Curriculum Structure & Detailed Syllabus

Bachelor of Technology

Effective from Academic Year 2026-2027

School of Computer Science and Engineering

Kalinga Institute of Industrial Technology

Deemed to be University

Bhubaneswar

Vision of the University

To create an advanced centre of professional learning of international standing where pursuit of knowledge and excellence shall reign supreme, unfettered by the barriers of nationality, language, cultural plurality and religion.

Mission of the University

- Imparting value based quality education of international standard and imbibing skill for solving real life problems.
- Inculcating global perspective in attitude.
- Creating leadership qualities with futuristic vision.
- Fostering spirit of entrepreneurship and realisation of societal responsibilities.
- Cultivating adaptation of ethics, morality and healthy practices in professional life.
- Instilling habit of continual learning.
- Encouraging and supporting creative abilities and research temperament.
- Establishing and promoting close interaction with industries and other utility sectors and keeping abreast with state-of-the-art technology.

Vision of the School of Computer Science and Engineering

To evolve as an internationally recognized center of excellence for teaching and research in computer science and engineering with societal and industry relevance.

Mission of the School of Computer Science and Engineering

- To offer multidisciplinary and interdisciplinary undergraduate, postgraduate and research programmes with focus on societal research and industrial needs.
- To provide a conducive environment for learning, leading to be efficient employee's and successful entrepreneurs.
- To establish strong and solution-oriented industry academia binding for sustainable growth.
- To inculcate ethical values for holistic nation building.

Approval History of the Syllabus by Apex Committee, BoS and CUPP of the University

ACM#	Date	Resolution
SCSE-01	09.04.2026	The internal BoS members of the School of Computer Science and Engineering finalized the Ist year detail syllabus for all the B. Tech. programs offered by the School.
SCSE-02	24.04.2026	The internal BoS members, Course Coordinators and a few invited faculty members finalized the Course Structure for the proposed new B. Tech Syllabus for the 2026 admitted batch.
SCSE-03	13.05.2026	The internal BoS members, Course Coordinators and a few invited faculty members finalized the CLOs, COs, PEOs, PSOs, Course Codes and nomenclature of some new courses from 2nd year to 4th year of the proposed syllabus for the new B. Tech. 2026 admitted batch.
SCSE-04	17.06.2026	The BoS members discussed, reviewed, modified and finalized the complete proposed syllabus for the B. Tech. 2026 admitted batch of the School of Computer Science and Engineering.
CUPP-01	01.08.2026	As per the MoM of CUPP the final version of the Complete syllabus is revised and prepared with due approval of the Academic Council.

Knowledge and Attitude Profile (WK's):

The Knowledge and Attitude Profile (WK1–WK9) represents the specific depth and breadth of knowledge, skills, and attitudes mandated by the NBA to achieve Programme Outcomes (POs). While POs define what a student can do at graduation, WKs provide the detailed, technical, and ethical foundation (curriculum content) required to achieve them.

WK Code	Key Description
WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modeling applicable to the discipline.
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
WK9	Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Programme Outcomes(POs):

Graduates Attributes (GAs) form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The Program Outcomes (POs) for UG Engineering programs as defined by NBA are:

PO Code	Key Description
PO1	**Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development (WK1 to WK4).
PO3	**Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required (WK5).
PO4	**Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions (WK8).
PO5	**Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems (WK2 and WK6).
PO6	**The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment (WK1, WK5, and WK7).
PO7	**Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9).
PO8	**Individual & Collaborative Team Work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	**Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.
PO10	**Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	**Life-Long Learning:** Recognize the need for, and have the preparation and ability for: (i) independent and life-long learning, (ii) adaptability to new and emerging technologies, and (iii) critical thinking in the broadest context of technological change. (WK8).

Acronyms and their Full Forms

Acronym	Full Form
L	Lecture
T	Tutorial
P	Practical
Cr	Credit
WCH	Weekley Contact Hour
HSS	Humanities and Social Sciences
GER	General Education Requirement
BS	Basic Science
ES	Engineering Science
PC	Programme Core
PE	Programme Elective
OE	Open Elective
PJ	Project
PT	Practical Training
RE	Research Elective
VE	Vocational Elective
ACM	Academic Council Meeting
BoS	Board of Studies
CUPP	Committee for Undergraduate and Post Graduate Programme
NCrF	National Credit Framework

Contents

Part I

Programme Educational Objectives and Programme Specific Outcomes

Computer Science and Engineering (CSE)	
Programme Educational Objectives(PEOs)	
PEO1	The graduates shall be employed in IT industries to provide solutions to Computer Science & Engineering problems involving design, simulation, and analysis of algorithms for theory and applications of computing.
PEO2	The graduates shall take up Masters and Research programmes for advancement of research and innovation in Computer Science and multidisciplinary contexts.
PEO3	The graduates shall inculcate ethical responsibility towards the society in their own area of interest solving societal problems and be successful entrepreneurs.
Programme Specific Outcomes(PSOs)	
PSO1	Ability to design and develop effective solutions based on state-of-the-art hardware and efficient software with a blend of creativity and performance.
PSO2	Ability to engage in lifelong learning and pursue higher education and research in interdisciplinary areas related to computer science and systems engineering.
PSO3	Ability to apply the Computer Science and Engineering concepts in different fields of Engineering culminating in successful careers and entrepreneurs with a focus on societal Problem solving.

Computer Science and System Engineering (CSSE)	
Programme Educational Objectives(PEOs)	
PEO1	The graduates shall be employed in IT industries to design, develop and deliver computing solutions for complex CSSE problems involving analysis, modeling, simulation and optimization of algorithms for applications.
PEO2	The graduates shall pursue higher studies and research to advance innovation in Computer Science and multidisciplinary fields.
PEO3	The graduates shall exhibit professionalism, ethical responsibility, and entrepreneurial skills by developing innovative computing solutions addressing societal and industrial challenges in CSSE domains.
Programme Specific Outcomes(PSOs)	
PSO1	Ability to analyze, design, and develop efficient computing solutions by integrating modern hardware technologies and optimized software practices to achieve creative and high-performance systems.
PSO2	Ability to pursue higher studies in a multidisciplinary perspective leading to Masters and Research degrees.
PSO3	Ability to utilize Computer Science and Systems Engineering principles in designing sustainable and technology-driven solutions that address societal needs and foster professional and entrepreneurial success.

Computer Science and Communication Engineering (CSCE)	
Programme Educational Objectives(PEOs)	
PEO1	The graduates shall be employed in IT and communication industries to design and develop solutions for CSCE problems involving analysis, simulation, and optimization of algorithms.
PEO2	The graduates shall be prepared to pursue higher studies, advanced research, and innovation in computer science, communication engineering, and related interdisciplinary fields.
PEO3	The graduates shall demonstrate professionalism, ethics, and entrepreneurial competence by developing innovative computing and communication solutions for societal and industrial challenges.
Programme Specific Outcomes(PSOs)	
PSO1	Ability to design and develop effective computing and communication solutions using state-of-the-art hardware and efficient software techniques with creativity, innovation, and performance optimization.
PSO2	Ability to apply foundational and advanced knowledge of Computer Science and Communication Engineering for higher studies and research in multidisciplinary domains.
PSO3	Ability to integrate Computer Science and Communication Engineering concepts to address real-world and societal challenges while demonstrating leadership in professional practice.

CSE with specialization in AI	
Programme Educational Objectives(PEOs)	
PEO1	The graduates shall be equipped for successful careers in IT and AI-driven industries through strong technical competence, adaptability to emerging technologies, and continuous learning and innovation.
PEO2	The graduates shall be prepared to pursue higher studies, advanced research, and innovation in artificial intelligence, computer science, and related interdisciplinary fields.
PEO3	The graduates shall demonstrate professionalism, ethical responsibility, and entrepreneurial ability by developing intelligent and innovative solutions to address societal and industrial challenges in their chosen areas of interest.
Programme Specific Outcomes(PSOs)	
PSO1	Ability to analyze, design, and implement AI-driven solutions by integrating modern hardware technologies, efficient software practices, and intelligent algorithms for high-performance applications.
PSO2	Ability to apply foundational and advanced knowledge of Computer Science and Artificial Intelligence for higher studies and research in multidisciplinary domains.
PSO3	Ability to utilize principles of Computer Science and Artificial Intelligence in diverse engineering domains to design intelligent and sustainable solutions for societal needs.

CSE with specialization in Cyber Security

Programme Educational Objectives(PEOs)	
PEO1	The graduates shall be equipped for successful careers in IT and cyber security industries through strong technical competence, adaptability to emerging security technologies, and continuous learning and innovation.
PEO2	The graduates shall be prepared to pursue higher studies, advanced research, and innovation in cyber security, computer science, and related interdisciplinary fields.
PEO3	The graduates shall demonstrate professional competence, ethics, and entrepreneurial mindset by designing and managing secure, innovative computing solutions addressing societal, organizational, and industrial challenges.
Programme Specific Outcomes(PSOs)	
PSO1	Ability to apply principles of Computer Science and Cyber Security to design secure, reliable, and efficient computing systems using modern hardware and software technologies.
PSO2	Ability to pursue higher studies and research in multidisciplinary domains related to Computer Science and Cyber Security, leading to advanced degrees and professional excellence.
PSO3	Ability to integrate Computer Science and Cyber Security concepts to address real-world and societal challenges while demonstrating leadership in professional practice.

CSE with specialization in Data Science

Programme Educational Objectives(PEOs)	
PEO1	The graduates shall be equipped for careers in IT and data science with strong technical competence, adaptability to emerging technologies, and commitment to continuous learning and innovation.
PEO2	The graduates shall be prepared to pursue higher studies, advanced research, and innovation in data science, computer science, and related interdisciplinary fields.
PEO3	The graduates will demonstrate professionalism, ethical responsibility, and entrepreneurial ability by developing data-driven and innovative solutions to address societal and industrial challenges in their chosen areas of interest.
Programme Specific Outcomes(PSOs)	
PSO1	Ability to analyze, design, and implement data science solutions by integrating modern hardware platforms, efficient software practices, and advanced data analytics techniques.
PSO2	Ability to pursue multidisciplinary higher studies and research leading to Master's and doctoral degrees in Data Science and related domains.
PSO3	Ability to utilize principles of Computer Science and Data Science in diverse engineering domains to design data-driven, scalable, and sustainable solutions addressing societal needs.

CSE with specialization in IoT	
Programme Educational Objectives(PEOs)	
PEO1	The graduates shall be equipped for successful careers in IT, IoT, and related industries through strong technical expertise, adaptability to emerging technologies, and a commitment to lifelong learning and innovation.
PEO2	The graduates shall be prepared to pursue higher studies, advanced research, and innovation in IoT, computer science, and related interdisciplinary fields.
PEO3	The graduates shall demonstrate professionalism, ethical responsibility, and entrepreneurial ability by developing IoT-based innovative computing solutions to address societal and industrial challenges in their chosen areas of interest.
Programme Specific Outcomes(PSOs)	
PSO1	Ability to analyze, design, and implement Internet of Things (IoT) systems by integrating modern hardware devices, embedded platforms, and efficient software solutions for intelligent applications.
PSO2	Ability to apply foundational and advanced knowledge of Computer Science and Internet of Things for higher studies and research in multidisciplinary domains.
PSO3	Ability to integrate Computer Science and Internet of Things concepts to address real-world and societal challenges while demonstrating leadership in professional practice and entrepreneurship.

CSE with specialization in AI & ML	
Programme Educational Objectives(PEOs)	
PEO1	The graduates shall be equipped for careers in IT, AI & ML domains with strong technical competence, adaptability to emerging technologies, and commitment to continuous learning and innovation.
PEO2	The graduates shall be prepared to pursue higher studies, advanced research, and professional careers in AI & ML, computer science, and related interdisciplinary domains, contributing to academic and industrial innovation.
PEO3	The graduates shall demonstrate professionalism, ethical responsibility, and entrepreneurial ability by developing intelligent AI and ML-based solutions aligned with industry trends to address societal and industrial challenges.
Programme Specific Outcomes(PSOs)	
PSO1	Ability to apply principles of Computer Science, Artificial Intelligence, and Machine Learning to design efficient, scalable, and intelligent systems using modern hardware and software technologies.
PSO2	Ability to pursue higher studies and research in multidisciplinary domains related to Computer Science, Artificial Intelligence, and Machine Learning, leading to advanced degrees and professional excellence.
PSO3	Ability to utilize principles of Computer Science, AI, and ML in diverse engineering domains to design intelligent, data-driven, and sustainable solutions addressing societal needs.

CSE with specialization in IoT and Cyber Security including Blockchain	
Programme Educational Objectives(PEOs)	
PEO1	The graduates shall be prepared for careers in IT, IoT, Cyber Security, and Blockchain industries with strong technical competence, industry-relevant skills, and adaptability to emerging secure and distributed technologies.
PEO2	The graduates shall pursue higher studies, research, and innovation in IoT, Cyber Security, Blockchain, and related fields, enabling real-world applications in smart infrastructure, healthcare, and cyber security.
PEO3	The graduates shall demonstrate professional competence, ethics, and entrepreneurial capability by developing innovative IoT, Cyber Security, and Blockchain solutions to address societal and industrial challenges.
Programme Specific Outcomes(PSOs)	
PSO1	Ability to apply principles of Computer Science, Internet of Things, Cyber Security, and Blockchain technology to design secure, scalable, and efficient computing systems using modern hardware and software technologies.
PSO2	Ability to pursue multidisciplinary higher studies and research leading to Master's and doctoral degrees in IoT, Cyber Security, Blockchain, and related domains.
PSO3	Ability to apply concepts of Computer Science, Internet of Things, Cyber Security, and Blockchain technology to develop secure and innovative solutions for societal problems, leading to successful professional careers and entrepreneurship.

B. Tech. with Minor in Computer Science	
Programme Specific Outcomes(PSOs)	
PSO1	Ability to apply foundational concepts of Computer Science to design reliable, scalable, and efficient solutions across engineering disciplines using modern hardware and software technologies.
PSO2	Ability to pursue higher studies and research in multidisciplinary domains, leveraging Computer Science knowledge, leading to advanced degrees and professional excellence.
PSO3	Ability to utilize Computer Science principles in multidisciplinary engineering fields to design sustainable and technology-driven solutions addressing societal needs and enabling career and entrepreneurial growth.

