms in MATLAB. Vol. 73. Berlin: Springer, 2011.

References:

1. R Mittle, I Nagrath, "Robotics and Control", Tata Mc Graw Hill, 2017

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 322	Advanced Network Theory	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
EC 322	Advanced Network Theory	40	40	40	60	25	--	25	150

Course Objectives:

1. To get familiar with emerging wireless technologies.
2. To understand basic concept of optical networking.
3. To study various WAN technologies like Frame relay and ATM.
4. To explore basics of network design.
5. To study basic fundamental of network security.
6. To discuss about network management and control.

Course Outcomes: Upon successful completion of the course students will be able to

1. Get familiar with emerging wireless technologies.
2. Understand basic concept of optical networking.
3. Study various WAN technologies like Frame relay and ATM.
4. Explore basics of network design.
5. Study basic fundamental of network security.
6. Discuss about network management and control

Prerequisite: Computer Networks

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1.	**Emerging Wireless Technologies**	**Wireless Personal Area Network –** Bluetooth Bluetooth (IEEE 802.15.1),Definitions of the Terms Used in Bluetooth, Bluetooth Protocol Stack, Bluetooth Link Types, Bluetooth Security, Network Connection Establishment in Bluetooth, Network Topology in Bluetooth, Bluetooth Usage Models Bluetooth Applications, WAP and Bluetooth Wireless Personal Area Networks (WPAN):Low Rate (LR) and High Rate (HR)Wireless Sensor Network, Usage of Wireless Sensor Networks, Wireless Sensor Network Model, Sensor Network Protocol Stack, ZigBee Technology, IEEE 802.15.4 LR-WPAN	05

		Device Architecture, IEEE 802.15.3a Ultra WideBand, Radio Frequency Identification.	
2.	**Optical Networking**	SONET/SDH Standards, devices, DWDM, frame format, DWDM, Performance and design considerations	09
3.	**WAN Technologies**	**Frame:** FR concept, FR specifications, FR design and VoFR and Performance and design considerations **ATM:** The WAN Protocol: Faces of ATM, ATM Protocol operations. (ATM cell and Transmission) ATM Networking basics, Theory of Operations, B-ISDN reference model, PHY layer, ATM Layer (Protocol model), ATM layer and cell Traffic Descriptor and parameters, Traffic Congestion control defined, AAL Protocol model, Traffic contract and QoS, User Plane overview, Control Plane AAL, Management Plane, Sub S3 ATM,ATM public services	08
4.	**Network Design**	Network layer design, access layer design, access network capacity, network topology and Hardware and completing the access network design	04
5.	**Network Security**	Security threats, safeguards and design for network security Enterprise Network Security: DMZ, NAT, SNAT, DNAT, Port Forwarding, Proxy, Transparent Proxy, Packet Filtering and Layer 7 Filtering	09
6.	**Network Management and Control**	Network management definitions, functional areas (FCAPS), SNMP, RMON, Designing a network management solutions, Monitoring and control of network activity and network project management	04

DETAILED LAB SYLLABUS:

Software Requirements:

1. Cisco PacketTRacer, ns 2
2. Ns-2: http://www.isi.edu/nsnam/ns/
3. Virtual Lab : http://vlab.amrita.edu/index.php?sub=78&brch=256
4. Scilab Experiments Book: https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjgwcelodTTAhVJrI8KHTQUC9AQFggqMAA&url=http%3A%2F%2Fscilab.in%2Ftextbook_companion%2Fenerate_book%2F3446&usg=AFQjCNGDs2a6AHGKL93l3_j8Ra1UN-5SQQ&sig2=yT9ep5_ZlhfRDVsv-GmsWw&cad=rja

Online Repository Sites:

1. Google Drive
2. GitHub
3. Code Guru

Sr. No.	Detailed Lab Description
1	Study of Hardware and Software aspects of Wireless Network.
2	Study, discussion and installation of different network simulation tools such as NS2/NS3, Netstumbler, Wireshark etc.
3	Analysis of Zigbee Network to compute the energy efficiency of the network.
4	Simulation of Wireless Sensor Network (IEEE802.15.4)in NS2 or any other simulator.
5	To analyze the performance of DWDM.

6	To study the performance of SONET.
7	To study the performance of Frame relay.
8	To analyze the performance of ATM.
9	To configure a Network topology using packet tracer software.
10	To study Eavesdropping Attacks and its prevention using SSH.

Theory Assessments:

1. **Internal Assessment:** Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.
2. **End Sem Theory Examination:**
   - Question paper will consist of 4 questions, each carrying 20 marks.
   - Total 3 questions need to be solved.
   - Q.1 will be compulsory, based on the entire syllabus.
   - Remaining questions will be randomly selected from all the modules.
   - Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

- At least 08 experiments covering entire syllabus and one mini project should be set to have well predefined inference and conclusion.
- The experiments should be students' centric and attempt should be made to make experiments more meaningful, interesting and innovative.

1.Term work assessment:

- Term work must be based on the overall performance of the student with every experiment graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme.
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.
- Students are encouraged to share their experiments/mini project codes on online repository.

2.Oral/Viva Assessment:

Based on the above contents and entire syllabus.

Text Books:

1. Vijay K. Garg, "Wireless Communication and Networking", Morgan -Kaufmann
2. Series in Networking—Elsevier
3. ATM and IP Internetworking: Khalid Ahmed, John Wiley and Sons Publication.
4. Network Security and Management: Brijendra Singh, Third Edition, PHI Publication.
5. Optical network design and planning: Jane Simmons (IInd Edition), Springer Publication

References:

1. Theodore S. Rappaport "wireless communications - principles and practice", PEARSON Second edition.
2. Dr SunilkumarS. Manvi, Mahabaleshwar S. Kakkasageri, "Wireless and Mobile Networks Concepts and Protocol"Wiley India Pvt Ltd.
3. T L Singal "wireless communications", Mc Graw Hill Education
4. Kazem Sohraby, Daniel Minoli, and Taieb Znati, "Wireless Sensor Networks:
5. Technology, Protocols, and Applications", Wiley Student Edition.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 323	Cloud Computing	03	02	--	03	01	-	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
EC 323	Cloud Computing	40	40	40	60	25	25	–	150

Course Objectives:

1. To understand the Software Development Life Cycle.
2. To introduce basic concepts and shell scripting of Linux Operating Systems.
3. Basics of cloud computing.
4. Key components of Amazon Web Services.
5. To provide master skills about virtual private cloud.
6. To understand the cloud security.

Course Outcomes:

1. Understand the basic elements and concepts related to Software Development Life Cycle
2. Illustrate the shell scripting for the various applications.
3. Define Cloud Computing and memorize the different Cloud Service and Cloud Deployment Models.
4. Describe the key components of Amazon web Service
5. Demonstrate the implementation of virtual private cloud.
6. Understand the cloud security constraints.

Prerequisite: Distributed systems & Networking

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1.	**Software Development Life Cycle (SDLC) & Process Management**	Importance of SDLC in software development Phases of SDLC: Requirement Gathering and Analysis, System Design, Implementation/Coding, Testing, Deployment, Maintenance and Support Waterfall Model Spiral Model Agile Model Introduction to Process management, process migration, threads, code migration.	08
2.	**Virtual Machine & Operating System.**	Introduction to Linux, Linux Installation and Basic Commands, File system Hierarchy Standard (FHS), Users and Groups Management, Process Management, Package Management, Linux Shell Scripting, File system Administration, Functions & Operators.	07
3.	**Introduction of Cloud Computing**	Introduction to cloud computing: Definition, Goals, Characteristics, Applications. Cloud types: Cloud Deployment Models and Service Models (NIST, Cloud cube model), Cloud computing architecture, Advantages and Disadvantages of Cloud Computing.	06
4.	**AWS Cloud Components and Storages**	EC2: Compute Basics, Instance types, Life cycle of instances. Amazon Machine Image (AMI). EBS: Volume Types & Features, Creation and Management, Key Management System. EFS: Features and Benefits, Architecture and Components. Simple Storage Service (S3): S3 Data Model and Storage Classes, Creating and Managing S3 Buckets, Creating and Managing S3 Buckets, S3 Object Lifecycle Management, DNS & Static Web Page Hosting	05
5.	**Virtual Private Cloud & Load Balancer**	Subnets, Route tables, Elastic IP Addresses (EIP), Elastic Network Interfaces (ENIs), Security groups & ACL, Internet Gateway, Network Address Translation (NAT) Gateway, VPC Peering. Load Balancer, Auto Scaling.	06
6.	**Cloud Security & Application**	Cloud Security Risks and Countermeasures, Data Protection in Cloud, Cloud Application Security, Cloud Identity and Access Management (IAM), Cloud Security as a Service, SAML, OAuth	07

DETAILED LAB SYLLABUS:

Module	Detailed Lab/Tutorial Description
1	1. Understanding of basic and advanced linux commands. 2. Linux Shell Scripting.
2	1. Creating and AWS Account. 2. Launching of EC2 instance and accessing through Mobaxtrem
3	1. Understanding of Amazon Machine Image and its sharing 2. EBS: Creating Snapshot & Sharing across region and account.
4	1. Design of VPC & NAT Gateway 2. Management of VPC Peering and NACL
5	1. Application of Auto Scaling Service of AWS for Managing load with different scaling policies. 2. Elastic Load Balancer with Auto Scaling
6	1. Application of Simple storage service in DNS. 2. IAM Services of AWS.

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 5 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to the number of hours assigned to each module.

Lab Assessment:

1. Term work Assessment:

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Equal weightage should be given to laboratory experiments and while assigning term work marks.

2. Oral/Viva Assessment:

Practical and Oral exam will be based on the entire syllabus.

Text Books:

1. Andrew S. Tanenbaum and Maarten Van Steen, ―Distributed Systems: Principles and Paradigms, 2nd edition, Pearson Education.
2. George Coulouris, Jean Dollimore, Tim Kindberg, , "Distributed Systems: Concepts and Design", 4th Edition, Pearson Education, 2005.
3. Barrie Sosinsky ,”Cloud Computing Bible”,Wiley Publication.

4. Kailash Jayaswal, Jagannath Kallalurchi, Donald J. Houde, Dr. Deven Shah, “Cloud Computing Black Book”, Dreamtech Press.

References:

- A. S. Tanenbaum and M. V. Steen, "Distributed Systems: Principles and Paradigms", Second Edition, Prentice Hall, 2006.
- M. L. Liu, ―Distributed Computing Principles and Applications‖, Pearson Addison Wesley, 2004.
- Pradeep K Sinha, “Distributed Operating Systems: Concepts and design”, IEEE computer society press.
- Ajay D. Kshemkalyani,Mukesh Singhal “Distributed Computing Principles, Algorithms, and Systems”.
- Thomas Erl,Robert Cope,Amin naserpour, “Cloud Computing Design Patterns”,Pearson Publication.
- Judith Hurwitz ,”Cloud Computing for Dummies” , Wiley Publication.

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 324	Advanced VLSI Design	03	02	--	03	01	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		1	2	Average					
EC 324	Advanced VLSI Design	40	40	40	60	25	--	25	150

Course Objectives:

1. To teach various CMOS adders circuits.
2. To highlight the CMOS multiplier and shift registers design
3. To study low power CMOS circuits.
4. To teach various clocking techniques .
5. To teach different clocking techniques and data paths.
6. To highlight different interconnects and delay models.

Course Outcomes: Upon successful completion of the course students will be able to

1. Apply the knowledge to demonstrate various CMOS adder circuits.
2. Understand the CMOS multiplier and shift registers design.
3. Analyze and design Low power CMOS circuits.
4. Understand various clocking techniques..
5. Develop different Data path design
6. Demonstrate a clear understanding of system level design issues such as protection, timing and power dissipation

Prerequisite: Analog Electronics Circuits, Digital Circuits and System Design(DCSD)

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs
1.	**Data Path Design**	**Adder:** Bit adder circuits, ripple carry adder, CLA adder, CMOS implementation of CLA adder, MODL Manchester carry chain adder, Manchester dynamic networks, carry skip adder, carry select adder, carry save adder.	08

2.	**Multipliers and shifter**	**Multipliers and shifter:** Partial-product generation, partial-product accumulation, final addition, Booth algorithm, barrel shifter	06
3.	**Low power design**	**Low power design:** Introduction to low power VLSI design-Need for low power-Charging and Discharging Capacitance-Short Circuit Current in CMOS Circuit-CMOS leakage current-static current-Basic principles of low power design Various components of power dissipation in CMOS, Limits on low power design, low power design through voltage scaling	06
4.	**IO pads and Power Distribution:**	**IO pads and Power Distribution:** ESD protection, input circuits, output circuits, simultaneous switching noise, power distribution scheme.	05
5.	**VLSI Clocking and System Design**	**Clocking:** CMOS clocking styles, Clock generation (single phase, two phase, four phase clocking), stabilization and distribution, Multiphase clock, H tree, Clock skew, Clock jitter	07
6.	**VLSI interconnect design**	**Interconnect:** Interconnect delay model, interconnect scaling and crosstalk, Floor planning & routing, pin ordering - network restructuring and reorganization, Power supply droop and ground bounce.	07

DETAILED LAB SYLLABUS: Students will have to perform experiments or write assignments on following topics.

Software Requirements: TINA**,** NGSpice, Microwind

Sr. No.	Detailed Lab Description
1	Design of CMOS adder circuits.
2	Design of multiplier circuits.
3	Design of barrel shifter circuits.
4	ESD protection, input circuits, output circuits,
5	Switching noise, voltage droop effect in CMOS Ics.
6	Switching noise, ground bounce effect in CMOS Ics.
7	Clock generation (single phase, two phase, four phase clocking),
8	interconnect scaling and crosstalk,

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

- Term work should consist of 8 experiments.
- Journal must include at least 3 assignments.

1. **Term work Assessment:**

Total 25 Marks (Experiments: 10-marks, Assignments: 10-marks, Attendance Theory & Practical: 05-marks)

2. **Oral/Viva Assessment**:

Based on the above contents and entire syllabus.

Text Books:

1. Sung-Mo Kang and Yusuf Leblebici, “CMOS Digital Integrated Circuits Analysis and Design”, Tata McGraw Hill, 3rd Edition.
2. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, “Digital Integrated Circuits: A Design Perspective”, Pearson Education, 2nd Edition.
3. John P. Uyemura, Introduction to VLSI circuits and systems, John Wiley & sons.