Part II

Curriculum Framework and Credit System

Structure of the B. Tech. Programme

Course Category-wise Distribution of credits of the B. Tech. Programme	
Course Category	**No. of Credits**
GER(General Education Requirements)	17
BS (Basic Science)	30
ES (Engineering Science)	18
PC(Programme Core)	60
PE (Programme Elective)	15
OE (Open Elective)	09
PJ (Project)	12
PT (Practical Training)	02
Total (B. Tech. (Hons.) Degree)	**163**
Additional Credits for (B. Tech. (Hons. with Research) Degree)	12
Additional Credits for Minor (Optional)	18

Curriculum Framework / Flexible Curriculum / NEP2020 / NCrF / B.Tech. (CSE and Allied Branches)

Semester	Total	GER		BS		ES		PC		PE		OE		PJ/PT
	Credits	Course	Credit	Course	Credit	Course	Credit	Course	Credit	Course	Credit	Course	Credit	Credit
I	**22**	1	3	4	10	4	9							
II	**21**	3	4	4	11	3	6							
III	**22**	1	1	1	4	1	3	5	14					
IV	**23**			1	3			7	17	1	3			
V	**23**	1	3					6	17	1	3			
VI	**21**							5	12	2	6	1	3	
VII	**17**	1	3	1	2					1	3	1	3	6
VIII	**14**	1	3									1	3	8
Total	**163**		**17**		**30**		**18**		**60**		**15**		**9**	**14**

B. Tech. Degrees

- Students, admitted in B. Tech. Programme, will obtain any of the following 2 degrees:
  1. B. Tech. (Hons.) in *Name of the Discipline*
  2. B. Tech. (Hons. with Research) in *Name of the Discipline*
- A student can also obtain an additional MINOR degree from other schools of the University by taking 18 credits more.
- The Courses for CSE and remaining 8 allied B. Tech. Programmes will remain same except 5 Program Electives (PE). The PE courses are fixed with respect to the specialization and allied disciplines of CSE.
- All the courses from first year to fourth year are common for B. Tech. (Hons.) and B. Tech. (Hons. with Research) Degrees. In the fourth year, B. Tech. (Hons. with Research) Degree students will have to study additional courses of 12 credits.

Curriculum Framework and Credit System

First Year B.Tech. : Semester I/II						
Sl	**Course Code**	**Course Title**	**WCH**			**Credit**
			L	**T**	**P**	
THEORY						
1	MA11009	Calculus and Differential Equations	3	1	0	4
2	PH10005	Physics	3	0	0	3
3	EE10002	Basic Electrical Engineering	2	0	0	2
4		Engineering Elective	2	0	0	2
5	LS10005	Science of Living Systems	2	0	0	2
6	ID10003	Universal Human Values	3	0	0	3
PRACTICAL						
1	CS13001	Introduction to Computer Programming	0	2	4	4
2	PH19001	Physics Laboratory	0	0	2	1
SESSIONAL						
1	ME18001	Workshop	0	0	2	1
		Total	**26**			**22**

First Year B.Tech.: Semester II/I						
Sl	**Course Code**	**Course Title**	**WCH**			**Credit**
			L	**T**	**P**	
THEORY						
1	HS10003	English Communication Skills	2	0	0	2
2	MA11011	Linear Algebra and Fourier Analysis	3	1	0	4
3	CH10009	Chemistry	3	0	0	3
4	EC10005	Electronic Circuits and Logic Design	3	0	0	3
5		Science Elective	3	0	0	3
PRACTICAL						
1	CH19001	Chemistry Laboratory	0	0	2	1
2	EC19001	Electronic Circuits and Logic Laboratory	0	0	2	1
SESSIONAL						
1		GER Elective	0	0	2	1
2	CE18003	Engineering Drawing & Graphics	1	0	2	2
3	HS18003	English Communication Laboratory	0	0	2	1
		Total	**26**			**21**
		Grand Total for First Year	**52**			**43**

Second Year B.Tech.: Semester III						
Sl	**Course Code**	**Course Title**	**WCH**			**Credit**
			L	**T**	**P**	
THEORY						
1	MA21005	Discrete Mathematics	3	1	0	4
2	EC	Principles of Communication Engineering	3	0	0	3
3	CS20001	Data Structures	3	0	0	3
4	CS21001	Computer Organization and Architecture	3	1	0	4
5	CS20003	Computer Networks	3	0	0	3
PRACTICAL						
1	CS29001	Data Structures Laboratory	0	1	2	2
2	CS29003	Computer Networks Laboratory	0	1	2	2
3		Vocational Elective	0	0	2	1
		Total	**25**			**22**

Second Year B.Tech. : Semester IV						
Sl	**Course Code**	**Course Title**	**WCH**			**Credit**
			L	**T**	**P**	
THEORY						
1	MA20008	Probability and Statistics	3	0	0	3
2	CS20002	Operating Systems	3	0	0	3
3	CS20004	Object Oriented Programming Using Java	3	0	0	3
4	CS20006	Database Management Systems	3	0	0	3
5	CS21002	Automata Theory and Formal Languages	3	1	0	4
6		Programme Elective - I	3	0	0	3
PRACTICAL						
1	CS29002	Operating System Laboratory	0	0	2	1
2	CS29004	Object Oriented Programming Laboratory	0	0	2	1
3	CS29006	Database Laboratory	0	1	2	2
		Total	**26**			**23**
		Grand Total for Second Year	**51**			**45**

Third Year B.Tech. : Semester V						
Sl	**Course Code**	**Course Title**	**WCH**			**Credit**
			L	**T**	**P**	
THEORY						
1	CS30001	Design and Analysis of Algorithms	3	0	0	3
2	CS30003	Artificial Intelligence	3	0	0	3
3	CS31001	Software Engineering	3	1	0	4
4	CS30005	Principles of Cryptography	3	0	0	3
5		Principles of Economics	3	0	0	3
6		Programme Elective - II	3	0	0	3
PRACTICAL						
1	CS39001	Algorithms Laboratory	0	1	2	2
2	CS39003	Full Stack Development Laboratory	0	1	2	2
		Total	**25**			**23**

Third Year B.Tech. : Semester VI						
Sl	**Course Code**	**Course Title**	**WCH**			**Credit**
			L	**T**	**P**	
THEORY						
1	CS30002	High Performance Computing	3	0	0	3
2	CS30004	Machine Learning	3	0	0	3
3	CS30006	Cloud Computing	3	0	0	3
4		Programme Elective - III	3	0	0	3
5		Programme Elective - IV	3	0	0	3
6		Open Elective - I	3	0	0	3
PRACTICAL						
1	CS39002	DevOps Laboratory	1	0	2	2
2	CS39004	Machine Learning Laboratory	0	0	2	1
		Total	**23**			**21**
		Grand Total for Third Year	**48**			**45**

Fourth Year B.Tech. : Semester VII						
Sl	**Course Code**	**Course Title**	**WCH**			**Credit**
			L	**T**	**P**	
THEORY						
1	ES40001	Engineering Professional Practices	3	0	0	3
2	CH40001	Environmental Science	2	0	0	2
3		Program Elective - V	3	0	0	3
4		Open Elective - II	3	0	0	3
SESSIONAL						
1	CS49001	Practical Training	0	0	0	2
2	CS47001	Project - I	0	0	0	4
	CS48001	Industry Internship - I	0	0	0	
		Total	**11**			**17**

Fourth Year B.Tech. : Semester VIII						
Sl	**Course Code**	**Course Title**	**WCH**			**Credit**
			L	**T**	**P**	
THEORY						
1		HSS Elective	3	0	0	3
2		Open Elective - III	3	0	0	3
3		Indian Constitution	3	0	0	0
SESSIONAL						
1	CS47002	Project - II	0	0	0	8
	CS48002	Industry Internship - II	0	0	0	
		Total	**9**			**14**
		Grand Total for Fourth Year	**20**			**31**

Fourth Year B.Tech. (Hons. with Research) Additional Courses: Semester VII						
Sl	**Course Code**	**Course Title**	**WCH**			**Credit**
			L	**T**	**P**	
1	CS40011	Research Method and Ethics	3	0	0	3
2	MA60003	Mathematical Foundations for Research	3	0	0	3
		Total	**6**			**6**

Fourth Year B.Tech. (Hons. with Research) Additional Courses : Semester VIII						
Sl	**Course Code**	**Course Title**	**WCH**			**Credit**
			L	**T**	**P**	
1		Research Elective - I	3	0	0	3
2		Research Elective - II	3	0	0	3
		Total	**6**			**6**
		Additional Grand Total for Fourth Year	**12**			**12**

Research Elective - I and II

Sl	Course Code	Course Title	Credit
1	CS40004	Combinatorics and Graph Theory	3
2	CS40006	Design and Analysis of Parallel Algorithms	3
3	CS40008	GPU Computing	3
4	CS40010	Metaverse and Blockchain	3

EXIT after First Year Summer Semester

Vocational Courses					
Sl	**Course Code**	**Course Title**	**Hours**	**Category**	**Credit**
1	CS19001	Web Design	60 hours	GER	2
2	EC28007	PCB Design	60 hours	GER	2
3		Vocational Training - I	90 hours	GER	2

Note: Students, who would opt for exit after first year, will have to study any two of the vocational courses.

EXIT after Second Year Summer Semester

Vocational Courses					
Sl	**Course Code**	**Course Title**	**Hours**	**Category**	**Credit**
1	CS29007	Multimedia Animation & Special Effects	60 hours	GER	2
2	CS29008	Network Security and Ethical hacking tools	60 hours	GER	2
3		Vocational Training - II	90 hours	GER	2

Note: Students, who would opt for exit after second year, will have to study any two of the vocational courses.

Part III

All Electives

Engineering Elective			
Sl	**Course Code**	**Course Title**	**Credit**
1	EE10005	Instrumentation and Automation	2
2	CE10001	Basics of Civil Engineering	2
3	EC10007	Biosensors and Instrumentation	2
4	ME10003	Basics of Mechanical Engineering	2

Science Elective			
Sl	**Course Code**	**Course Title**	**Credit**
1	CH10011	Nanoscience	3
2	LS10007	Molecular Diagnostics	3
3	MA10013	Linear Programming	3
4	PH10009	Smart and Emerging Materials	3
5	PH10011	Introduction to Quantum Technologies	3
6	CH10013	Geology and Geohazards	3
7	ID10001	Citizen Science and Open Data	3

General Education Requirement(GER) Elective			
Sl	**Course Code**	**Course Title**	**Credit**
1	SY18001	Sports and Yoga	1
2	ID18001	National Service Scheme (NSS)	1
3	ID18002	National Cadet Corps (NCC)	1
4	SA38021	Debate and Public Speaking	1
5	SA38011	Hindustani Classical Music	1
6	SA38009	Indian Classical Dance	1
7	SA38031	Quiz and Knowledge Excellence	1

Program Elective - I			
Sl	**Course Code**	**Course Title**	**Credit**
1	EC	Analog Electronics	3
2	CS20010	Data Analytics	3
3	CS20012	Real Time Systems	3
4	CS20014	Mobile Application Developments	3
5	EC	Image Processing and Applications	3
6	CS20016	Cyber Physical System	3
7	EC	Quantum Communication	3

Program Elective - II			
Sl	**Course Code**	**Course Title**	**Credit**
1	CS30007	Computational Intelligence	3
2	CS30009	Distributed Operating Systems	3
3	CS20008	Information Theory and Coding	3
4	CS30011	Big data Analytics	3
5	CS30013	Data Warehousing and Data Mining	3
6	EC	Sensor and Devices	3
7	EC	Wireless Mobile Communication	3

Program Elective - III			
Sl	**Course Code**	**Course Title**	**Credit**
1	CS30008	Human Computer Interaction	3
2	CS30010	Computer Vision	3
3	CS30012	Natural Language Processing	3
4	CS30014	Privacy and Security in IoT	3
5	CS30016	Fundamentals of Cyber Security	3
6	CS30018	Data Modeling and Visualization	3
7	CS30015	Compiler Design	3

Program Elective - IV			
Sl	**Course Code**	**Course Title**	**Credit**
1	EC	Optical Satellite Communication	3
2	CS30022	Reinforcement Learning	3
3	CS30024	Industrial IoT	3
4	CS30026	Machine Learning Operations	3
5	CS30028	Cloud Security	3
6	EC30007	ARM and Advanced Microprocessors	3
7	CS30032	Augmented and Virtual Reality	3

Program Elective - V			
Sl	**Course Code**	**Course Title**	**Credits**
1	EC	Drone System Engineering	3
2	CS30036	Deep Learning	3
3	CS40001	Agile Software Development	3
4	EC30002	Cognitive Radio and Cooperative Communications	3
5	CS40003	Generative AI and Large Language Models	3
6	CS40005	Blockchain Technology	3
7	CS40007	Software Testing and Automation	3
8	CS40009	Time Series Data Analysis	3

Note: A specific programme elective course will be allotted from each programme elective to the students who have taken admission for any specialization in the B. Tech programmes of Computer Science and Engineering as follow:

B. Tech. in Computer Science and System Engineering (CSSE) must choose the following courses from PE baskets:

Sl	Course Code	Course Title	Category
1	CS20012	Real Time Systems	PE - I
2	CS30009	Distributed Operating Systems	PE - II
3	CS30008	Human Computer Interaction	PE - III
4	EC30007	ARM and Advanced Microprocessors	PE - IV
5	CS40001	Agile Software Development	PE - V

B. Tech. in Computer Science and Communication Engineering (CSCE) must choose the following courses from PE baskets:

Sl	Course Code	Course Title	Category
1	EC	Analog Electronics	PE - I
2	EC30002	Wireless Mobile Communication	PE - II
3	CS30014	Privacy and Security in IoT	PE - III
4	EC	Optical Satellite Communication	PE - IV
5	EC30002	Cognitive Radio and Cooperative Communications	PE - V

B. Tech. in Computer Science and Engineering with Specialization in AI must choose the following courses from PE baskets:

Sl	Course Code	Course Title	Category
1	CS20010	Data Analytics	PE - I
2	CS30007	Computational Intelligence	PE - II
3	CS30010	Computer Vision	PE - III
4	CS30026	Machine Learning Operations	PE - IV
5	CS40003	Generative AI and Large Language Models	PE - V

B. Tech. in Computer Science and Engineering with Specialization in Cyber Security must choose the following courses from PE baskets:

Sl	Course Code	Course Title	Category
1	CS20016	Cyber Physical System	PE - I
2	CS20008	Information Theory and Coding	PE - II
3	CS30016	Fundamentals of Cyber Security	PE - III
4	CS30028	Cloud Security	PE - IV
5	CS40005	Blockchain Technology	PE - V

B. Tech. in Computer Science and Engineering with Specialization in Data Science must choose the following courses from PE baskets:

Sl	Course Code	Course Title	Category
1	CS20010	Data Analytics	PE - I
2	CS30011	Big data Analytics	PE - II
3	CS30018	Data Modeling and Visualization	PE - III
4	CS30022	Reinforcement Learning	PE - IV
5	CS30036	Deep Learning	PE - V

B. Tech. in Computer Science and Engineering with Specialization in IoT must choose the following courses from PE baskets:

Sl	Course Code	Course Title	Category
1	EC	Analog Electronics	PE - I
2	EC	Sensor and Devices	PE - II
3	CS30014	Privacy and Security in IoT	PE - III
4	CS30024	Industrial IoT	PE - IV
5	EC	Drone System Engineering	PE - V

B. Tech. in Computer Science and Engineering with Specialization in AI & ML must choose the following courses from PE baskets:

Sl	Course Code	Course Title	Category
1	CS20010	Data Analytics	PE - I
2	CS30007	Computational Intelligence	PE - II
3	CS30012	Natural Language Processing	PE - III
4	CS30026	Machine Learning Operations	PE - IV
5	CS40003	Generative AI and Large Language Models	PE - V

B. Tech. in Computer Science and Engineering with specialization in IoT and Cyber Security including Blockchain must choose the following courses from PE baskets:

Sl	Course Code	Course Title	Category
1	CS20010	Data Analytics	PE - I
2	EC	Sensor and Devices	PE - II
3	CS30016	Fundamentals of Cyber Security	PE - III
4	CS30024	Industrial IoT	PE - IV
5	CS40005	Blockchain Technology	PE - V

HSS ELECTIVE			
Sl	**Course Code**	**Course Title**	**Credit**
1	HS20220	Organizational Behaviour	3
2	HS20222	Human Resource Management	3
3	PS11103	Indian Psychology	3
4	PS11104	Science of Happiness and Well-being	3
5	HS30052	Climate Change Narrative	3
6	ES40436	International Economics	3
7	ES40438	Sustainable Development	3

Vocational Elective (VE)

Offered by: School of Electrical Engineering			
Sl	**Course Code**	**Course Title**	**Credit**
1	EE28011	Industrial Wiring and Control Panel Design	1
2	EE28013	Installation, operation and maintenance of solar power system	1
3	EE28015	Domestic Wiring and Home Automation	1
4	EE28017	Cyber Physics Application in Industrial IOT	1
5	EE28019	Industrial Control and Remote Monitoring	1
6	EE28021	MATLAB Applications	1

Offered by: KIIT Skill Centre			
Sl	**Course Code**	**Course Title**	**Credit**
1	IS29101	Introduction to Industry 4.0	1
2	IS29102	Cyber Physical System	1
3	IS29103	IoT Gateway – Sensor to Cloud	1
4	IS29104	IT Security for Production Systems	1
5	IS29402	Foundations of XR Technologies	1
6	IS29404	Unity XR Development	1
7	IS29401	C# Programming for XR	1
8	IS29403	AR Application Development	1
9	IS29405	XR Capstone Project	1

Open Elective: Students must choose open Elective courses offered by other Schools. Those students must not study any of the courses offered by their parent School which matches fully (more than **60%** similar) with a course in the open elective courses.