References:

1. Etienne Sicard and Sonia Delmas Bendhia, “Basics of CMOS Cell Design”, Tata McGraw Hill, First Edition. 2. Neil H. E. Weste, David Harris and Ayan Banerjee, “CMOS VLSI Design: A Circuits and Systems Perspective”, Pearson Education, 3rd Edition.
2. Debaprasad Das, “VLSI Design”, Oxford, 1st Edition. 6. Kaushik Roy and Sharat C. Prasad, “Low-Power CMOS VLSI Circuit Design”, Wiley, Student Edition.
3. Neil H. E. Weste , Kamran Eshraghian, Principle of CMOS VLSI Design: A system perspective, Addison Wesley publication.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 360	Entrepreneurship	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 360	Entrepreneurship	40	40	40	60	-	-	--	100

Course Objectives:

1. To understand the basic concepts of entrepreneurship.
2. To understand the role of entrepreneurship in economic development
3. To understand the importance of opportunity recognition and internal and external analyses to the success of a business venture
4. To enable the learners to know the factors contributed in failure of the enterprise

Course Outcomes: Learner will be able to

1. Analyse the business environment in order to identify business opportunities
2. Identify the elements of success of entrepreneurial ventures
3. Evaluate the effectiveness of different entrepreneurial strategies,
4. Interpret their own business plan

Module	Detailed Contents	Hrs
1	Conceptual definition of entrepreneurs and entrepreneurship, Advantages and Disadvantages of Being an Entrepreneur , Entrepreneurial motivation, Entrepreneurial characteristics	8
2	Recognizing, assessment and Exploiting the Opportunity, Conducting Internal and External Analyses, Determining the Feasibility of the Concept, Selecting a Marketing Strategy	6
3	Entrepreneurial Business Types A. Overview of Franchising and Their Advantages and Disadvantages B. Overview of Buyouts & Their Advantages and Disadvantages C. Overview of Family Businesses and Their Advantages and Disadvantages	6
4	The Overall Business Plan, Purpose of the Business Plan, Components of the Business Plan, Presentation of the Business Plan, Matching the Business Plan to the Needs of the Firm	6
5	The Marketing Plan, Conducting a Market Analysis, Understanding the Target Market, Reaching the Target Market through Locale and Engagement	8
6	Entrepreneurial failure, early stage failure, late stage failure	6

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation: Class Test/ Assignments / Quiz/ Case studies/ Seminar presentation of 40 Marks

End Semester Examination: 60 marks

Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the syllabus.

Reference Books:

1. Fundamentals of Entrepreneurship by H. Nandan, PHI
2. Entrepreneurship by Robert Hisrich, Michael Peters, Dean Shepherd, Sabyasachi Sinha, Mc Graw Hill
3. Why startups fail: A new roadmap for entrepreneurial success by Tom Eisenmann

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 361	E-Commerce and E-Business	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 361	E-Commerce and E-Business	40	40	40	60	-	-	--	100

Course Objectives:

1. To understand the factors needed in order to be a successful in ecommerce
2. Identify advantages and disadvantages of technology choices such as merchant server software and electronic payment options.
3. Analyse features of existing e-commerce businesses, and propose future directions or innovations for specific businesses.

Course Outcomes: Learner will be able to

1. Appreciate the global nature and issues of electronic commerce as well as understand the rapid technological changes taking place.
2. Define and differentiate various types of E-commerce
3. Discuss various E-business Strategies.

Module	Detail Content	Hrs.
1	**E-commerce system:** Introduction- scope of electronics commerce, definition of e-commerce, difference between e-commerce and e-business, business models of e-commerce transactions. E-commerce infrastructure: client server technology, two tier client server architecture for e-commerce, drawbacks, three tier architecture for e-commerce.	8
2	**Business strategies for e-commerce:** Introduction- elements of e-commerce strategy, simplicity, mobile responsiveness, choosing e-commerce store platform, user-based focus, compliance and security measures, e-commerce strategy: strategy overview, strategy task, technology issues. Case study: Flipkart v/s Amazon, competitive edge, marketing strategy, sales strategy	8
3	**Design of E-commerce systems:** e-commerce types- electronic market, electronics data interchange EDI, modeling of e-commerce system, three tier component model of e-commerce system, e-commerce system design- data model, web modeling, database structure design, process model, user friendly design of e-commerce site.	7
4	**Technologies for e-commerce systems:** Introduction- technologies for e-commerce, PHS and Java script, SEO, Social Plugins, payment processes, SSL Encryption, hosting server, Service oriented architecture.	7
5	**Scalability of e-commerce systems:** Web scalability- Vertical scalability , horizontal scalability, Load balancing- working of load balancers, global server load balancers, cloud load balancing- goals of cloud balancing, automated cloud balancing. web caching and buffering	6

6	**E-commerce system implementation:** E-commerce implementation, - website testing, web maintenance, web advertisement, copyright services, SMS alert services, bulk email services, Web personalization- techniques for gathering information, analysis techniques for website personalization, domain name registration and web hosting- different types of web hosting, different components of web hosting, features in web hosting.	6

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation: Class Test/ Assignments / Quiz/ Case studies/ Seminar presentation of 40 Marks

End Semester Examination: 60 marks

Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the syllabus.

Reference Books:

1. Electronic Business and Electronic Commerce Management, 2nd edition, Dave Chaffey, Prentice Hall, 2006
2. Elias. M. Awad, " Electronic Commerce", Prentice-Hall of India Pvt Ltd.
3. E-Commerce Strategies, Technology and applications (David Whitley) Tata McGrawHill
4. E-business- theory and practise, Brahm Canzer, cengage learning
5. Secure e-commerce systems (Kindle edition), Amazon publishing, P S Lokhande, B B Meshram, first edition

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 362	Research Methodology	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 362	Research Methodology	40	40	40	60	-	-	--	100

Course Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Course Outcomes: At the end of the course learner will be able to

1. Prepare a preliminary research design for projects in their subject matter areas.
2. Accurately collect, analyse and report data.
3. Present complex data or situations clearly.
4. Review and analyse research findings.

Module	Detail Content	Hrs.
1	**Introduction and Basic Research Concepts** 1.1 Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Philosophy and validity of research 1.2 Objectives of Research 1.3 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical 1.4 Need of Research in Business and Social Sciences 1.5 Issues and Problems in Research	8
2	**Types of Research** 2.1. Pure and Applied Research 2.2. Descriptive and Explanatory Research 2.3. Analytical Research 2.4 Qualitative and Quantitative Approaches 2.5 Literature review 2.6 Developing the objectives.	8
3	**Research Design and Sample Design** 3.1 Research Design – Meaning, Types and Significance 3.2 Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	7
4	**Research Methodology** 4.1 Meaning of Research Methodology	8

	4.2. Stages in Scientific Research Process: a. Identification and Selection of Research Problem b. Formulation of Research Problem c. Review of Literature d. Formulation of Hypothesis e. Formulation of research Design f. Sample Design g. Data Collection h. Data Analysis i. Hypothesis testing and Interpretation of Data j. Preparation of Research Report	
5	**Formulating Research Problem** 5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis.	4
6	**Outcome of Research** 6.1 Preparation of the report on conclusion reached. 6.2 Validity Testing & Ethical Issues 6.3 Suggestions and Recommendation 6.4 Identification of future scope	4

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation: Class Test/ Assignments / Quiz/ Case studies/ Seminar presentation of 40 Marks

End Semester Examination: 60 marks

Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the syllabus.

Books/References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 363	Introduction to Bioengineering	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 363	Introduction to Bioengineering	40	40	40	60	-	-	--	100

Course Objectives:

1. To understand and analyze the human body as a mechanical assembly of linkages and describe the fundamentals of biomechanics.
2. To Study the deformability, strength, visco elasticity of bone and flexible tissues, modes of loading and failure and describe the types and mechanics of skeletal joints.
3. To describe movement precisely, using well defined terms (kinematics) and also to consider the role of force in movement (kinetics).
4. To teach students the unique features of biological flows, especially constitutive laws and boundaries.
5. To teach students approximation methods in fluid mechanics and their constraints.
6. To consider the mechanics of orthopedic implants and joint replacement , mechanical properties of blood vessels and Alveoli mechanics

Course Outcomes: Learner will be able to

1. Apply a broad and coherent knowledge of the underlying principles and concepts of biomechanics, particularly in the fields of kinematics and kinetics as applied to human and projectile motion.
2. Understand and describe the properties of blood , bone and soft tissues like articular cartilage tendons and ligaments.
3. Gain broad knowledge about the mechanics of moving systems and familiarity with human anatomy to competently analyze gross movement of the human body.
4. Be able to computationally analyze the dynamics of human movement from the most commonly used measurement devices in the field, such as motion capture and force platform systems.
5. Use knowledge gained to competently interpret the current understanding of human movement and present recommendations for further study.