Open Electives (OE-I, OE-II & OE-III)

Offered by: School of Computer Science and Engineering				
Sl	**Course Code**	**Course Title**	**Credit**	**Open Electives**
1	CS20004	Object Oriented Programming using Java	3	OE-I
2	CS20001	Data Structures	3	OE-II
3	CS40002	Fundamentals of Software Engineering	3	OE-III

Offered by: School of Liberal Studies				
Sl	**Course Code**	**Course Title**	**Credit**	**Open Electives**
1	HS30225	Leadership & Team Effectiveness	3	OE-I
2	HS30223	Business Ethics & Corporate Governance	3	OE-II
3	HS30250	Organizational Change & Development	3	OE-III

Offered by: School of Economics & Commerce				
Sl	**Course Code**	**Course Title**	**Credit**	**Open Electives**
1	CB1047	Foundation of Macroeconomics	3	OE-I
2		Econometric Modelling and Software Applications	3	OE-II
3		Circular Economy and Sustainable Engineering	3	OE-III
4		Accounting for Everyone	3	
5	CB21312	Cost Analysis and Managerial Decision Making	3	

Offered by: Department of Language & Literature				
Sl	**Course Code**	**Course Title**	**Credit**	**Open Electives**
1	FR30202	French for Engineers	3	OE-I
2	GR30202	German for Engineers	3	
3	SP30202	Spanish for Engineers	3	
4	JP30202	Japanese for Engineers	3	
5	FR40203	Cultural Trends in Contemporary France	3	OE-II
6	GR40203	Cultural Trends in Contemporary Germany	3	
7	SP40203	Spanish & Latin American Society & Culture	3	
8	JP40203	Gateway to Japan	3	
9	FR40204	Immersive French: Audio-Visual Listening Skills	3	OE-III
10	GR40204	Immersive German: Audio-Visual Listening Skills	3	
11	SP40204	Immersive Spanish: Audio-Visual Listening Skills	3	

Part IV

Minor Programmes

Minor Programmes Offered by different Schools

Minor Programmes: Students pursued a degree in one School (parent School) can opt for a minor programme offered by other Schools. Those students must not study any of the courses offered by their parent School which matches fully (more than **60%** similar) with a course in the minor programme.

Minor Programmes and It's Offering School		
Sl	**Name of the Programme**	**Offering School**
1	Minor in Computer Science	School of Computer Engineering
2		School of Civil Engineering
3		School of Electrical Engineering
4		School of Electronics Engineering
5		School of Mechanical Engineering
6	Minor in Quantum Technologies	School of Applied Sciences
7	Minor in Sustainable Development	School of Economics & Commerce
8	Minor in Financial Analytics for Engineers	
9		School of Liberal Studies Engineering

Curriculum Framework and Credit System for Minor

School of Computer Science and Engineering				
Minor in Computer Science				
Sl	**Course Code**	**Course Title**	**Credit**	**Semester**
1	CS49002	Python Programming	2	V
2	CS20004	Object Oriented Programming using Java	3	
3	CS20001	Data Structures	3	VI
4	CS29001	Data Structures Laboratory	2	
5	CS20006	Database Management Systems	3	VII
6	CS29006	Database Laboratory	2	
7	CS40002	Fundamentals of Software Engineering	3	VIII
		Total Credit	**18**	

School of Applied Sciences				
Minor in Quantum Technologies				
Sl	**Course Code**	**Course Title**	**Credit**	**Semester**
1	PH30004	Introduction to Quantum Computation	3	V
2	PH40001	Survey of Quantum Technologies and Applications	3	
3	PH40003	Foundations of Quantum Technologies	3	VI
4	PH40005	Computational Techniques and applications	3	
5	PH49001	Basic Laboratory Course for Quantum Technologies	3	VII
6	PH40002	Introduction to Quantum Communication	3	
7	PH40004	Introduction to Quantum Materials	3	VIII
		Total Credit	**21**	

School of Economics and Commerce				
Minor in Quantum Technologies				
Sl	**Course Code**	**Course Title**	**Credit**	**Semester**
1		Sustainable Practices in Engineering	3	VI
2		Poverty to Prosperity	3	VII
3		Employment, Employability and Growth	3	
4		Applied Econometrics for Sustainable Development	3	
5		Advanced Econometrics for Sustainable Development	3	VIII
6		Global Institutions and Economic Policies for Peace, Justice, and SDG	3	
		Total Credit	**18**	

School of Economics and Commerce				
Minor in Financial Analysis (Using Data Analytics)				
Sl	**Course Code**	**Course Title**	**Credit**	**Semester**
1	HS 30152	Money and Financial Markets	3	VII
2		Econometrics for Business Data Analysis	3	
3	HS40153	Financial Economics	3	
4	HS4025	Corporate Finance	3	
5		Public Economics	3	VIII
6		Advanced Econometrics	3	
		Total Credit	**18**	

Part V

Detailed Syllabus

Course Title: **Calculus and Differential Equations**	
Course Code: **MA11009**	Contact Hours: **L-T-P-Cr : 3-1-0-4**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the formulation and solution of first-order ordinary differential equations using standard analytical methods, and to apply these techniques to model and solve real-world problems. To develop a fundamental understanding of 2nd order ordinary differential equations and equip students with analytical methods to solve them, with emphasis on applications in science and engineering. To acquire analytical skills in maxima and minima of functions of several variables, and power series methods for solving differential equations. To develop proficiency in the application of Laplace transform techniques for solving initial value problems and analyzing dynamic systems.

Course Contents:

UNIT I:

First-order ODEs: Basic concepts and definitions of 1st order differential equations, solution of differential equations: variable separable, homogeneous, equations reducible to homogeneous form, exact differential equation, equations reducible to exact form, linear differential equation, equations reducible to linear form (Bernoulli's equation), applications of first-order ordinary differential equations.

UNIT II:

Second-order ODEs: Second-order linear homogeneous equations with constant coefficients; differential operators; solution of homogeneous equations; Euler-Cauchy equation; linear dependence and independence; Wronskian; solution of non-homogeneous equations: general solution, complementary function, particular integral; solution by undetermined coefficients method and variation of parameters method. Applications of second-order ODEs in real life problems.

UNIT III:

Calculus for Functions of Several Variables: Taylor's theorem, Maxima, minima and saddle points, Lagrange's method of undetermined multipliers.

Gamma and Beta functions. Power Series, radius of convergence, solution of differential equations by the power series method.

UNIT IV:

Laplace Transform: Laplace transform, Inverse Laplace transform, Laplace transform of derivatives and integrals, Unit step function, Second shifting theorem, Dirac's delta function, Differentiation and integration of transforms, Laplace transform of periodic functions, Convolution, Solution of ODEs and integral equations by the Laplace transforms.

Textbooks:

1. Kreyszig, E., "*Advanced Engineering Mathematics*", 10th Edition, Wiley, INC
2. Narayan, S. and Mittal, P. K., "*Differential Calculus*", (2009), S. Chand reprint.

Reference Books:

1. Grewal, B. S., "*Higher Engineering Mathematics (44th Edition)*", (2015), Khanna Publishers, ISBN: 81-7409-195-5.
2. Dass, H. K., "*Introduction to Engineering Mathematics (11th Edition)*", S. Chand & Co Ltd.
3. Ramana, B. V. , "*Higher Engineering Mathematics (11th Edition)*", (2010), Tata McGraw-Hill, ISBN: 13-978-07-063419-0; ISBN: 10-0-07-063419-X.
4. Roy, S. and Padhy, S., "*A Course on Ordinary & Partial Differential Equations (3rd Edition)*", Kalyani Publication.

Course Outcomes (CO):

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

CO1: Formulate and solve first-order ordinary differential equations using appropriate analytical methods.

CO2: Explore and solve real-world models arising in engineering and applied sciences.

CO3: Analyze and solve second-order differential equations using appropriate methods and apply them to electrical circuit models.

CO4: Use concepts of calculus techniques in engineering problems.

CO5: Understand and explain power series expansions and their role in solving ordinary differential equations.

CO6: Apply the Laplace transform techniques to solve initial value problems and analyze engineering systems.

Course Title: **Physics**	
Course Code: **PH10005**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The primary objective of this course is to provide students with a robust foundation in classical and modern physics, bridging the gap between fundamental theory and engineering applications. By exploring the wave nature of light in Wave Optics and the mathematical rigor of Electromagnetic Theory, students will develop the analytical tools necessary to understand field interactions and wave propagation. The curriculum further transitions into the microscopic realm through Quantum Mechanics and Semiconductor Physics, enabling students to grasp the behavior of matter at the atomic level and its critical role in the functionality of electronic components. Finally, the course introduces the principles of Lasers and Fiber Optics, ensuring students can evaluate and apply photonics technologies in modern communication and industrial systems.

Course Contents:

UNIT I:

Wave Optics: Huygens' principle, interference of light by wave front splitting and amplitude splitting, Conditions for interference; Newton's rings and its applications, Michels on interfero meter and its applications. Fraunhofer diffraction by a single slit, Plane diffraction grating: Grating equation, Absent spectra, Dispersive power.

UNIT II:

Electromagnetic Theory: Vector calculus: Scalar and vector field, Gradient, Divergence and Curl, Gauss divergence and Stoke's theorem. Maxwell's electromagnetic equations, Equation of Continuity, Displacement current, Electromagnetic wave equations, Transverse nature of EM waves.

UNIT III:

Quantum Mechanics: Dual nature of radiation and matter, de Broglie hypothesis, Phase velocity and group velocity, Heisenberg's uncertainty principle and applications, Wave function and its interpretation, Schrodinger's time-dependent and time-independent equations, Particle in one-dimensional box, Quantum mechanical tunnelling and applications.

UNIT IV:

Semiconductor Physics: Classification of solids based on energy bands, Intrinsic and extrinsic semiconductors, Concept of effective mass, Fermi level and its importance, Energy band diagram and position of Fermi level in intrinsic and extrinsic semiconductor, Carrier concentration in intrinsic semiconductor, mobility, conductivity and resistivity of semiconducting material.

UNIT V:

Laser and Fiber Optics: Properties and applications of laser, Spontaneous and stimulated emission,meta stable state, Population inversion, pumping, three-levellaser, Rubylaser. Principle and construction of optical fiber, Types of optical fiber,Propagation of light through optical fiber, Acceptance angle, Numerical aperture, Applications.

Textbook:

1. A Textbook of Engineering Physics, M. N. Avadhanulu, P. G. Kshirsagar and T. V. S. Arun Murthy, S Chand Publications, 11th Edition, 2024, ISBN: 9789352833993

Reference Books:

1. Introduction to Electrodynamics, D J Griffiths, Pearson Education, 4th Edition, 2015.
2. Engineering Physics, B. K. Pandey and S. Chaturvedi, Cengage Publication, New Delhi, 2nd Edition 2022, ISBN-13: 978-81-953536-7-5.
3. Optics, A. K. Ghatak, Tata McGraw-Hill Publications, 4th Edition, 2008, ISBN- 9780070262157.
4. Concepts of Modern Physics, A. Beiser, Tata McGraw-Hill Publications, 6th Edition, 2002, ISBN-10:0071234608.
5. Engineering Physics, R K Gaur and S. L. Gupta, Dhanpat Rai Publications, New Delhi, 2nd Edition, 2012, ISBN-19:8189928228

Course Outcomes (CO):

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

CO1: Demonstrate a clear understanding of wave optics by explaining the Huygens' principle and analyzing interference and diffraction phenomena.

CO2: Apply the principles of interference and diffraction to evaluate optical parameters such as wavelength, refractive index, dispersive power, etc., using Newton's rings, Michelson interferometer and plane diffraction grating experiments.

CO3: Analyse the propagation and nature of electromagnetic waves using Maxwell's equations.

CO4: Understand quantum mechanical concepts such as wave-particle duality, the de Broglie hypothesis, etc., and apply the principles of quantum mechanics to solve Schrödinger equations for simple systems such as the particle in a one-dimensional box and quantum mechanical tunnelling.

CO5: Analyse semiconductor materials using energy band theory and evaluate electrical properties such as conductivity, mobility, and Fermi-level position.

CO6: Explain the fundamental principles of laser operation and optical fiber and apply these concepts to analyze laser systems, propagation of light in optical fiber and their technological applications.

Course Title: **Basic Electrical Engineering**	
Course Code: **EE10002**	Contact Hours: **L-T-P-Cr : 2-0-0-2**
Course Type: **ES**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The course provides a comprehensive overview of the fundamentals of electrical engineering, including DC and AC circuit analysis, magnetic circuits, the working principles and applications of electrical machines, and essential safety measures for electrical apparatus and appliances.

Course Contents:

UNIT I:

DC Circuits: Network Terminology, Kirchhoff's law, Source transformation, Star-delta transformation, and equivalent resistance of the circuits, Mesh and Nodal analysis, Superposition, Thevenin and Norton's theorem.

UNIT II:

AC Circuits: Different Terminologies in AC circuits, Average, R.M.S. values of sinusoidal quantities, Peak factor, Form factor, Phasor representation, AC through R, L, C, AC Series Circuit (RL, RC, RLC), Three-phase AC circuits: Voltage, current, and power in star and delta connections.

UNIT III:

Magnetic Circuits: Magnetic Flux, Magnetic Flux Density, Magnetomotive force, Magnetizing Force, Magnetic permeability, Reluctance, Permeance, Analogy between Electric Circuits and Magnetic Circuits, Series magnetic circuit, BH curve, Hysteresis loop.

UNIT IV:

Electrical Energy and Safety Measures: Electrical Energy Scenario in India, Construction, working principle, and application of Single-phase Transformers, Three-phase and single-phase induction Motors, Electricity tariffs, Types of Earthing, Electrical Safety Practices and Precautions, and the Working Principles of a Fuse, Miniature Circuit Breaker (MCB), Residual Current Circuit Breaker (RCCB), and Earth Leakage Circuit Breaker(ELCB).

Textbooks:

1. V. K. Mehta, Rohit Mehta, Principles of Electrical Engineering and Electronics, S Chand Publishing, New Delhi, 2019 Edition.
2. D. C. Kulshreshtha, Basic Electrical Engineering, McGraw-Hill Education (India) Private Limited, New Delhi, 2nd Edition 2019.

Reference Books:

1. Dr. RamanaPilla, Dr. M. Surya Kalavathi & Dr. G. T. Chandra Sekhar, Basic Electrical Engineering, S. Chand Publishing, New Delhi, 2022.
2. Basic Electrical Engineering, S. Chand Publishig, New Delhi, 2022.
3. Sanjeev Sharma, Basics of Electrical Engineering, I.K. International Publishing House, New Delhi, 2nd Revised Edition 2013.
4. T. K. Nagsarkar, M. S. Sukhija, Basic Electrical Engineering, Oxford University Press, New Delhi, 3rd Edition 2017.
5. Vivekananda Mukherjee, Aparajita Mukherjee, Basic Electrical Engineering, Khanna Publishers, New Delhi, 2nd Edition, 2024.

Course Outcomes (CO):

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

CO1: Analyze the fundamentals of DC circuits.

CO2: Understand the principles of AC circuits.

CO3: Analyze three-phase circuits.

CO4: Interpret the behavior of magnetic circuits.

CO5: Explain the principles and operation of electrical machines.

CO6: Understand the concepts of electrical safety and protection systems.

Course Title: **Science of Living Systems**	
Course Code: **LS10005**	Contact Hours: **L-T-P-Cr : 2-0-0-2**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Understand the molecular basis of life, including biomolecules and bioenergetics, and relate them to engineering principles. Explain the flow of genetic information and interpret biological coding systems using computational analogies. Analyze the interaction between biology and engineering through biomimetics and bioinspired technologies. Compare biological systems with engineering devices using functional analogies. Apply bio-inspired concepts to materials, environmental systems, and emerging technologies.

Course Contents:

UNIT I:

Molecular Organization of Living Machines: Cell and different Biomolecules as functional units: Carbohydrates, Lipids, Proteins for versatility, Nucleic Acids (structure-based function and engineering applications), Bioenergetics and system efficiency: Energy dynamics in biological systems – principles of energy conservation and optimization, Energy generation and usage, Basic thermodynamic concepts in living systems, Efficiency of biological energy systems.

UNIT II:

Programming Code in Living Systems: Information storage and flow: Central Dogma, Transcription and Translation, Coding and representation:

Genetic Code Language, Numerical Representation of Genetic Code (mapping to computational logic and encoding systems).

UNIT III:

Crosstalk between Biology and Engineering: Biologically inspired technologies: Case studies of designs in nature and inspired Technologies (Macro/Micro/Nano), Biomimetics: Nature inspired material and mechanisms. Application-driven systems: Self-cleaning surfaces; Self-healing materials (Bio concrete), Biomining, Algorithms in Nature (optimization and efficiency principles)

UNIT IV:

Functional Analogy of Biological Systems and Engineering Devices: Organ & system analogies: Brain (Natural Neural Network) & AI (Artificial Neural Network), Eye & Camera, Kidney & Filtration system, Lungs & purification systems, Heart & Pumping systems, Process analogies: Photosynthesis & solar cells, Thermoregulation in human body & heat transfer in machines, Defence mechanisms in organisms, signal processing in biology and electronics.

UNIT V:

Bio-Inspired Materials, Systems, and Environmental Applications: Biomechanics and Structural Systems in Biology, Bioremediation and Environmental Engineering, Molecular Machines and Biosensing Concepts.

Textbook:

1. Biology for Engineers, 1st Edition , by Vidya Rajesh, Cengage Learning India Private Limited.

Reference Books:

1. Molecular Biology of the Cell – Bruce Albert, Garland Science (Taylor & Francis Group) 6thedition, ISBN-13: 978-0815344322.
2. Biological Engineering Fundamentals – Ann Saterbak, Prentice Hall, 1 st Edition, ISBN-13: 978-0130461148.
3. Introduction to Systems Biology – Uri Alon, CRC Press, 1 st Edition, ISBN-13: 978-1584886426.
4. Bioinspiration and Biomimetics – Yoseph Bar-Cohen, CRC Press, 1 st Edition, ISBN- 13: 978-1439834763.

5. Bioinspired Materials Science and Engineering – Guang Yang, Lin Xiao & Lallepak Lamboni, 1st Edition, John Wiley & Sons, 2018, ISBN 13: 978-1-119-39032-9

Course Outcomes (CO):

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

CO1: Describe biomolecular structures and energy principles in biological systems.

CO2: Interpret genetic information flow and relate it to computational models.

CO3: Apply bio-inspired approaches to solve engineering problems.

CO4: Analyze and design systems using analogies between biology and engineering.

CO5: Evaluate and develop bio-inspired materials, molecular machines, and environmentally sustainable technologies.

CO6: Integrate interdisciplinary knowledge to propose innovative and efficient solutions to engineering challenges inspired by biological principles.

Course Title: **Universal Human Values**	
Course Code: **ID10003**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The objective of the course is to develop a holistic perspective based on self-exploration, understand the harmony in the human being, strengthen self-reflection, and develop commitment and courage to act.

Course Contents:

UNIT I:

Need, Basic Guidelines, Content and Process for Value Education: Purpose and motivation for the course, recapitulation from Universal Human Values-I. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice-based on liking-disliking.

UNIT II:

Understanding Harmony in the Human Being - Harmony in Myself!: Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease .

UNIT III:

Understanding Harmony in the Family and Society- Harmony in Human Relationship: Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT IV:

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence: Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all pervasive space. Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.

UNIT V:

Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal human order b) Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c) Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations. Sum up. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Textbook:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010 .

Reference Books:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi, Human ValuesNew Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).

4. Mohandas Karamchand Gandhi,The Story of My Experiments with Truth.
5. Small is Beautiful - E. F Schumacher

Course Outcomes (CO):

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

CO1: Understand the concept of value education and its need.

CO2: Apply their knowledge on value education for apt self-assessment.

CO3: Comprehend human-human relationship.

CO4: Build holistic perception of harmony at all levels of existence.

CO5: Develop the sense of natural acceptance of human values

CO6: Create people friendly and eco-friendly environment.

Course Title: **Introduction to Computer Programming**	
Course Code: **CS13001**	Contact Hours: **L-T-P-Cr : 0-2-4-4**
Course Type: **ES**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves lab component which is designed to give the student hands-on experience with the concepts.

Course Contents:

UNIT I:

Introduction to Computer and Programming: Basic concepts of computer organization, CPU, Memory. I/O devices, Number Systems, Evolution of programming languages, structured programming, Compilation process, source code, object code, executable code, Operating systems, interpreters, linkers, loaders, Algorithms, flow charts, pseudo-code. Program Constructs: Character set, Identifiers, Keywords, Data Types, Constant and Variables, Operators: Precedence and associativity, Expressions, Statements, Input and Output functions, Control structures: Branching & Looping.

UNIT II:

Arrays and Strings: One dimensional Array, Multidimensional Array and their applications, String Manipulation.

UNIT III:

Functions: Library and User defined functions, Formal and Actual parameters, function prototypes, Parameter passing: Call-By-value, Call-by-reference, Recursion, Storage Classes.

UNIT IV:

Pointers: Pointer variable, Pointer Arithmetic, passing parameters by reference, pointer to pointer, pointers to functions, Dynamic memory allocation.

UNIT V:

Structures, Unions: Structures, Unions, pointer to structure & pointer to union, linked list.

UNIT VI:

File Handling: Declaration of file pointer, opening and closing files, Working with text and binary files. Command line arguments, bit wise operators, enumerated data types, type casting, macros, Preprocessor directives.

List of Experiments:

1. Write All Linux commands in the LAB report
2. Practice and write programs on simple input and output operations
3. Practice and write programs on Operators and Expressions
4. Practice and write programs on branching statements
5. Practice and write programs on looping (control) statements
6. Practice and write programs on Arrays
7. Practice and write programs on Character Arrays
8. Practice and write programs on Functions
9. Practice and write programs on Pointers
10. Practice and write programs on Structures
11. Practice simple programs on file handling

Textbook:

1. Programming in ANSI C (8th Edition) by E. Balagurusamy

Reference Book:

1. The C Programming Language by Brian Kernighan and Dennis Ritchie

(Second Edition)

Course Outcomes (CO):

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

CO1: Have fundamental knowledge of computers hardware and number systems with commands in Linux.

CO2: Write, compile and debug programs in C language.

CO3: Design programs involving decision structures, loops, and functions.

CO4: Construct arrays to store, manipulate, search and display data.

CO5: Apply the dynamics of memory by the use of pointers

CO6: Use different data structures and create/update basic data files.

Course Title: **Physics Laboratory**	
Course Code: **PH19001**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This lab course covers different measurement techniques of various parameters using the instruments i.e. interferometer, spectrometer, spherometer, screw gauge, vernier calliper, microscope, and telescope. It includes the application of photoelectric effect and photovoltaic effect in photo cell and solar cell respectively. Evaluation of the mechanical strength of materials by calculating elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio are also included. This course provides hands on training for the usage of electrical, optical and mechanical systems for various measurements with precision and analysis of the experimental data by graphical interpretation and error calculation.

Course Contents:

Measurement by vernier callipers, screw gauge, spherometer: A review

- Determination of wavelength (λ) of a monochromatic light by Newton's ring experiment.
- Determination of wavelength (λ) and difference ($d\lambda$) between wavelengths of

sodium D-lines by Michelson's interferometer.

- Determination of grating element (e+d) of a plane diffraction grating.
- Determination of Planck's constant using photocell.
- Study of the characteristics of a photo cell.
- Study of the characteristics of a solar cell.
- Determination of Young's modulus (Y) of a material by bending of beam method.
- Determination of Poisson's ratio (σ) of rubber.
- Determination of rigidity modulus (η) of a material by dynamic method.
- Determination of refractive index (μ) of a transparent liquid by Boy's method.
- Determination of numerical aperture of optical fibre.
- Determination of acceleration due to gravity (g) by bar pendulum.
- Determination of damping coefficient, relaxation time and quality factor of damped harmonic oscillation by simple pendulum.
- Measurement of velocity of sound in air using resonance column method.
- Studies on dielectric/multi-ferroic materials (Open ended)
- Diffraction studies using Laser sources (Open ended)

Course Outcomes (CO):

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

CO1: Understand the wave nature of light through experiments based on interference and diffraction Phenomena.

CO2: Apply the laws of quantum physics to understand the photoelectric emission using the particle nature of light.

CO3: Characterize photovoltaic cells to find out efficiency in terms of power output.

CO4: Evaluate mechanical properties of materials using their elastic properties.

CO5: Apply the principles of optics such as refraction, total internal reflection to calculate refractive index and related parameters.

CO6: Use the principles of oscillation to understand phenomena such as damping, resonance and to determine the factors (such as gravity, elasticity etc) affecting the time period of various oscillators.

Reference Materials:

1. Physics laboratory instruction manual, School of Applied Sciences, Department of Physics, KIIT Deemed to be University, Bhubaneswar.
2. S. L. Gupta and V. Kumar, 2018, Practical Physics, Pragati Prakashan, 33rd Edition, ISBN: 978-93-87151-58-1.

Course Title: **Workshop**	
Course Code: **ME18001**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type:	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This workshop practice is designed to impart students the basic knowledge on manufacturing or developing a given object irrespective of their branch of engineering. While furnishing the given object, students will familiar with various mechanical operations and the respective tools or machines. This course involves four different sections namely Fitting, Welding, Turning and Sheet metal which cover both conventional and advanced tools to provide students the updated manufacturing experience. Students are also advised with various safety precautions to be followed during a specific manufacturing practice. At the end, students will also gain knowledge on different advanced machines such as CNC machine tools and 3D printing.

Course Contents:

- Turing operatios
- Sheet metal operations
- Fitting
- Weldig

Course Outcomes (CO):

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

CO1: Practice different operations related to fitting shop.

CO2: Use different welding tools to prepare a given type of joint.

CO3: Demonstrate various turning operations including taper turning and knurling using a conventional lathe machine.

CO4: Design a tray and prepare it using sheet metal equipment involving soldering.

CO5: Appraise different operations using a CNC machines.

CO6: Interpret different advanced machines such as 3D printing/additive manufacturing.

Course Title: **English Communication Skills**	
Course Code: **HS10003**	Contact Hours: **L-T-P-Cr : 2-0-0-2**
Course Type: **ES**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Develop understanding of professional and technical communication processes in workplace contexts. Strengthen listening and speaking competencies for effective professional interaction. Expand reading abilities for comprehension and analysis of technical and digital texts. Acquire structured writing skills for academic, business, and technical communication. Enhance awareness of ethical writing practices, and responsible use of generative.

Course Contents:

UNIT I:

Fundamentals of Professional communication: General and Technical Communication (Definitions, Differences), Process of Communication (Definition, Explanation, Diagram), Verbal and Non-verbal Communication: (Spoken, Written, Digital/Electronic, Kinesics, Proxemics, Chronemics, Oculesics, Olfactics, Gustorics, Haptics, Iconics, Paralanguage, Visual and Audio Sign Language), Flow of Communication: (Horizontal, Vertical, Diagonal, External), Levels of Communication: (Extrapersonal, Intrapersonal, Interpersonal, Organizational, Mass/Public), Barriers in Effective Communication: (Intrapersonal, Interpersonal, Organizational)

Literature Component: *'The Gift of the Magi', O. Henry* (Unit 1-related topics to be illustrated: Communication barriers between the characters, lack of communication, silence, communication process with the characters as sender and receiver, tone, body language)

UNIT II:

Professional Listening And Speaking: Listening vs Hearing (Definitions, Differences), Types of Listening: (Empathetic, Critical, Comprehensive, Superficial, Appreciative, Focused), Speaking and Pronunciation: (Types and sounds of vowels and consonants, IPA, British vs American Accent, Mother Tongue Influence, Problem Sounds), Grammar Revision: (Subject-verb Agreement, Tense, Active and Passive Voice, Preposition)

Literature Component: *'Thank You, Ma'am', Langston Hughes* (Unit 2-related topics to be illustrated: Empathetic listening and speaking, listening vs hearing as shown by the characters' actions and responses, accent, pronunciation)

UNIT III:

Effective Reading Skills: Types of Reading: (Skimming, Scanning, Intensive, Extensive), Reading Technical Content: (User Manual, Product Specification, White Paper, Infographic).