Module	Detail Content	Hrs.
1	**Introduction:** Definition of Biomechanics, Selected Historical highlights, The Italian Renaissance, Gait century, Engineering Physiology & Anatomy	6
2	**Biomedical Instrumentation:** Patient monitoring system, Arrythmia and ambulatory monitoring instrumentation, cardiac pacemakers, cardiac defibrillators, physiotherapy and electrotherapy equipment, ventilators	8
3	**Medical Image Processing:** Introduction to X-rays based imaging systems, Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), Single-Photon Emission Computerized Tomography (SPECT) scan, Computed Tomography (CT) scan and Ultrasound (sonography)	7
4	**Biomaterials:** Brief Anatomy, Bone, cartilage, ligament, tendon, Muscles, biofluid their physical properties	6
5	**Implants:** General concepts of Implants, classification of implants, Soft tissues	6
6	Application of advanced engineering techniques to the human body, case studies.	6

Assessment:
Internal Assessment: 40 marks
End Semester Examination: 60 Marks

Books/References:

1. Nigg, B.M.and Herzog, W., "BIOMECHANICS of Musculo skeleton system", John Willey & Sons, 1st Edition.
2. Saltzman, W.L., "BIOMEDICAL ENGINEERING: Bridging medicine and Technology", Cambridge Text, First Edition.
3. Winter, D., "BIOMECHANICS and Motor Control of Human Movement", WILEY Interscience Second edition
4. "Biomedical Instrumentation and Measurements" by Leslie Cromwell, Fred J. Weibell, and Erich A. Pfeiffer
5. W. Birkfellner, Applied Medical Image Processing: A Basic Course, CRC Press , Second Edition, 2014
6. Prof. Ghista, Biomechanics, Private Publication UAF, 2009
7. White & Puyator, Biomechanics, Private publication UAE, 2010
8. R. M. Kennedy, A textbook of Biomedical Engineering, GTU, 2010
9. Richard Shalak & Shu Chien, Handbook of Bioengineering,
10. Sean P. Flanagan, Flanagan, Biomechanics: A case based Approach, Jones & Bartlett Publishers, 2013
11. Y. C. Fung, Yuan-Cheng Fung, Biomechanics: mechanical Property of living Tissue, Springer, 1996.
12. Carol A. Oatis, The Mechanics and Pathomechanics of Human Movement, Lippincott Williams & Wilkins, 2010

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 364	Biomedical Instrumentation	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 364	Biomedical Instrumentation	40	40	40	60	-	-	--	100

Course Objectives:

1. Develop a fundamental understanding of human physiology and anatomy to comprehend the sources of biomedical signals and their role in medical diagnosis and treatment.
2. Understand the origin and characteristics of bioelectric signals and learn about the various types of electrodes, biosensors, smart sensors, and biomedical recorders used in healthcare.
3. Gain knowledge of biomaterials, bone structure, composition, and the biomechanics of soft tissues and joints, as well as their applications in implants, prosthetics, and orthotics.
4. Learn about the operation and application of diagnostic instruments
5. Understand the principles and applications of therapeutic instruments
6. Study the integration of AI in healthcare

Course Outcomes: Learner will be able to

1. Explain the fundamentals of human physiology and anatomy and identify the sources of biomedical signals critical to medical diagnostics and instrumentation.
2. Analyze the structure and properties of biomaterials, bones, soft tissues, and joints, and evaluate their applications in developing implants, prosthetics, and orthotic devices.
3. Describe the principles, design, and functionality of basic and intelligent medical instrumentation systems.
4. Assess the functionality and clinical applications of diagnostic instruments.
5. Explain the working principles and applications of therapeutic instruments.
6. Illustrate the role of artificial intelligence in healthcare.

Module	Detail Content	Hrs
1	**Fundamentals of Bioengineering:** A brief on human physiology and anatomy, sources of biomedical signals, basic medical instrumentation system, intelligent medical instrumentation systems, regulation of medical devices.	6
2	**Biomaterials and Biomechanics:** Introduction to biomaterials, Bone structure & composition, Structure and functions of Soft Tissues, types of joint , Implants, Prosthetics and orthotics.	6
3	**Bioelectric signals and electrodes:** Origin of Bioelectrical signals, Recording electrodes, Microelectrodes, Biosensors, Smart Sensors, Biomedical recorders.	8
4	**Introduction to Diagnostics Instruments:** Patient monitoring system, Arrythmia and ambulatory monitoring instrumentation, oximeters, Blood flowmeter, Cardiac output measurement, Pulmonary analyzers, Blood gas analyzers, Blood cell counters.	7
5	**Introduction to Therapeutic Instruments:** cardiac pacemakers, cardiac defibrillators, instruments for surgery, physiotherapy and electrotherapy equipment, hemodialysis machine, ventilators	6
6	**AI for Health care:** Medical Imaging, Surgical Assistance, Personalized medicine, Wearable Devices and monitoring, Healthcare management system	6

Assessment:
Internal Assessment: 40 marks
End Semester Examination: 60 Marks

Books/References:

1. "Handbook of Biomedical Instrumentation" by R. S. Khandpur
2. "Biomedical Instrumentation and Measurements" by Leslie Cromwell, Fred J. Weibell, and Erich A. Pfeiffer
3. "Medical Instrumentation: Application and Design" by John G. Webster
4. "Biomechanics: Principles and Applications" by Donald R. Peterson and Joseph D. Bronzino
5. "Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again" by Eric Topol

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 365	Design of Experiments	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 365	Design of Experiments	40	40	40	60	-	-	--	100

Course Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Course Outcomes: Learner will be able to…

1. Fundamentals of experiments and its uses
2. Basic statistics including ANOVA and regression
3. Experimental designs such as RCBD, BIBD, Latin square, factorial and fractional factorial designs.
4. Apply statistical models in analyzing experimental data
5. RSM to optimize response of interest from an experiment
6. Use software such as Minitab

Module	Detailed Contents	Hrs
1	**Introduction** 1. Why experiment? 2. Terms and Component of Experiment 3. Experimental Units and Responses 4. Types of Data ,Plots and Charts 5. Importance of Product Reliability 6. Uncertainty of Measurement 7. Classification of DOE 8. Software for DOE 9. Principle of Experimental Design 10. Types of Experimental Design	08
2	**Basic Statistics and ANOVA** 1. Random Variable and Probability Distribution 2. Normal Distribution 3. Sampling Distribution 4. Estimation	08

	5. Hypothesis Testing 6. Determination of Sample size 7. Analysis of Variance(ANOVA) 8. Estimation of model parameters and Adequacy test 9. ANOVA-Pair wise comparison and Tukey's and Fishers LSD test 10. Two way ANOVA 11. Multi way ANOVA 12. Determination of Sample Size for ANOVA	
3	**Regression** 1. Introduction to Multiple Linear Regression(MLR) 2. Sampling distribution of Regression coefficients 3. MLR: Hypothesis testing and Model Adequacy Test 4. MLR:Diagnostic and Testing for Lack of Fit 5. Regression approach to ANOVA	07
4	**Experimental Designs** 1. Randomized Complete block design (RCBD) 2. RCBD-Estimation of Parameters 3. RCBD-Balanced Incomplete block design(BIBD) 4. RCBD-Latin square design 5. Introduction to Factorial Design 6. Statistical Analysis of Factorial Design 7. Estimation of parameters and Model Adequacy test 8. Full factorial design 9. Two level factorial design 10. Statistical Analysis of the 2^k Design 11. Blocking and Confounding in the 2^k Design 12. Fractional Factorial Design	08
5	**Response Surface Methods and Designs** 1. Introduction to Response Surface Methodology 2. RSM-First order model 3. Experimental design for fitting Response Surfaces 4. RSM-Fitting Second order model 5. Analysis of Second order RSM	06
6	**Taguchi Approach** 1. Crossed Array Designs and Signal-to-Noise Ratios 2. Analysis Methods 3. Robust design examples	04

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation: Class Test/ Assignments / Quiz/ Case studies/ Seminar presentation of 40 Marks

End Semester Examination: 60 marks
Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the syllabus.