Literature Component: *'The Fun They Had' by Isaac Asimov* (Unit 3-related topics to be illustrated: Reading as a meaningful engagement with texts, reading as an experience-based learning through social interaction)

UNIT IV:

Business Writing: Writing Bias-free English: (Familiar Words, Concrete Words, Limited Abbreviations, Limited Jargon, Avoiding Cliché, Avoiding Redundancy, Avoiding Discriminatory Language), Paragraph Writing: (Components: topic sentence, restatement, coherence, cohesion, connective, clincher; Styles: narration, description, classification, illustration, persuasion),Business Letter: (Enquiry, Claim/Complaint, Order),

Technical Reports: (Formats: manuscript, memorandum, pre-printed, letter), Style: (Structure, language, tone, voice), Referencing: (Number: IEEE; Author-date: APA, Chicago), Generative AI in Writing: (Upgradation of traditional writing skills with AI usage, fact verification of information in AI usage, maintaining academic integrity with ethical AI usage)

Literature Component: *'On Letter Writing', A. G. Gardiner* (Unit 4-related topics to be illustrated: Precision and clarity in writing, writing style, bias in writing, tone shift in writing, writing as an expression of authenticity)

Textbooks:

1. Effective Technical Communication – M. Ashraf Rizvi & Priyadarshi Patnaik

(eds.), TMH, 2024.

2. Technical Communication: Principles and Practice – Meenakshi Raman & Sangeeta Sharma (eds.), OUP, 3rd ed., 2015.

Reference Books:

1. The Oxford Grammar (English) – Sidney Greenbaum, OUP, 1st ed., 2005.
2. Technical Communication for Engineers – Shalini Verma, Vikas Publishing House, 2015.
3. Communication Skills: Sanjay Kumar & Pushpalata published by Oxford University Press, 2018.

Course Outcomes (CO):

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

CO1: Define key concepts of professional communication, listening strategies, and reading techniques.

CO2: Understand the role of tone, accent, vocabulary, and context in professional communication.

CO3: Demonstrate effective communication skills by applying appropriate verbal and non-verbal strategies in spoken communication.

CO4: Analyze texts and communication situations by assessing the credibility of online/AI-generated content.

CO5: Evaluate technical reports and business documents by identifying bias and ethical concerns in writing.

CO6: Create coherent and context-appropriate written communication integrating verified information from multiple sources.

Course Title: **Linear Algebra and Fourier Analysis**	
Course Code: **MA11011**	Contact Hours: **L-T-P-Cr : 3-1-0-4**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the theory and methods for solving linear systems of equations analytically and numerically. To understand eigenvalues and eigenvectors of matrices, their computation methods, and applications. To develop proficiency in numerical methods for solving nonlinear equations, interpolation, numerical integration, and IVPs with accuracy and efficiency. To cultivate a deep understanding of Fourier analysis for the representation and interpretation of periodic and non-periodic phenomena.

Course Contents:

UNIT I:

Vector Space and System of Linear Equations: Linear system of equations; rank of matrix; consistency of linear systems; Solution of system of linear equations: Gauss elimination, Gauss-Jacobi and Gauss-Seidel methods; inverse of a matrix by Gauss-Jordan method. Vector space, basis, dimension, linear independence and linear dependence. Linear transformation.

UNIT II:

Eigenvalues and Eigenvectors of Matrices: Eigen values, Eigenvectors, complex matrices; quadratic form, Hermitian form, and Skew-Hermitian form; similar matrices; diagonalization of matrices; transformation of quadratic form to principal axis (conic section).

UNIT III:

Numerical Methods: Solutions by the Bisection method, Fixed point iteration method, Newton-Raphson method, Regula-Falsi and Secant method, Rate of convergence of iterative methods. Finite differences operators and relation between them. Interpolation: Newton's forward and backward difference interpolation, Newton's divided difference interpolation and Lagrange interpolation. Numerical differentiation of 1st and 2nd order using the finite difference operators. Trapezoidal rule, Simpson's 1/3 and 3/8 rules, Gauss-Legendre's two-point and three-point formulae. Numerical solution of IVPs: Taylor's series method, Euler's method, Modified Euler's method, fourth order Runge-Kutta method.

UNIT IV:

Fourier Series and Fourier Transform: Fourier series, arbitrary periods, even and odd functions, half-range expansions, Fourier integral, Fourier cosine and sine transforms, Fourier transform, Inverse Fourier transform, Linearity properties, Fourier transform of derivatives and Convolution theorem.

Textbooks:

1. 1. Kreyszig, E., "Advanced Engineering Mathematics", 10th Edition. Wiley, INC.
2. Jain, M. K., Iyengar, S. R. K. and Jain, R. K. (2022), "Numerical Methods for Scientific and Engineering Computation (8th Edition)", New Age International Private Limited, ISBN:978-93-93159-15-1.

Reference Books:

1. Grewal, B. S. "Higher Engineering Mathematics (44th Edition)", (2015), Khanna Publishers, ISBN: 81-7409-195-5.
2. Arumugam, S., Thangapandi Isaac, A. and Somasundaram, A. "Numerical Methods (2nd Edition)", (2002), SCITECH Publishers.
3. Ramana, B. V. "Higher Engineering Mathematics (11th Edition)", (2010), Tata McGraw-Hill, ISBN: 13-978-07-063419-0; ISBN: 10-0-07-063419-X.
4. Dass, H. K. & Verma, R. "Introduction to Engineering Mathematics-Voumel-I (8th Edition), (2014), S. Chand & Company Pvt. Ltd., ISBN: 81-219-3524-5.

Course Outcomes (CO):

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

CO1: Solve systems of linear equations and apply linear transformations to model and interpret engineering problems.

CO2: Compute and apply eigenvalues and eigenvectors of matrices to solve and interpret engineering and scientific problems.

CO3: Identify and quantify different types of errors in numerical approximation.

CO4: Implementation of numerical methods to solve nonlinear equations and use interpolation techniques for estimating unknown data values.

CO5: Demonstrate numerical methods for differentiation, integration, IVPs, and implement algorithms using computational tools.

CO6: Analyze Fourier series and transforms to represent and interpret periodic and non- periodic functions.

Course Title: **Chemistry**	
Course Code: **CH10009**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This course aims to provide a comprehensive foundation in the fundamental principles of chemistry and material science, bridging the gap between theoretical molecular behaviour and practical engineering applications. Students will analyze the thermodynamic and kinetic factors governing chemical transformations, explore the electrochemical mechanisms underlying modern energy storage systems like lithium-ion batteries and fuel cells, and master the spectroscopic and microscopic techniques essential for material characterization. Furthermore, the curriculum explores the properties and applications of some functional materials—including semiconductors, liquid crystals, and magnetic storage media—equipping learners with the analytical tools necessary to innovate in the fields of sustainable energy, electronic devices, and advanced manufacturing.

Course Contents:

UNIT I:

Chemical Thermodynamics: Basic thermodynamic concepts: internal energy, enthalpy, entropy and Gibbs free energy. Dependence of free energy on temperature and pressure. Gibbs-Helmholtz equation. Chemical equilibrium and equilibrium constants. Van't Hoff equation. Phase equilibria and Clausius-Clapeyron equation. Concept of chemical potential in an open system..

UNIT II:

Chemical kinetics and catalysis: Rate of reaction and rate laws of complex reactions (steady state approximation), Integrated rate laws (parallel, opposing and consecutive reactions), Temperature dependence of reaction rates: Collision theory, Lindemann's time lag theory and Absolute reaction rate theory, Theories of catalysis and kinetics of enzyme catalyzed reactions (Michaelis-Menten mechanism & Lineweaver-Burke plot).

UNIT III:

Electrochemical Energy Systems: Electrochemical cells and electrode potentials, Nernst equation and its applications in electrochemical measurements such as pH and solubility product, Modern energy systems: Fuel cells (AFC, PEMFC, SOFC), lithium-ion batteries, sodium-ion batteries, zinc-air batteries and nickel-metal hydride batteries.

UNIT IV:

Material Characterization Techniques: Principles of spectroscopy, selection rules, electronic (UV-Vis) and vibrational (IR & Raman) spectroscopies, Surface characterization techniques (SEM & AFM), X-Ray diffraction technique

UNIT V:

Functional materials: Semiconductors and their uses in electronic devices. Magnetic material for data storage, Introduction of display systems, liquid crystals (LCs)-classification, properties and its applications. Construction, working principle and applications of Light Emitting Diodes (LEDs)

Textbook:

1. "Engineering Chemistry", 2nd Edition, Wiley, ISBN: 9788126543205
2. Jain and Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, ISBN: 9788198917805

Reference Books:

1. P. Rath, "Engineering Chemistry", Cengage Learning India Pvt. Ltd.
2. G. Dasmohapatra, "Engineering Chemistry", 3rd Edition, Vikash Publishing House Pvt. Ltd., 9789359306568
3. RobertM. Silverstein, "Spectrometric Identification of Organic compounds" 7th,FransisX, Webster, Dravid j. Kiemle; Jhon Wiley & Sons, INC.
4. Y. Leng, "Materials Characterisation: Introduction to Microscopic and Spectroscopic Methodas, John Wiley & Sons (Asia) Pte Ltd, ISBN: 9780470822982

Course Outcomes (CO):

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

CO1: Rationalize bulk properties and processes using thermodynamic consideration and application the knowledge to decide the feasibility of a given process.

CO2: Analyze the kinetics of simple and multi-step reactions including different types of catalysis and the temperature dependence of reaction rates

CO3: Apply the Nernst equation to electrochemical measurements such as pH and solubility product

CO4: Design and Evaluate Electrochemical Energy Storage Systems.

CO5: Interpret Material Characterization Data from UV-Vis, IR, and Raman spectroscopy, and explain the principles of surface imaging (SEM, AFM) and X-ray diffraction (XRD) techniques.

CO6: Explain the structure-property relationships of functional materials including semiconductors, magnetic storage materials etc.

Course Title: **Electronic Circuits and Logic Design**	
Course Code: **EC10005**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **ES**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The objective of this course is to provide a foundational understanding of electronic circuits and digital logic. It covers the principles of semiconductor physics, P–N junction behavior, along with the operation of diodes, transistors and operational amplifiers. The course builds a strong concept in digital electronics, including number systems, Boolean algebra, logic gates, and flip-flops, enabling the analysis of combinational and sequential circuits.

Course Contents:

UNIT I:

Analog Circuits: Basic concepts of semiconductor material, Transport of carriers, Mobility and resistivity, Drift and diffusion currents, P-N junction diode, Diode characteristics and Breakdown mechanisms, Applications of P-N junction diode, BJT and JFET Physical structure, Operation, and Static characteristics, BJT biasing and DC loadline analysis. Introduction to Op-Amp, Characteristics, Applications of Op-Amp.

UNIT II:

Binary Codes & Boolean Algebra: Signed Binary numbers and its arithmetic (1's and 2's complement form), Binary codes (Weighted and non-weighted codes, Gray codes, BCD codes), Boolean Algebra-Laws and Axioms, SOP and POS (Min-term and Max-term), K-Maps (2-,3-,4- variables with don't care condition)

UNIT III:

Combinational Circuits: Adders (Half adder, Full adders, Binary Parallel Adders), Subtractor (Half Subtractor, Full Subtractor), Combined Adder-Subtractor Block, Decoders and Encoders, Multiplexer and

Demultiplexer.

UNIT IV:

Sequential Circuits: Basic latch, Flip-flops (SR, D, JK, T, Master-Slave), Triggering of flip-flops, FF conversions, Shift Registers (SISO, SIPO, PISO, PIPO), Counter Design (Synchronous and Asynchronous).

Textbook:

1. Theraja, B. L. and R.S Sedha "Principles of Electronic Devices and Circuits", Revised edition. S. Chand Publishing.2026

Reference Books:

1. Anand Kumar, "Fundamentals of Digital Logic", Fourth Edition, PHI, 2016.
2. Chattopadhyay, D., & Rakshit, P. C. (n.d.). "Electronics: Fundamentals and Applications" Fourteenth Edition. New Age International, 2018.
3. Boylestad, R. L., & Nashelsky, L., "Electronic devices and circuit theory," Eleventh Edition, Pearson Education India. 2015

Course Outcomes (CO):

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

CO1: Explain the properties of semiconductors, analyze the characteristics of diodes, and transistors.

CO2: Comprehend the fundamentals of operational amplifiers and apply them in designing basic electronic circuits.

CO3: Demonstrate the design principles of digital electronic.

CO4: Evaluate and simplify Boolean functions by using Boolean algebraic methods like K-maps.

CO5: Design and analyse different combinational circuits.

CO6: Design and analyse different sequential circuits.

Course Title: **Chemistry Laboratory**	
Course Code: **CH19001**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This lab course covers different types of chemical experiments ranging from volumetric analysis to spectroscopic techniques. This course provides the students with hands-on training in many of the advanced spectroscopic and analytical techniques in chemistry. The experiments in the course span over diverse applications in chemistry. It contains experiments dealing with environmental chemistry, volumetric analysis, organic and inorganic synthesis, electrochemistry, and spectroscopy.

Course Contents:

- Estimation of total hardness in a given water sample in terms of calcium and magnesium hardness by EDTA method.
- Estimation of the amount of NaOH and Na_2CO_3 present in a given mixture solution
- (a) Determination of the strength of $KMnO_4$ solution by using standard sodium oxalate solution. (b) Determination of the amount of Ferrous (Fe^{2+}) ions present in the Mohr's salt solution by using standard KMnO4 solution.
- Determination of the amount of dissolved oxygen present in a given water sample by Winkler's method.
- Finding the strength of Fe^{2+} present in the supplied Mohr's salt solution by potentiometric titration.
- Determination of the rate constant of acid-catalyzed hydrolysis of ethyl acetate.
- Determination of the chloride ion ($Cl-$) present in a given water sample by the argentometric method.
- Finding the strength of supplied acid by pH-metric titration against a standard alkali.
- Finding the strength of a given hydrochloric acid solution by titrating it against standard sodium hydroxide solution conducto-metrically.
- Verification of Beer Lambert's Law and application of this law to determine the unknown concentration of a given solution.
- Determination of the concentration of ferric ions (Fe^{3+}) in a given water sample by a spectrometric method using KCNS as color developing agent.
- Determination of the Isoelectric point (pI) of glycine amino acid.
- Synthesis of transition metal complexes and characterization by using IR and $^1H - NMR$. (Open ended)

- Determination of the concentration of different ions (cations and anions) in a given water sample by colorimetry. (Open ended).
- Application of potentiometric titrations (Open ended).