Books/References:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statistics for Experimenters: Design, Innovation and Discovery, 2 nd Ed. Wiley
4. W J Diamond, Practical Experiment Designs for Engineers and Scientists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 366	Design for Sustainability	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 366	Design for Sustainability	40	40	40	60	-	-	--	100

Course Objectives:

1. Understand the complex environmental, economic, and social issues related to sustainable engineering
2. Become aware of concepts, analytical methods/models, and resources for evaluating and comparing sustainability implications of engineering activities
3. Critically evaluate existing and new methods
4. Develop sustainable engineering solutions by applying methods and tools to research a specific system design
5. Clearly communicate results related to their research on sustainable engineering

Course Outcomes: Learner will be able to

1. Account for different theoretical and applied design principles and models for sustainable design
2. Account for and critically relate to sustainable design from an ethical, cultural and historical perspective
3. Critically review different design solutions ecological, social and economical consequences, risks, possible uses and functions in the work for a sustainable development
4. Independently apply a specific design theory on a specific challenge within the sustainability field.

Module	Detailed Contents	Hrs
1	Introduction - Need, Evolution of sustainability within Design, environmental - economic sustainability concept, Challenges for sustainable development, Environmental agreement & protocols	6
2	Product Life Cycle Design – Life Cycle Assessment, Methods & Strategies, Software Tools	6
3	Sustainable Product - Service System Design, Definition, Types & Examples ,Transition Path and Challenges, Methods and Tools, Design thinking and design process for sustainable development	8
4	Design for Sustainability – Engineering Design Criteria and Guidelines	6
5	Design for Sustainability – Architecture, Agriculture, Cities & Communities, Carbon Footprint	6
6	Green Building Technologies - Necessity, Principles, low energy materials, effective systems	6

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation: Class Test/ Assignments / Quiz/ Case studies/ Seminar presentation of 40 Marks

End Semester Examination: 60 marks

Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the syllabus.

Books/References:

1. C. Vezzoli, System Design for sustainability. Theory, methods and tools for a sustainable / satisfaction system/design, Rimini, Maggioli Edition, 2007.
2. C. Vezzoli and E. Manzini, Design for Environmental Sustainability, Springer – Verlag, London, 2008.
3. L. Nin and C. Vezzoli, Designing Sustainable Product-Service Systems for all. Milan: Libreria, CLUP, 2005
4. A. Tukker and U. Tischner (eds.), New Business for Old Europe, Product Services, Sustainability and Competitiveness, Greenleaf Publishing, Shefield, 2008.
5. A. Tukker, M. Charter, C. Vezzoli, E. Sto and M.M. Andersen (eds.), System innovation for Sustainability Perspective on Radical Changes to sustainable consumption and production, Greenleaf Publishing, Shefield, 2008
6. UNEP, Product-Service Systems and Sustainability. Opportunities for sustainable solutions, CEDEX, Paris, 2002, at http://www.uneptie.org/pc/sustain/reports/pss/pss-imp-7.pdf

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 367	Political Science	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 367	Political Science	40	40	40	60	-	-	--	100

Course Objectives:

1. Provide a good grounding in the basic concepts of Political Theory.
2. Familiarize learners with fundamental rights and duties.
3. Teach students the structure and process of the electoral system, the features and trends of the party system and create an awareness of the social movements in India.
4. To inculcate the values of renowned thinkers on law, freedom of thought and social justice.
5. To prepare the learners for understanding the importance of Comparative Government and Politics.
6. To train learners in understanding International Relations.

Course Outcomes: Learner will be able to

1. Acquire conceptual and theoretical knowledge in the basic concepts of political theory.
2. Demonstrate understanding of fundamental rights and duties and directive principles.
3. Perform successfully in expressing the process of the electoral system, the features and trends of the party system and the importance of the social movements in India.
4. Illustrate the contribution of renowned thinkers and relate it to the current scenario.
5. Compare and contrast Indian Government and Politics with European countries.
6. Develop an understanding of International Relations with respect to Indian foreign policy.

Module	Detail Content	Hrs.
1	Understanding Political Theory- Evolution of State, Nation, Sovereignty, Types and Linkages between Power and Authority; Interrelationships between Law. Liberty, Equality, Rights; Justice and Freedom, Democracy vs Authoritarianism	4
2	Constitutional Government in India - Evolution of the Indian Constitution, Fundamental Rights and Duties. Directive Principles. Union-State Relations, Union Legislature: Rajya Sabha, Lok Sabha: Organisation, Functions – Law making procedure, Parliamentary procedure, Government in states: Governor, Chief Minister and Council of Ministers: position and functions – State Legislature: composition and functions. Judiciary: Supreme Court and the High Courts: composition and functions – Judicial activism. Constitutional amendment. Major recommendations of National Commission to Review the Working of the Constitution.	6

3	Politics in India: Structures and Processes- Party system: features and trends – major national political parties in India: ideologies and programmes. Coalition politics in India: nature and trends. Electoral process: Election Commission: composition, functions, role. Electoral reforms. Role of business groups, working class, peasants in Indian politics, Role of (a) religion (b) language (c) caste (d) tribe. Regionalism in Indian politics. New Social Movements since the 1970s: (a) environmental movements (b) women's movements (c) human rights movements.	6
4	Indian Political Thought- Ancient Indian Political ideas: overview. Kautilya: Saptanga theory, Dandaniti, Diplomacy. Medieval political thought in India: overview (with reference to Barani and Abul Fazal). Legitimacy of kingship. Principle of Syncretism, Modern Indian thought: Rammohun Roy as pioneer of Indian liberalism – his views on rule of law, freedom of thought and social justice. Bankim Chandra Chattopadhyay, Vivekananda and Rabindranath Tagore: views on nationalism. M.K. Gandhi: views on State, Swaraj, Satyagraha.	7
5	Comparative Government and Politics- Evolution of Comparative Politics. Scope, purposes and methods of comparison. Distinction between Comparative Government and Comparative Politics.	6
6	Perspectives on International Relations- Understanding International Relations: outline of its evolution as academic discipline. Major theories: (a) Classical Realism and Neo-Realism (b) Dependency (c) World Systems theory. Emergent issues: (a) Development (b) Environment (c) Terrorism (d) Migration. Making of foreign policy. Indian foreign policy: major phases: 1947-1962; 1962-1991; 1991-till date. Sino-Indian relations; Indo-US relations.	7

Assessments:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation: Class Test/ Assignments / Quiz/ Case studies/ Seminar presentation of 40 Marks

End Semester Examination: 60 marks

Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the syllabus.

Books/References:

1. O.P. Gauba. (2021). *An Introduction to Political Theory*. Mayur books
2. Vibhuti Bhushan Mishra. (1987). *Evolution of the Constitutional History of India (1773-1947 : With Special Reference to the Role of the Indian National Congress and the Minorities).* South Asia Books
3. Chetna Sharma Pushpa Singh. (2019). *Comparative Government and Politics.* SAGE Publications India Pvt Ltd.
4. Henry R. Nau. (1900). *Perspectives on International Relations: Power, Institutions and Ideas*. CQ Press

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 368	Visual Art	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 368	Visual Art	40	40	40	60	-	-	--	100

Course Objectives:

1. To enable learners to develop aesthetic judgement, visual perception, critical thinking skills in the different forms of art and understand its application.
2. To promote the concept of visual design and understand the different meanings assigned to colours, its impact and problems.
3. To provide the opportunity and scope to use the image editing software for creating images for Web and Video.
4. To inculcate the basic skills required in drawing and painting through exposure in nature and study of still objects.
5. To train students to express their feelings and write imaginatively.
6. To prepare the learners for the use of clay modelling techniques and its industrial applications.

Course Outcomes: Learner will be able to

1. Acquire the skills necessary for aesthetic judgement, visual perception and critical thinking required in different forms of art.
2. Demonstrate the understanding of the concept of visual design with respect to the different meanings assigned to colours and the problems associated.
3. Illustrate effective use of image editing software for creating images for the Web and Video.
4. Determine the importance of drawing and painting with respect to nature and still objects.
5. Perform successfully in expressing their feelings creatively.
6. Develop the techniques required for clay modelling and sculpture for industrial use.

Module	Detail Content	Hrs.
1	History of Art and Architecture- Changing needs and forms of art from the Palaeolithic period to The Renaissance period with special reference to Roman, Indian and Chinese art	4
2	Introduction and concepts of visual design with special emphasis on the psychological impact of colour	5
3	Introduction to image editing software, tools, application and creating Images for Web and Video. With special reference to Adobe Photoshop	7
4	Fundamentals of Drawing- study of forms in nature, study of objects and study from life, creative painting- basic techniques, tools and equipment, medium of painting.	6
5	Creative writing- Movie critique, book reviews, Poems, short plays and skits, Humorous Essays, Autobiography and short stories.	7

6	Creative sculpture- Introduction to clay modelling techniques, study of natural and man-made objects in clay, Sculpture with various materials - Relief in Metal Sheets – Relief on Wood – Paper Pulp - Thermocol. Sculpture with readymade materials.	7

Assessments:
Internal Assessment: 40 marks
End Semester Examination: 60 marks
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Reference Books:

1. Gill Martha. (2000). Color Harmony Pastels: A Guidebook for Creating Great Color Combinations. Rockport Publishers.
2. Janson, Anthony F. (1977). History of art, second edition, H.W. Janson. Instructor's manual. Englewood Cliffs, N.J.: Prentice-Hall.
3. Brommer, Gerald F. (1988). Exploring Drawing. Worcester, Massachusetts: Davis Publications.
4. Wendy Burt Thomas. (2010). The Everything Creative Writing Book: All you need to know to write novels, plays, short stories, screenplays, poems, articles, or blogs: All You Need ... - Stories, Screenplays, Blogs and More. Fw Media; 2nd edition.
5. Élisabeth Bonvalot. (2020). Sculpting Book: A Complete Introduction to Modeling the Human Figure.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 369	Modern Day Sensor Physics	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 369	Modern Day Sensor Physics	40	40	40	60	-	-	--	100

Course Objectives:

1. Acquire knowledge about the principles and analysis of sensors.
2. Emphasis on characteristics and response of micro sensors.
3. Acquire adequate knowledge of different transducers and Actuators.
4. Learn about the Micro sensors and Micro actuators.
5. Selection of sensor materials for fabrication for different applications

Course Outcomes: On successful completion of course learner/student will be able to:

1. Analyze the basics and design the resistive sensors.
2. Identify the materials and designing of inductive and Capacitive Sensors.
3. Analyze various types of Actuators.
4. Design Micro sensors and Micro Actuators for various applications.
5. Implement fabrication process and technologies and compare various Micro machining processes

Module	Detail Content	Hrs.
1	**Fundamentals of Sensors :** Difference Between Sensor, Transducer And Actuators- Classification Of Sensors: Proprioceptive And Exteroceptive – Active And Passive– Contact And Non-Contact, Selection And Characteristics: Range; Resolution, Sensitivity, Error, Repeatability, Linearity And Accuracy, Primary Sensing Elements.	6
2	**Temperature sensors:** Principle of operation, construction details, characteristics and applications of Bimetallic thermometer, Resistance thermometer, Thermistor, Thermocouples and Total radiation Pyrometers	8
3	**Strain, Force, Torque and Pressure Sensors** Strain gauges, strain gauge beam force sensor, piezoelectric force sensor, load cell, torque sensor, Piezo- resistive and capacitive pressure sensor, Manometer, vacuum sensors, Pirani gauge.	6
4	**Displacement, Level and Flow Sensors**	8

	Displacement Sensors: LVDT, RVDT, eddy current, transverse inductive, Hall Effect, magneto resistive, magnetostrictive sensors. **Liquid level sensor**: Fabry Perot sensor, ultrasonic sensor, capacitive liquid level sensor. **Flow sensors**: pressure gradient technique, ultrasonic, electromagnetic sensors and Hot wire anemometer. Micro flow sensor, Coriolis mass flow and drag flow sensor.	
5	**Micro Machining Technologies** Overview of silicon processes techniques, Photolithography, Ion Implantation, and Diffusion, Chemical Vapor Deposition, Physical vapor Deposition, Epitaxy, Etching, Bulk micromachining, Surface Micromachining, LIGA and other techniques.	6
6	**Actuators** Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator, Hydraulic actuator - Control valves and cylinders Electrical actuating systems: Solenoids, Electric Motors- D.C motors - AC motors - Three Phase Induction Motor, Stepper motors -Piezoelectric Actuator.	5

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation: Class Test/ Assignments / Quiz/ Case studies/ Seminar presentation of 40 Marks

End Semester Examination: 60 marks

Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the syllabus.

Books/Reference:

1. Robert H Bishop, “The Mechatronics Hand Book”, CRC Press, 2002.
2. Thomas. G. Bekwith and Lewis Buck.N, “Mechanical Measurements”, Oxford and IBH publishing Co. Pvt. Ltd.,
3. Massood Tabib and Azar, “Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures”, First edition, Kluwer academic publishers, Springer, 1999.
4. Manfred Kohl, Shape Memory Actuators, first edition, Springer.
5. Patranabis.D, Sensors and Transducers, Wheeler publisher, 1994.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 370	Energy Audit and Management	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 370	Energy Audit and Management	40	40	40	60	-	-	--	100

Course Objectives:

1. To impart basic knowledge to the students about current energy scenario, energy conservation, audit and management.
2. To inculcate among the students systematic knowledge and skill about assessing the energy efficiency, energy auditing and energy management.
3. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
4. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Course Outcomes: Upon successful completion of this course, the learner will be able to

1. To identify and describe the present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities.
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detail Content	Hrs.
1	**Energy Scenario:** Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sector reforms, Energy and environment: Air pollution, Climate change, Energy security, Energy conservation and its importance, Energy strategy for the future, Energy conservation Act2001 and its features.	4
2	**Energy Management and Audit:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments.	10

	Material and Energy balance: Facility as an energy system, Methods for preparing process flow, Material and energy balance diagrams. **Financial Management:** Investment-need, Appraisal and criteria, Financial analysis techniques- Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis, Financing options, Energy performance contracts and role of ESCOs	
3	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
4	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
5	**Energy Performance Assessment: On site Performance evaluation techniques, Case studies based on:** Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	3
6	**Energy conservation in Buildings: Energy Conservation Building Codes (ECBC):** Green Build Building, LEED rating, Application of NonConventional and Renewable Energy Sources	3

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation: Class Test/ Assignments / Quiz/ Case studies/ Seminar presentation of 40 Marks

End Semester Examination: 60 marks

Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the syllabus.