Course Outcomes (CO):

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

CO1: Handle different chemicals with proper safety protocols in an advanced Chemistry laboratory.

CO2: Learn and apply basic techniques used in Chemistry laboratory for preparation, purification and identification.

CO3: Analyze the kinetics of 1st order reactions and estimate the rate constant.

CO4: Use different instrumental techniques such as Conductometry, pH-metry, Potentiometry and Colorimetry.

CO5: Analyse basic water quality parameters like hardness, dissolved oxygen, alkalinity, chloride ferrous iron contents etc.

CO6: Rationalize and learn the spectroscopic and synthesis techniques in chemistry.

Reference Materials:

1. Chemistry laboratory Instruction manual, School of Applied Sciences, KIIT Deemed to be University.
2. Vogel's Quantitative Chemical Analysis, J. Mendham, R.C. Denney J. D. Barnes, M.J.K. Thomas, 6th Edition, Longman.
3. Standard methods for examination of water and wastewater, 23rd Edition, APHA.

Course Title: **Electronic Circuits and Logic Laboratory**	
Course Code: **EC19001**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **ES**	Pre-requisites: Electronic Circuits and Logic Design

Course Learning Objectives (CLO):

This laboratory course is designed to provide students with practical knowledge and hands-on experience in basic electronics and digital systems. Students gain experience in the design, testing, and analysis of analog electronic circuits, including diode-based rectifiers, transistor switching circuits, and operational amplifier applications. The laboratory also develops the ability to construct, verify, and analyze combinational digital circuits using logic gates and related digital building blocks, enabling students to understand and interpret their logical behavior. Furthermore, the course provides exposure to sequential digital circuits, including flip-flops, counters, and shift registers, allowing students to investigate their operation, timing characteristics, and practical applications. Through experimental learning and design-oriented activities, students develop essential skills in circuit implementation, measurement, troubleshooting, analysis, and engineering problem-solving.

Course Experiments:

1. Identification and characterization of basic electronic components using laboratory instruments. Familiarization to course objective and policy.
2. Design and performance evaluation of a full-wave rectified power supply.
3. Implementation of transistor-based logic gates for digital switching applications.
4. Design and analysis of operational amplifier circuits for signal conditioning.
5. Design and testing of adder and subtractor circuits for arithmetic operations.
6. Design and performance verification of multiplexer and demultiplexer circuits.
7. Implementation and functional verification of flip-flops and their conversions
8. Design and analysis of asynchronous counters using JK flip-flops.
9. Design and verification of shift registers for data storage and transfer applications.
10. Open Ended Experiment: Design and develop an innovative electronic system integrating analog and/or digital circuits to solve a real-world problem. Students are encouraged to incorporate sensors, operational amplifiers, logic circuits, and demonstrate the functionality through hardware implementation and performance testing.

Textbook:

1. Theraja, B. L. and R.S Sedha “Principles of Electronic Devices and Circuits”, Revised edition. S. Chand Publishing, 2026.

Reference Books:

1. Anand Kumar, "Fundamentals of Digital Logic", Fourth Edition, PHI, 2016.
2. Chattopadhyay, D., & Rakshit, P. C. (n.d.). "Electronics: Fundamentals and Applications" Fourteenth Edition. New Age International, 2018.
3. Boylestad, R. L., & Nashelsky, L., "Electronic devices and circuit theory," Eleventh Edition, Pearson Education India. 2015

Course Outcomes (CO):

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

CO1: Students will be able to gain knowledge about Verilog HDL and also able to design and simulate various boolean functions.

CO2: Students will be able to simulate and design adder and parallel binary adder.

CO3: Students will be able to simulate and design combinational logic circuits like decoder and Multiplexer.

CO4: Students will be able to simulate and design sequential logic circuits like Synchronous type counter and Asynchronous type counters.

CO5: Students will be able to simulate and design sequential logic circuits using shift registers.

CO6: Students will be able to simulate and design synchronous sequential circuit using concept of finite state machine.

Course Title: **Engineering Drawing & Graphics**	
Course Code: **CE18003**	Contact Hours: **L-T-P-Cr : 1-0-2-2**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The objective of this course is to enable students to visualize, interpret, and communicate engineering ideas graphically using standard drawing practices. Students will develop the ability to represent three-dimensional (3D) objects on two-dimensional (2D) planes through manual drafting and Computer Aided Drafting (CAD), with emphasis on accuracy and engineering applications.

Course Contents:

UNIT I:

Introduction to Engineering Graphics & Lettering Importance and applications of engineering drawing; BIS standards, drawing instruments and sheet layout; Types of lines and conventions; Lettering and dimensioning practices.

UNIT II:

Projection of Points and Lines: Principles of orthographic projection; Projection of points in different quadrants; Projection of straight lines; Lines inclined to one plane and both planes.

UNIT III:

Projection of Planes Projection of plane figures (triangle, square, pentagon, etc.); Planes inclined to one plane and both planes; True shape of plane surfaces.

UNIT IV:

Projection of Solids and Sections of Solid: Classification of solids; Projections of prisms, pyramids, cylinders, and cones; Axis inclined to one plane and both planes; Sectional views and types of section planes; True shape of sections; Development of surfaces of solids; Applications in sheet metal work.

UNIT V:

Computer Aided Drafting (CAD): Introduction to CAD environment and interface; Basic drawing commands (line, circle, arc, etc.); Editing commands (trim, extend, offset, mirror, etc.); Dimensioning and annotation; Preparation of simple 2D engineering drawings.

Textbook:

1. K. Venugopal, Engineering Drawing + Auto CAD, New Age Publishers, 1st Edition, 2011.

Reference Books:

1. N. D. Bhatt and V.M. Panchal, Engineering Drawing, Charotar Publishing House.
2. R.S. Agrawal and Basant Agrawal, Engineering Drawing and Computer Graphics, McGraw Hill.

Course Outcomes (CO):

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

CO1: Explain the fundamentals of engineering graphics, BIS standards, drawing instruments, types of lines, lettering, and dimensioning practices.

CO2: Apply the principles of orthographic projection to represent points and straight lines in different quadrants and orientations.

CO3: Analyze and construct projections of plane figures inclined to one or both reference planes and determine their true shapes.

CO4: Develop projections of solids such as prisms, pyramids, cylinders, and cones with different axis inclinations and sectional views.

CO5: Evaluate and prepare development of surfaces of solids for practical applications like sheet metal work.

CO6: Use CAD tools to create, modify, and annotate basic 2D & 3D engineering drawings.

Course Title: **English Communication Laboratory**	
Course Code: **HS18003**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Develop competence in professional and technical communication for real-world workplace situations. Strengthen spoken communication skills through listening and speaking practice. Expand the ability to read, and analyse technical and digital texts. Acquire the proficiency to compose coherent, and well-structured documents for academic and professional purposes. Enhance the skills for creation and delivery of well-structured presentations.

Course Contents:

Reading Comprehension: Comprehension Question Types, Answering Strategies Listening Comprehension: Comprehension Question Types, Answering Strategies

Situational Vocabulary/ Phrasal Verbs: Formal, Semi-formal, and Informal Vocabulary, Application of Vocabulary according to Occasion and Purpose Types and Examples of Phrasal Verbs.

Self-Introduction/ Mock Interview: Structure and Example Netiquette and E-mail Writing: Professional, Public, and Community Netiquette, E-mail

Structure, Format, Purpose, Response Etiquette Resume Writing: CV/ Resume Difference, Formats, Structure, including professional profiles on websites like LinkedIn, Power/ Action Verbs.

Group Discussion: Types, Structure, Roles

PPT Presentation Skills: Purpose, Structure, Delivery, Use of AI tools

Course Outcomes (CO):

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

CO1: Define and apply listening strategies, and reading and writing techniques in practical situations.

CO2: Understand the application of situational vocabulary in workplace communication.

CO3: Demonstrate competence in spoken professional communication.

CO4: Analyze texts and communication situations across formal, semi-formal, and informal contexts.

CO5: Evaluate communication strategies and performance in group discussions and Interview rounds.

CO6: Create well-structured emails, resumes, and powerpoint presentations for effective communication.

Course Title: **Discrete Mathematics**	
Course Code: **MA21005**	Contact Hours: **L-T-P-Cr : 3-1-0-4**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The main objective of this course is to provide mathematical concepts and build up strong mathematical fundamentals to support many subjects of computer science engineering such as design and analysis of algorithms, computability theory, software engineering, computer systems, syntactical analysis, information organization and retrieval, switching theory, computer representation of discrete structures and programming languages etc.

Course Contents:

UNIT I:

Logic: Propositional Logic, Application of Propositional Logic, Propositional Equivalence, Predicates and Quantifiers, Rules of Inference.

UNIT II:

Basic Structures and Advanced Counting Techniques: Set, Set Operations, Functions, Sequences and Summations, Zero-one Matrices, Application of Recurrence Relation, Solving Linear Recurrence relation using Substitution, Generating Functions. Solving Linear Recurrence relation using generating functions.

UNIT III:

Relation: Relation and Their Properties, Representing Relations, Closure of Relations, Equivalence Relation, Partial Ordering.

UNIT IV:

Graphs and Trees: Graph and Graph Models, Graph Terminology and Special type of graphs, Representing graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Path, shortest path Problems, Introduction to Trees, spanning trees, Minimal Spanning Trees.

UNIT V:

Groups and Rings: The structure of Algebras, Concept of binary operations and their properties, Semigroup, Monoid, Group, Homomorphism and Normal Subgroups, Ring, Integral Domain and Field.

Textbooks:

1. Discrete Mathematics and its Applications by Kenneth H Rosen (Mc Graw Hill 8th Edition).

Reference Books:

1. Elements of Discrete Mathematics. A Computer oriented approach by C.L Liu, D.P. Mohapatra (Tata Mc Graw Hill 4th Edition-2013).
2. Discrete Mathematics by Sudarsan Nanda, Allied Publisher Pvt. Ltd., 2022.
3. Introduction to Graph Theory by Douglas B. West, Pearson, 2nd Edition, 2002.
4. Discrete Mathematics by N Ch S N Iyengar et al., Vikas Publishing House Pvt.Ltd., 2020.

Course Outcomes (CO):

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

CO1: Convert sentences in natural language into mathematical statements and understand predicate and quantifiers, rules of inference and prove results by principle of mathematical induction.

CO2: Understand the basic structures and some special functions.

CO3: Solve problems on recurrence relations by substitution and method of generating functions and know a powerful method of counting.

CO4: Know the concepts of partition of sets, partial ordering relation, Hasse diagram and Lattice.

CO5: Apply Graph theory in related areas like Syntactic analysis, Fault detection and diagnosis in computers, Scheduling problems and Minimal-path problems, network flow problems.

CO6: Understand the concept of algebraic structures like groups, semi group, ring, integral domain and field.

Course Title: **Principles of Communication Engineering**	
Course Code:	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The Objective of the course is to learn the concepts of various analog and digital communication systems. Also students will be able to analyze and develop the problem solving abilities related to communication Engineering.

Course Contents:

UNIT I:

Introduction: To communication system, Signals in time and frequency domain, Fourier transform and Series, properties of FT and FS, Various Signal functions, Brief Idea of Probability, Cumulative Distributive Function, Probability Distributive Function, Gaussian and Rayleigh PDF. Concept of Signal to Noise Ratio (This module introduces readers to basic mathematics and probability required for communication system analysis. Derivation/Proof are not required, students may be encouraged to self-study regarding the derivation and proofs for better understanding)

UNIT II:

Amplitude Modulation Techniques: Need of Modulation, Frequency Translation, Principle of AM, side bands, Power Relationship, Assignable Frequency spectrum, Side band Transmission, DSB, SSB, VSB, AM modulators and Demodulators, AM Radio Receiver, Super hetero-dyne Principle.

UNIT III:

Frequency Modulation Techniques: Principle of FM, Frequency Deviation, Spectrum of FM wave, Power in Modulated wave, Narrow band FM, Pre-emphasis and De-emphasis, Block Diagram of FM Transmitter, FM Detector, Block Diagram of FM Receiver,

UNIT IV:

Pulse Modulation Techniques: Analog vs Digital modulation, Sampling Process, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation, Time Division Multiplexing, Frequency Division Multiplexing, The Quantization Process, Pulse Code Modulation, Bandwidth vs SNR trade-off in PCM.

UNIT V:

Digital Modulation: Data Form, Principles involved in ASK, PSK (BPSK, QPSK, $\pi/4$ QPSK), FSK.

UNIT VI:

Different Communication Systems: Introduction to Modems, Brief concept of satellite communication, Fiber optic communication and Mobile communication.

Textbooks:

1. Modern Digital and Analog Communications Systems -B.P. Lathi - Hardcover, Oxford Univ Press, 4th Edition.
2. Introduction to Analog & Digital Communication System – Simon Haykins, Wiley Student edition 2011 – John Wiley.

Reference Books:

1. Principles of Communication System – H. Taub & D.L.Schilling – TMH, 3rd Edition

Course Outcomes (CO):

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

CO1: Comprehend the basics of signals and systems like Fourier series, Fourier transform and their properties, random variable, random process, power spectral density of a signal etc.

CO2: Identify the need of communication and analyze different Amplitude Modulation based communication systems and their functions.

CO3: Comprehend, analyze and design Angle Modulation based communication systems and their functions.

CO4: Comprehend, analyze and Compare different Pulse Modulation based communication systems and their functions.

CO5: Comprehend and analyze various Digital communication techniques and Systems.

CO6: Gain broad Knowledge about Wireless, Satellite and Optical Communication.

Course Title: **Data Structures**	
Course Code: **CS20001**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Analyze time and space complexity of algorithms. Design and implement linear data structures (arrays, stacks, queues, linked lists). Understand non-linear data structures (trees and graphs). Apply sorting and searching techniques. Solve real-world problems using appropriate data structures.

Course Contents:

UNIT I:

Introduction: Introduction to Data Structures and Algorithms, Time and Space Complexity, Asymptotic Notations, Arrays: Representation and Operations, Sparse Matrices, Introduction to Stacks and Queues, Applications.

UNIT II:

Linked Lists: Singly, Doubly, and Circular Linked Lists, Operations on Linked Lists, Linked Implementation of Stacks and Queues, Polynomial Representation and Operations, Dynamic Memory Allocation.

UNIT III:

Tree: Tree Representation, Binary Trees, Binary Search Trees, Tree Traversals, Expression Trees and Manipulation, Height Balanced Trees, AVL Trees.

UNIT IV:

Graphs: Representation (Adjacency Matrix and List), Graph Traversals (BFS, DFS), Topological Sorting, Applications of Graphs, String Representation, String Operations, Pattern Matching Algorithms.

UNIT V:

Sorting Techniques: Selection, Bubble, Insertion, Merge, Quick, Heap, Radix Sort, Searching: Linear and Binary Search, Hashing: Hash Functions, Collision Resolution Techniques, Hash Tables.

Textbooks:

1. Fundamentals of Data Structures in C by E. Horowitz, S. Sahani and S. Anderson-Freed, 2nd Ed, Universities Press.

Reference Books:

1. Data Structures, Algorithms and Applications in C++, Sartaj Sahni, 2nd Ed., Universities Press Pvt. Ltd., 2008.

Course Outcomes (CO):

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

CO1: Apply basic concepts of data structures and abstract data types to solve problems.

CO2: Implement linear data structures such as stacks, queues, and linked lists.

CO3: Use trees and graphs in problem-solving.

CO4: Apply sorting and searching algorithms.

CO5: Analyze time and space complexity of algorithms.

CO6: Select appropriate data structures for efficient solutions.

Course Title: **Computer Organization and Architecture**	
Course Code: **CS21001**	Contact Hours: **L-T-P-Cr : 3-1-0-4**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the basic hardware and software issues of computer organization. To understand how computations are performed at machine level. To understand how data storage is happening at machine level. To understand the memory hierarchies, cache memories, and virtual memories. To learn the different ways of communication with I/O devices.

Course Contents:

UNIT I:

Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Machine Instructions and Programs: Memory Locations and Addresses, Memory Operations, Encoding of Machine Instructions, Addressing Modes, Instruction Types, Instruction Format, Instruction Length, Assembly Language, Subroutines, Additional Instructions, RISC vs CISC.

UNIT II:

Basic Processing Unit: Fundamental Concepts, Execution of a Complete Instruction, Single and Multiple Bus CPU Organization, Hard-wired Control, Micro programmed Control unit.

UNIT III:

Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, memory module design, Memory Hierarchy, Cache Memories, Mapping Functions, Replacement Algorithms, Memory Performance Considerations, Memory interleaving, Virtual Memories.

UNIT IV:

Arithmetic: Design of fast adders, Multiplication of Positive Numbers, Signed Operand Multiplication, Fast Multiplication, Integer Division, Floating-point Numbers and Operations.

UNIT V:

Input/ Output Organization: Accessing I/O Devices, Modes of I/O Transfer, Program Controlled I/O, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Exceptions, Direct Memory Access.

UNIT VI:

Case Study: IA-32 Register Structure, IA-32 Addressing Modes, IA-32 Instructions, Machine Instruction Format, IA-32 Assembly Language, Program Flow Control, Logic and Shift/Rotate Instructions, Subroutines for IA-32, Programming examples.

Textbooks:

1. Computer Organization and Embedded Systems by Carl Hamacher, Zvonko Vranesic, SafwatZaky, 6th Edition, MGH, 2022.

Reference Books:

1. Computer System Architecture, M.Morris Mano,3rd Edition Pearson Education India.
2. Computer Organization & Architecture, William Stallings 11th Edition, Pearson Education, 2006.

Course Outcomes (CO):

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

CO1: Perceive the functions of hardware components of computer and its requirements for the execution of instructions.

CO2: Choose Instruction Set Architecture (ISA): Instruction format, types, and various addressing modes.

CO3: Apply the basic components to design the CPU: the ALU and control unit.

CO4: Assess the different levels of memory organization: SRAM, DRAM, Cache memory, Virtual Memory.

CO5: Design the ALU and it's operations: Addition, Subtraction, Multiplication, and Division.

CO6: Classify and compare the I/O Organization and types of I/O Transfer.

Course Title: **Computer Networks**	
Course Code: **CS20003**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To provide insight about fundamental concepts and reference models (OSI and

TCP/IP) and their functionalities. To gain comprehensive knowledge about the principles, protocols, and significance of layers in OSI and TCP/IP. To know the implementation of various protocols and cryptography techniques. To learn the flow control and congestion control algorithms.

Course Contents:

UNIT I:

Data Communications: Data Transmission, Multiplexing, Data Encoding Techniques, Introduction to Computer Networks, Network Topologies, Reference Models: ISO/OSI Model and TCP/IP Model.

UNIT II:

Physical Layer: Transmission Media, Analog Signals, Digital Signals. Data Link Layer, Error Detection and Correction, Parity, LRC, CRC, Hamming Code, Flow Control and Error Control, Stop and Wait ARQ, Sliding Window (IEEE), Ethernet.

UNIT III:

Network Layer: Packet Switching and Circuit Switching, IP Addressing Methods, Sub netting, Super netting, Routing Protocols: IP, ARP, RARP, DHCP, Routing Algorithms: Distance Vector Routing, Link State Routing.

UNIT IV:

Transport Layer: Transport Services, UDP, TCP, Congestion Control, Quality of Services (QOS).

UNIT V:

Application Layer: Domain Name Space(DNS), Electronic Mail, HTTP, WWW.

Textbooks:

1. Andrew S.Tanenbaum, David J.Wetherall, “Computer Networks”, Sixth Edition, Pearson Publication, 2011.
2. Data Communications and Networking with TCP/IP Protocol Suite, Behrouz A. Forouzan, 6th Edition, Mc Graw Hill.

Reference Books:

1. W.Stallings, “Data and Computer Communication”, Tenth Edition, Pearson Education, 2018.

2. Larry L. Peterson, Bruce S.Davie, “Computer Networks: A Systems Approach”, Sixth Edition, Morgan Kaufmann Publishers, 2011.
3. Nader F. Mir, “Computer and Communication Networks”, First Edition, Pearson Publishers, 2007.

Course Outcomes (CO):

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

CO1: Use of different models for study of computer networks.

CO2: Identify the components required to build different types of networks.

CO3: Choose the required functionality at each layer for given application.

CO4: Identify solution for each functionality at each layer.

CO5: Trace the flow of information from one node to another node in the network.

CO6: Build networking solutions using the concepts of world wide web and electronic mail technologies.

Course Title: **Data Structures Laboratory**	
Course Code: **CS29001**	Contact Hours: **L-T-P-Cr : 0-1-2-2**
Course Type: **PC Lab**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the practical application of linear and nonlinear data structures. To introduce and practice advanced algorithms, programming techniques. To write modules for developing sophisticated computer application programs.

Topics:

1. Problems in C using data structures involving arrays, stacks, queues, strings, linked lists, trees, graphs, sorting and searching.
2. Operations on linked lists, stack, and queues.
3. Applications of stack, Conversion of infix expressions to postfix and evaluation of postfix expressions.
4. Implementation of Binary Tree, and Binary Search Tree.
5. Implementation of BFS, DFS – Application of stack, queues.
6. Implementation of sorting and searching Techniques.

Reference Book:

1. Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein “Data Structures using C”, Third Edition, Pearson Education, 2007.

Course Outcomes (CO):

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

CO1: Apply and implement the learned algorithm for problem solving.

CO2: Identify the data structure to develop program for real time applications.

CO3: Design and develop optimal algorithms using appropriate data structures.

CO4: Implementation of optimal algorithms using appropriate data structures.

CO5: Implement Binary Tree, and Binary Search Tree for problem solving.

CO6: Implement sorting and searching techniques for real time applications.

Course Title: **Computer Networks Laboratory**	
Course Code: **CS29003**	Contact Hours: **L-T-P-Cr : 0-1-2-2**
Course Type: **PC Lab**	Pre-requisites: **Programming**

Course Learning Objectives (CLO):

To create client and server applications using the “Sockets” API and the implementation of Data link layer protocol and TCP layer. To conduct computer communication network simulations. To have a hands on experience of computer network simulation and modelling techniques using NS-3 simulation software.

List of Experiments:

1. Exercises on Socket Programming using C and Java.
2. Exercises using NS-3 Network Simulator
   (a) Basics of Network Simulation
      i. Introduction
      ii. Platform required to run network simulator
      iii. Backend Environment of Network Simulator
      iv. Agents and applications
      v. Tracing
   (b) Simulating a Local Area Network

i. Local Area Network, LAN Topologies, MAC Protocol, Taking turns, Ethernet, Ethernet Frame Structure, Ethernet Versions, Simulating a LAN using Network Simulator3 (NS3)
ii. Implementation of various MAC protocols
iii. Setting up of various network topologies
iv. Measurement of routing protocols

(c) Measuring Network Performance

i. Network Performance Evaluation, Performance Evaluation Metricsm Parameters Affecting the Performance of Networks, Performance Evaluation Techniques, Network Performance Evaluation using NS-3
ii. Setting up of network that carries various application protocols and analyzing the performances

3. Hands on experiments on Network equipments
   (a) Switches, Routers
   (b) Hardware, firewall

Reference Books:

1. W. Richard Stevens, "UNIX Network Programming – Networking APIs: Sockets and XTI", Vol. 1, Second Edition, Prentice Hall, 1998.
2. Eitan Altman, Tania Jimenez, "NS Simulator for Beginners", Morgan & Claypool Publishers, 2011.

Course Outcomes (CO):

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

CO1: Invoke analytical studies of Computer Networks through network simulation.

CO2: Design a network using NS-3 toolkit and its importance in designing a real network.

CO3: Measure and analyze the network parameters for a high throughput network.

CO4: Practice experiments on Network Equipments.

CO5: Evaluate Network Performance Evaluation using NS-3.

CO6: Build experiments on Network equipments.

Course Title: **Probability and Statistics**	
Course Code: **MA20008**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The objective of this course is to familiarize the students with the foundation of probability and statistics and to use it in solving the problems arises in engineering and real life applications.

Course Contents:

UNIT I:

Probability and random variables: Basic concepts of sample space, events, independent events, Axiom of Probability. Discrete random variable, probability mass function, cumulative distribution function for discrete random variable, some special distributions like Uniform distribution, Binomial distribution, Negative binomial distribution, Poisson distribution, mean and variance. Continuous random variable, density function, cumulative distribution function. Uniform distribution, normal distribution, mean, variance and normal approximation of the binomial distribution.

UNIT II:

Joint probability and distributions: Joint probability mass function and marginal probability mass function, joint probability density function and marginal probability density function, concept of independent random variable (joint probability). Expected value, covariance and correlation for jointly distributed random variable (both continuous and discrete).

UNIT III:

Descriptive Statistics: Population, sample, random sample, distribution of sample mean, sample variance, central limit theorem, Correlation, Coefficient of Correlation, Regression Analysis: Least square method.

UNIT IV:

Inferential statistics: Point estimator, point estimation of parameter using method of maximum likelihood estimation, confidence interval, confidence interval for the mean of a normal population with known and unknown variance, confidence interval for the variance of a normal population, hypothesis testing, one sided and two sided alternatives, Tests for mean of the normal distribution with known variance, Tests for mean of the normal distribution with unknown variance, tests for variance of the normal distribution.

Textbooks:

1. Probability and Statistics for Engineers and Sciences by J. L. Devore, CENGAGE Learning, 9th Edition.
2. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, INC, 10th Edition.

Reference Books:

1. Introduction to Probability and Statistics for Engineers and Scientists by S.M. Ross, Elsevier/AP, 6th Edition.
2. Introduction to Probability and Statistics by J.S. Milton & J.C. Arnold, McGraw Hill, 4th Edition.
3. Introduction to Probability Theory and Statistical Inference by H.J. Larson, John Wiley & Sons Inc, 3rd Edition.
4. Fundamental of Mathematical Statistics by S. C. Gupta & V. K. Kapoor, S. Chand, 12th Edition.
5. Probability and Statistics by TKV Ayengar, B. K. Gandhi, S. Ranganatham, & MVSSN Prasad, S. Chand and Company Ltd, 7th Revised Edition.

Course Outcomes (CO):

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

CO1: Understand basic probability and its applications.

CO2: Study probability distributions and can use it in real life data analysis.

CO3: Have a knowledge on univariate and bivariate distributions and their properties.

CO4: study the correlation of data, regression analysis and know the relation of y on x by the concept of sample regression analysis.

CO5: Have good understanding of the Central Limit Theorem and its applications.

CO6: Analyze the statistical inference.

Course Title: **Operating Systems**	
Course Code: **CS20002**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To provide knowledge about the services rendered by operating systems. To explore the various scheduling policies and to provide solutions for critical section and deadlock problems. To provide a detailed discussion of the various memory management techniques. To discuss the various file-system design and implementation issues. To discuss how protection domains help to achieve security in a system. To explore the design and implementation issues of Distributed Operating Systems.

Course Contents:

UNIT I:

Introduction: Need for Operating Systems, Computer Systems, OS Operations, Abstract view of OS, Virtualization, Computing Environments, OS Services,OS Structures, System Calls, Building and Booting OS, Process, Threads, Multithreading.

UNIT II:

Process Management: Process Scheduling, Process Co-ordination, Synchronization, Semaphores, Monitors, Hardware Synchronization, Deadlocks, Methods for Handling Deadlocks.

UNIT III:

Memory Management: Memory Management Strategies, Contiguous and Non-Contiguous allocation, Virtual memory Management, Demand Paging, Page Placement and Replacement Policies.

UNIT IV:

File Management: File System, Basic concepts, File System design and Implementation, Case Study: Linux File Systems, Mass Storage Structure, Disk Scheduling, Disk Management, I/O Systems, System Protection and Security.

UNIT V:

Distributed Systems: Distributed Systems, Distributed operating systems, Distributed file systems, Distributed Synchronization, OS architecture, Case study on LINUX and Windows OS.

Textbooks:

1. Silberschatz, Galvin, Gagne, "Operating System Concepts", Tenth Edition, Wiley, 2018.

Reference Books:

1. William Stallings, "Operating Systems: Internals and Design Principles", Ninth Edition, Pearson Publication.
2. Andrew S. Tanenbaum and Herbert Bos, "Modern Operating Systems", Fourth Edition, Pearson Publication.

Course Outcomes (CO):

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

CO1: Distinguish between different types of modern operating systems and virtual machines.

CO2: Comprehend the techniques used to implement the process manager.

CO3: Comprehend virtual memory abstractions in operating systems.

CO4: Design and develop file system and I/O system.

CO5: Apply various mechanisms in storage management.

CO6: Design and develop OS modules for distributed environment.

Course Title: **Object Oriented Programming using Java**	
Course Code: **CS20004**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **C Programming**

Course Learning Objectives (CLO):

This course provides a basic overview of object oriented programming concepts. Also it develops programming skills of students in Java and enables students to design object-oriented applications with Java.

Course Contents:

UNIT I:

Evolution of Programming Paradigm: Procedure oriented programming vs Objects oriented programming, Object oriented programming concepts: Object, classes, encapsulation and abstraction, inheritance, polymorphism.

Java Overview: JDK, JRE, Java Virtual Machine,Byte code, Java Characteristics, Data types, Operators, Control statements, Class fundamentals, Objects, Methods, Parameterized method, Use of static keyword, Input stream reader, scanner class, Command Line Argument,Constructors, Overloading, Array

UNIT II:

Inheritance: Basics of Inheritance, Use of super and final keywords, method overriding, Abstract classes, Dynamic Method Dispatch, defining and importing packages, access protection, interfaces, inner class

UNIT III:

Exception handling: Exception fundamentals, types, understanding different keywords (try, catch, finally, throw, throws), User defined exception handling.