Books/References:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 371	Maintenance of Electronics Equipment	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 371	Maintenance of Electronics Equipment	40	40	40	60	-	-	--	100

Course Objectives:

1. To demonstrate use of different types of hand tools.
2. To understand testing of different active and passive components mounted on PCB
3. To understand functionality TTL and CMOS digital IC tester.
4. To demonstrate computer assembling, troubleshooting and software installation.
5. To understand/demonstrate concept of circuit diagram of LED/LCD TV, DTH and mobile phone troubleshooting.
6. To understand concept of designing, manufacturing electronic circuit, medical equipment.

Course Outcomes:

1. Demonstrate use of different types of hand tools.
2. Understand testing of different active and passive components mounted on PCB.
3. Understand functionality TTL and CMOS digital IC tester.
4. Demonstrate computer assembling, troubleshooting and software installation.
5. Understand/demonstrate concept of circuit diagram of LED/LCD TV, DTH and mobile phone troubleshooting.
6. Understand concept of designing, manufacturing electronic circuit, medical equipment.

Detailed Lab/Tutorial Description: Students will have to perform six to eight experiments / tutorials in lab from the following list and write journal as a term work.

SN	Detailed Lab/Tutorial Description	Hrs.
1	Demonstrate working, use of two instruments in electronics laboratory.	4
2	Test the performance of different passive electronic components (fixed/variable)	4
3	Test the performance of active electronic components like general purpose transistor/FET/MOSFET/SCR/ DIAC/TRIAC with DMM and CRO OR Components Tester	4
4	Verify the functionality of TTL and CMOS Digital IC's using IC tester	4

5	Explore a datasheet of minimum any five electronics components and analog/ Digital IC's.	4
6	Draw the given regulated power supply circuit/ SMPS (from any television/fridge/ computer system/ laboratory etc)	4
7	Identify basic sections of a personal computer/Laptop	4
8	Demonstrate Assembling of Personal Computer/Laptop	4
9	Troubleshoot the booting process of computer system and install different hardware associated with computer (HDD, LAN Card, Audio System etc)	4
10	Study Installation of Software and Configure Internet	4
11	Explore circuit diagram of LED/LCD TV.	4
12	Demonstrate Installation of DTH system	4
13	Demonstrate installation Solar power system	4
14	Practice steps for mobile troubleshooting	4

In addition, the students will have to submit report in prescribed format and give presentation at the end of semester on any one of the following activity:

SN	Details of Activity	Hrs.
1	Design and assembling of small electronic project circuit on PCB. Students will learn design of circuit, its simulation, PCB design, PCB manufacturing, soldering of components, troubleshooting of the circuit.	12
2	Visit to medical equipment industry / laboratory	12

Assessments:
Internal Assessment: 40 marks
End Semester Examination: 60 marks

Books/References:

1. Troubleshooting and Maintenance of Electronics Equipment, Singh K. Sudeep, Katson Book, New Delhi, II edition, Reprint 2014
2. Mobile repairing Books, Manohar Lotia, BPB Publication, New Delhi , latest edition
3. Troubleshooting Electronic Equipment: Includes Repair and Maintenance, Second Edition, Khandpur R. S., Tata McGraw-Hill Education, New Delhi, India, latest edition.
4. Data Books, National semiconductor.
5. Modern Digital Electronics, Fourth edition, R. P. Jain, Tata McGraw-Hill Education, New Delhi, India.
6. Manuals of instruments in electronics laboratories.

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 372	Cooking and Nutrition	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 372	Cooking and Nutrition	40	40	40	60	-	-	--	100

Course Objectives: The course is aimed to

1. To understand nutrition and of health problems related to diet and various factors affect diet
2. To various statistical tools required to analyze the experimental data in nutrition and community research
3. Gain information about various food constituents, and changes that occur in them during food processing.
4. To gain food-related knowledge and skills so that they can organise and manage family resources effectively according to the needs and lifestyles of family members
5. To be able to make informed judgements and choices about the use of food available.
6. To create interest in the creative side and enjoyment of food and the skills necessary for food preparation and food preservation. And to be aware of relevant mandatory and other necessary safety and hygiene requirements

Course Outcomes: On successful completion of course learner/student will be able to

1. To understand the importance and mechanisms of the food components taking place during food processing,
2. To understand nutrition and of health problems related to diet and various factors affect diet
3. To aware how eating patterns and dietary needs depend on age and social group
4. Ability to assess the effectiveness and validity of claims made by advertisers
5. To enhance aesthetic and social sensitivity to dietary patterns and to develop an interest in the creative aspect and enjoyment of food
6. To develop skills necessary for food preparation and food preservation and knowledge of safety and hygiene requirements

Module	Detail Content	Hrs.
1	**Nutritional terms**: proteins (high biological and low biological value), carbohydrates (monosaccharide, disaccharide and polysaccharide), fats, vitamins (A, C, D, E, K, B group – thiamin, riboflavin, nicotinic acid and cobalamin), mineral elements (calcium, iron, phosphorous, potassium, sodium, iodide) water Sources and uses of food energy. Sources and functions of dietary fibre.	3
2	**Kitchen equipment & Kitchen planning:** Selection, Use and care of: modern cookers, thermostatic control and automatic time-controlled ovens, microwave ovens, slow electric cook pots, refrigerators and freezers, small kitchen equipment, e.g. knives, pans, small electrical kitchen equipment, e.g. food processors, electric kettles, Advantages and	4

	disadvantages of microwave ovens, Organisation of cooking area and equipment for efficient work., Selection, Use and care of: work surfaces, flooring, walls and wall coverings, lighting, ventilation	
3	**Meal planning and guidelines:** Factors affecting food requirements, Planning and serving of family meals, Meals for different ages, occupations, cultures and religions, Special needs of: people with food allergies and intolerances, people with medical conditions linked to diet, such as diabetes, convalescents, vegetarians, including vegans and lacto-vegetarians, Meals for special occasions, festivals, packed meals, snacks, beverages, Use of herbs, spices and garnishes, Attractive presentation of food, Terminology describing recommended dietary intakes, e.g. Dietary Reference Value (DRV) and Reference Daily Intake (RDI).	6
4	**Strategic cooking**: Transfer of heat by conduction, convection and radiation. Principles involved in the different methods of cooking, baking, boiling, braising, cooking in a microwave oven, frying, grilling, poaching, pressure cooking, roasting, simmering, steaming, stewing, use of a slow cooker. Reasons for cooking food, Sensory properties of food (flavour, taste, texture), Effect of dry and moist heat on proteins, fats and oils, sugars and starches, and vitamins to include: caramelisation, coagulation dextrinization, enzymic and non-enzymic browning, gelatinisation, rancidity, smoking point, Preparation and cooking of food to preserve nutritive value, Economical use of food, equipment, fuel and labour.	6
5	**Convenience foods and Basic proportions:** Foods partly or totally prepared by a food manufacturer – dehydrated, tinned, frozen, ready-to-eat, Intelligent use of these foods, Advantages and disadvantages, Food additives – types and function, Packaging – types, materials used, Labelling – information found on labels, Importance of maintaining proportions, maintaining proportions for : Bakery products, melting, rubbing-in and whisking methods, Pastries – shortcrust, flaky and rough puff, Sauces – pouring and coating, roux and blended methods, Batters – thin (pouring) and coating, Sweet and savoury yeast products	5
6	**Food preservation & Kitchen safety and first aid**: Food preservation & Kitchen safety and first aid: Reasons for preserving food, Methods of preservation and an understanding of the principles involved: heating – canning, bottling; removal of moisture – dehydrating; reduction in temperature – freezing; chemical preservation – sugar, salt, vinegar; modified atmosphere packaging; irradiation; Awareness of potential danger areas in the kitchen. Safety precautions. First aid for burns and scalds, cuts, electric shock, fainting, shock.	5

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation: Class Test/ Assignments / Quiz/ Case studies/ Seminar presentation of 40 Marks

End Semester Examination: 60 marks

Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the syllabus.

Books/References:

1. Fundamentals of Food and Nutrition by Tejmeet Rekhi, Heena Yadav
2. Food Process Engineering And Technology by Akash Pare, B L Mandhyan

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 373	Environmental Management	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 373	Environmental Management	40	40	40	60	-	-	--	100

Objectives:

1. To promote the safety, health, and welfare of people and the environment through engineering professionals.
2. To encourage students to be productive and contributing members of the environmental profession as practitioners, entrepreneurs, researchers, or teachers.
3. To develop environmental awareness among students that meet specified engineering needs with consideration of public health, safety, and welfare, as well as global, environmental, and legal factors.

Outcomes: On successful completion of the course learner/student will be able to:

1. Understand core concepts and methods from ecological sciences and their application in environmental problem-solving.
2. Recognize different types of toxic substances and analyze toxicological information
3. Acquire and apply environmental knowledge to the engineering field as needed.
4. 4. Assist industries and projects in obtaining environmental clearance and compliance with other environmental laws.
5. Interpret appropriate environment-related legislation.
6. Develop a thorough understanding of practice and procedure followed by various enforcing agencies/bodies/countries.

Module	Detail Contents	Hrs.
1	**Fundamentals of Environmental Sciences** Definition, Principles, and Scope of Environmental Science. Structure and composition of the atmosphere, hydrosphere, lithosphere, and biosphere. Concept of Ecology- Ecosystem, Food chain, Food web, Ecological pyramid, Ecological succession, limiting factor, and carrying capacity. Global Environmental Concerns (Global warming, Loss in Bio-diversity, Ozone depletion, E-waste management) and Renewable Energy Resources (Solar Energy, Wind Energy, Hydrothermal Energy, etc.)	8
2	**Environmental Chemistry Toxic chemicals:** Pesticides and their classification and effects. Biochemical aspects of heavy metals (Hg, Cd, Pb, Cr) and metalloids (As, Se), Sewage	8

	treatment, Concept of DO, BOD, and COD. Composition of air-chemical processes in the formation of inorganic and organic particulate matter, Thermochemical and photochemical reactions in the atmosphere, Oxygen and Ozone chemistry. Photochemical smog, Air Quality Index	
3	**Fundamentals of Environmental Management** Concept of Environmental Management, Need & Objective of Environmental Management, Role of Engineers in Environmental Management, Career Opportunities. The need for sustainable development, Sustainable Development Goals	5
4	**Scope of Environmental Management** Role and functions of Government as a planning and regulatory agency. Environment Quality Management and Corporate Environmental Responsibility. Total quality Environmental management: ISO 14000, EMS Certification. Environmental Management System Standards (ISO-14000 series). Environment and Social Management Plan	7
5	**Overview of Environmental Laws in India** Constitutional provisions in India (Articles 48A and 51A). Wildlife Protection Act, 1972 Indian Forest Act, Water (Prevention and Control of Pollution) Act, Air (Prevention and Control of Pollution) Act, Environmental (Protection) Act, 1986, The e-waste (Management) Rules 2016	5
6	**Environmental Conventions and Agreements** Stockholm Conference on Human Environment 1972, Montreal Protocol, 1987, Earth Summit at Rio de Janeiro, 1992, Agenda-21, Convention on Biodiversity (1992), UNFCCC, Kyoto Protocol, 1997, Copenhagen Summit, Paris Agreement, CITES.	6

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation: Class Test/ Assignments / Quiz/ Case studies/ Seminar presentation of 40 Marks

End Semester Examination: 60 marks

Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the syllabus.

Books/References:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G.Oakwell, Edward Elgar Publishing
3. Environmental Management, V Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000

Course Code	Course Name	Theory (Hrs.)	Practical (Hrs.)	Tutorial (Hrs.)	Theory (Credits)	Practical /Oral (Credits)	Tutorial (Credits)	Total (Credits)
EC 392	Project-A	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg. of 2 Tests					
EC 392	Project-A	--	--	--	--	50	--	50	100

Lab Objectives:

1. To offer students a glimpse into real world problems and challenges that need Engineering based Solutions
2. To enable students to create very precise specifications of the Engineering solution to be designed.
3. To introduce students to the vast array of literature available of the various research challenges in the field of Electronics and Computer Science Engineering.
4. To create awareness among the students of the characteristics of several domain areas where Electronics and Computer Science Engineering can be effectively used.
5. To enable students to use all concepts in creating a solution for a problem
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Discover potential research areas in the field of Electronics and Computer Science Engineering.
2. Conduct a survey of several available literatures in the preferred field of study
3. Compare and contrast the several existing solutions for research challenge.
4. Demonstrate an ability to work in teams and manage the conduct of the research study.
5. Formulate and propose a plan for creating a solution for the research plan identified
6. To report and present the findings of the study conducted in the preferred domain

Guidelines:

1. The project work is to be conducted by a group of two to four students
2. Each group will be associated with a project mentor/guide. The group should meet with the project mentor/guide periodically and record of the meetings and work discussed must be documented.
3. Department has to allocate half day for the project work in VI semester.
4. To encourage project based learning in the curriculum students may identify their technical domain area in semester VI and can perform the Mini-project in the VI semester or students may do literature survey.
5. Each group along with its guide/mentor shall identify a potential research area/problem domain, on which the study is to be conducted.

6. Each team will do a rigorous literature survey of the problem domain by reading and understanding at least 3-5 research papers from current good quality national/international journals/conferences.
7. (Papers selected must be indexed by Scopus/IEEE/Springer/ACM etc.). The list of papers surveyed must be clearly documented.
8. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) members as internal examiners (including the project guide/mentor) appointed by the Head of the department.
9. A report is to be prepared summarizing the findings of the literature survey. A comparative evaluation of the different techniques surveyed is also to be done.
10. Teams must analyze all the results obtained by comparing with other standard techniques.
11. Every team must publish their work in national / international conference/journals if possible (publish in Scopus indexed journals).
12. The team will finally propose a plan for project work to be continued in the final year.

Project Assessment:

1.Evaluation:

1. Each team has to give presentation/demo to the Internal Panel and External examiner.
2. Each team will prepare a report that will summarize the results of the literature survey and the project proposal. The list of papers surveyed must be clearly documented.
3. Each group will be jointly evaluated by a team of Internal and External Examiners approved by the Department of Electronics and Computer Science Engineering.
4. Oral exam will be conducted on the project done by the students.

2.Term Work:

Term Work shall consist of full Literature survey/ Mini-project and Presentation on above guidelines/syllabus.

3.Oral Exam:

An Oral exam will be held based on the Literature survey/ Mini-project and Presentation.