UNIT IV:

String Handling: Basics of String handling, String class, String Buffer class, constructor and methods of both classes.

Input/Output: Stream classes - Byte stream, character stream, reading and writing from console, Files - reading and writing onto file using Byte stream and character stream, Random Access File.

UNIT V:

Multithreading: Basic thread concept, Life cycle of thread, Thread Model, Thread Priorities, Synchronization, Thread Class and Runnable Interface, Inter Thread Communication.

UNIT VI:

GUI Programming: Introduction to Swing, Swing controls, Event handling: Delegation event model, event classes, sources, listeners, Adapter class.

JDBC: JDBC API, Comparison between JDBC & ODBC, Type of JDBC Drivers, JDBC Architecture, JDBC classes and interfaces, Basic steps in Developing JDBC Applications, Working with Data Base, Result Set, Statement & Prepared Statement interfaces, Result Set Meta Data

Textbooks:

1. Java - The Complete Reference , Herbert Schildt, 12th edition, McGraw Hill Education.

Reference Books:

1. Java Programming – for Core and Advanced Users, Sagayaraj, Denis, Karthik and Gajalakshmi, Universities Press.
2. Java - One Step Ahead, by Anita Seth and B L Juneja, published by Oxford University Press.

Course Outcomes (CO):

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

CO1: Examine the basic concepts of Object Oriented Programming and Perceive syntax and semantics of Java Programming language

CO2: Design Java application programs using basic concepts of OOP principles, abstract classes, interfaces and packages.

CO3: Develop robust Java programs using exception handling.

CO4: Design java programs using string classes and I/O operations.

CO5: Design multitasking programs using multithreading techniques.

CO6: Design GUI applications using Swing and interactive applications using event handling and java database connectivity.

Course Title: **Database Management Systems**	
Course Code: **CS20006**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To learn data models, conceptualize, and depict a database system using an ER diagram. To understand the internal storage structures in a physical database design. To know the fundamental concepts of transaction processing techniques. To understand the concept of database design in normalization techniques. To know the manipulation of SQL queries.

Course Contents:

UNIT I:

Introduction: Purpose of Database System, Views of Data, Data Models, Database Languages, Database System Architecture, Components of DBMS, Entity-Relationship Model (E-R Model), E-R Diagram Notation, EER

Notations, Examples.

UNIT II:

Relational Model: Relational Data Model, Concept of Relations, Schema–Instance Distinction, Keys, Integrity Rules, Relational Algebra Operators.

SQL: Data Definition, Data Manipulation, Aggregate Functions, Null Values, Nested Sub-queries, Joined Relations.

UNIT III:

Database Design: Dependencies and Normal forms, Dependency theory, Functional dependencies, Armstrong's axioms for FD's, Closure of a set of FD's, minimal covers, Definitions of 1NF, 2NF,3NFandBCNF,4NF, 5NF, Decompositions and desirable properties of them.

UNIT IV:

Transaction Management: ACID properties, Serializability and concurrency control, Lock based concurrency control (2PL), Timestamp ordering protocol, Database recovery management.

UNIT V:

Implementation Techniques: Overview of Physical Storage Media, Magnetic Disks, RAID, Tertiary Storage, Organization of Records in Files, Indexing and Hashing, Ordered Indices, Primary and Secondary Index Structures.

Textbooks:

1. Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, Mc GrawHill, 2006.
2. C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition,Pearson Education,2006.

Reference Books:

1. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems", Seventh Edition, Pearson, 2007.

Course Outcomes (CO):

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

CO1: Demonstrate basic elements of database management systems.

CO2: Conceptualize a relational database system of simple database application scenarios using ER & EER model.

CO3: Construct relational database and solve database queries using relational algebra and SQL.

CO4: Solve problems on functional dependencies and design database systems using normalization.

CO5: Assess transaction processing for controlling the concurrent data access and data recovery schemes.

CO6: Use database storage access techniques including indexing methods.

Course Title: **Automata Theory and Formal Languages**	
Course Code: **CS21002**	Contact Hours: **L-T-P-Cr : 3-1-0-4**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To introduce the fundamental concepts of formal languages, automata, and their role in computation theory. To develop a clear understanding of finite automata, regular expressions, and their equivalence. To enable students to analyze and design context-free grammars and pushdown automata for language recognition. To provide knowledge of Turing machines as a model of computation and explore their computational power. To familiarize students with decidability, undecidability, and the limitations of computational models.

Course Contents:

UNIT I:

Finite Automata: Alphabets, Strings and Languages, Automata and Grammars, Deterministic Finite Automata (DFA), Formal Definition, Simplified notation: State transition graph, Transition table. Language of DFA, Non-deterministic Finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata.

UNIT II:

Regular Expression(RE): Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, State Ellimination Method, Non Regular Languages, Pumping Lemma for regular Languages, Application of Pumping Lemma, Closure properties of Regular Languages.

UNIT III:

Context Free Grammar(CFG) and Context Free Languages: Definition, Examples, Derivation, Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure properties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership (CYK Algorithm), Pumping lemma for CFLs.

UNIT IV:

Push Down Automata(PDA): Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of acceptance by empty stack and final state, Equivalence of CFG and PDA (Conversion of CFG to PDA and PDA to CFG).

UNIT V:

Turing Machines(TM) and Undecidability: Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computer of Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to Undecidability, Undecidable problems about TMs, Post correspondence problem(PCP), Modified PCP and undecidable nature of post correspondence problem, Introduction to recursive function theory.

Textbooks:

1. Peter Linz, "An Introduction to Formal Language and Automata", 4th Edition, Jones & Bartlett Learning, 2011.

Reference Books:

1. J. E. Hopcroft, R. Motwani, and J. D. Ullman, Introduction to Automata Theory, Languages and Computation, 3rd Edition, Pearson Education, 2007.
2. M.Sipser, Introduction to the Theory of Computation, 3rd Edition, Cengage Learning, 2012.
3. Martin J. C., "Introduction to Languages and Theory of Computations",

Fourth Edition, TMH, 2010.

4. Papadimitriou C., Lewis C. L., "Elements of the Theory of Computation", Pearson, 1997.

Course Outcomes (CO):

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

CO1: Construct and analyze deterministic & non-deterministic finite automata.

CO2: Design regular expression for any tokenization task and convert any finite automata to its equivalent regular expression.

CO3: Construct a context free grammar for parsing any language, and apply normal forms & the pumping lemma for CFLs.

CO4: Model and analyze pushdown automata, and establish equivalence between PDA and CFG representations.

CO5: Design Turing machines for computational problems, distinguish between decidable and un decidable problems.

CO6: Apply mathematical and formal techniques for solving real-world problems.

Course Title: **Operating System Laboratory**	
Course Code: **CS29002**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **PC Lab**	Pre-requisites: **Data Structure**

Course Learning Objectives (CLO):

To understand the concept of Operating System. To have insight knowledge on different system calls and Unix Utilities. To experience the practical side of the functioning of various blocks in OS. To design a real world application by considering process synchronization, Memory management.

List of Experiments:

1. Hands on Unix Commands.
2. Shell programming for file handling.
3. Shell Script programming using the commands grep, awk, and sed.
4. Programs on Multithread using P-thread.
5. Implementation of CPU scheduling algorithms.

6. Implementation of Synchronization problems using Semaphores, Message Queues and Shared Memory.
7. Implementation of Memory Management, Allocation, Placement and replacement Algorithms.
8. Implementation of various Disk scheduling algorithms.

Reference Books:

1. Silberschatz, Galvin, Gagne, "Operating System Concepts", Ninth Edition,Wiley , 2013.
2. William Stallings, "Operating Systems – Internals and Design Principles", Nineth Edition, Pearson Publications, 2014.
3. Behrouz A. Forouzan, and Richard F. Gilberg, "UNIX and Shell Programming", Cengage Learning, 2003.

Course Outcomes (CO):

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

CO1: Experiment on shell script and P-thread.

CO2: Solve synchronization problems.

CO3: Develop programs for CPU scheduling, Memory allocation policy.

CO4: Devise algorithm for deadlock avoidance.

CO5: Implement memory management techniques.

CO6: Implement various disk scheduling algorithms

Course Title: **Object Oriented Programming Laboratory**	
Course Code: **CS29004**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **PC Lab**	Pre-requisites: **Programming in C**

Course Learning Objectives (CLO):

To develop programming skill in Java. To explore the concepts of Object-Oriented Programming using Java. To implement the concepts of abstract class, interface and package in Java. To apply the concept of string handling, To develop robust program using exception handling in java. To design interactive application using GUI, file handling and event handling technique in Java. To design real world application using JDBC.

List of Experiments:

1. Programs on basic Java concept, array class and object.
2. Programs on use of static modifier, method and constructor overloading.
3. Programs on different types of inheritance, method overriding.
4. Programs on abstract class and interface
5. Programs using packages.
6. Program on String in java.
7. Program on File Handling.
8. GUI Programming using swing and Event handling.
9. Program on Multithreading and thread synchronization.
10. Program using JDBC.

Reference Books:

1. Java - The Complete Reference, Herbert Schildt, 10th edition, McGraw HillEducation.
2. Java Programming – for Core and Advanced Users, Sagayaraj, Denis, Karthik and Gajalakshmi, Universities Press.
3. Introduction to JAVA Programming, Y.Daniel Liang, 10th Edition, Pearson Education, 2007
4. Java - One Step Ahead, by Anita Seth and B L Juneja, Oxford University Press.

Course Outcomes (CO):

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

CO1: Run java programs using java compiler.

CO2: Write java programs using basic object-oriented programming concepts.

CO3: Write programs using abstract classes interfaces and packages.

CO4: Write java program using multi-threading and exception handling.

CO5: Design Java application using String and I/O classes.

CO6: Design GUI application using Swing and interactive application using event handling and JDBC.

Course Title: **Database Laboratory**	
Course Code: **CS29006**	Contact Hours: **L-T-P-Cr : 0-1-2-2**
Course Type: **PC Lab**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To explore the features of a Database Management Systems. To interface a database with front end tools. To understand the internals of a database system. To identify Structure Query Language statements used in creation and manipulation of Database. To identify the methodology of conceptual modeling through Entity Relationship model.

List of Experiments:

1. Working with DDL, DML and DCL.
2. Inbuilt functions in RDBMS.
3. Nested Queries & Join Queries.
4. Set operators & Views in SQL.
5. Control structures.
6. Working with cursors and exception handling
7. Working with Procedures and Functions.
8. Triggers.
9. Dynamic & Embedded SQL.
10. Database Design and implementation (Mini Project).
11. Working with XML*.
12. Forms & Reports*.

Reference Books:

1. Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Seventh Edition, McGraw Hill, 2006.
2. C. J. Date, A. Kannan, S. Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.

Course Outcomes (CO):

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

CO1: Identify Structure Query Language statements used in creation and manipulation of Database.

CO2: Use databases for building client server applications.

CO3: Comprehend the internal working of a database system.

CO4: Design and develop a database using SQL and the mechanism in connecting with a Web based GUI.

CO5: Analyze and design a real database application.

CO6: Evaluate the efficiency of the database design for real time applications.

Course Title: **Design and Analysis of Algorithms**	
Course Code: **CS30001**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the importance of algorithms. To analyze the complexity of an algorithm in terms of time and space complexities. To understand various problem-solving techniques. To learn about amortized analysis of algorithms. To design and implement various programming paradigms and their complexity.

Course Contents:

UNIT I:

Introduction: Concepts in algorithm analysis & design motivation, Space and Time Complexity of algorithm, Asymptotic Notations (Big Oh, Omega, Theta), Analysis of time complexity of Insertion Sort by step count method, Solving recurrences using Iterative, Substitution, Recurrence Tree, Master theorem.

UNIT II:

Divide & Conquer and Greedy Approaches: Divide and Conquer Method, Greedy Method, Huffman Code, Minimum Spanning Trees, Dijkstra Algorithm, Knapsack Problem, Job Sequencing with Deadlines.

UNIT III:

Dynamic Programming Approaches: Dynamic Programming, Knapsack Problem, Matrix Chain Multiplication, Longest Common Subsequence, Multistage Graphs, All-Pairs Shortest Paths, Travelling Salesman Problem.

UNIT IV:

Amortization: Randomized Algorithms and Amortized Analysis, Las Vegas and

Monte Carlo Types, Randomized Quicksort and Its Analysis, Min-Cut Algorithm.

UNIT V:

NP Problems: NP-Hard and NP-complete problems, Basic concepts, Reducibility, Vertex cover, 3CNF-SAT, clique, Hamiltonian cycle, TSP, Approximation algorithms, Vertex cover, TSP.

Textbooks:

1. T.Cormen, C. Lieserson, R.Rivest, C.Stein, "Introductions to Algorithms", Third Edition, Prentice-Hall/India, 2009.

Reference Books:

1. A. M.Tenenbaum, Y. Langsam, M. J. Augestien, "Data Structures using C", First Edition, Pearson Education,2007.
2. Fundamentals of Computer Algorithms, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, 2nd Edition, Universities Press.

Course Outcomes (CO):

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

CO1: Analyze the time and space complexity for any algorithm.

CO2: Compare and contrast different algorithm techniques.

CO3: Apply the design techniques of algorithm in solving real world problems.

CO4: Perform amortize analysis for any algorithm.

CO5: Modify existing algorithms to apply in common engineering design situations.

CO6: Use NP class of problems to propose approximation algorithms.

Course Title: **Artificial Intelligence**	
Course Code: **CS30003**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the various characteristics of Intelligent agents. To understand the different search strategies in AI. To understand the knowledge represention in solving AI problems. To understand the ways of planning and acting in the real world. To know about the probabilistic reasoning and related models behind the AI application.

Course Contents:

UNIT I:

Introduction: Introduction, Definition, Foundation, History and state of the Art applications of Artificial Intelligence, Characteristics of Intelligent Agents, Types of Intelligent Agents.

UNIT II:

Problem Solving Methods: Problem solving Methods, Search Strategies, Uninformed, Informed, Heuristics, Local Search Algorithms and Optimization Problems, Searching with Partial Observations, Backtracking Search, Performance of Search algorithms.

UNIT III:

Knowledge Representation: Propositional logic, First Order Predicate Logic, Model checking approach and theorem proving approach, Unification, Forward Chaining, Backward Chaining, Resolution, Knowledge Representation using First order Predicate logic, Reasoning Systems.

UNIT IV:

Planning: Planning with state-space search, Partial-order planning, Planning graphs, planning and acting in the real world.

UNIT V:

Uncertain Knowledge and Reasoning: Uncertainty, Review of probability, Probabilistic Reasoning, Bayesian networks, Inferences in Bayesian networks, Temporal models, Hidden Markov models.

Textbooks:

1. Stuart Russel, Peter Norvig, "Artificial Intelligence–A Modern Approach", FourthEdition, Pearson Education, 2022.

Reference Books:

1. Introduction to Artificial Intelligence and Expert Systems, Dan W. Patterson, Pearson Education.

Course Outcomes (CO):

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

CO1: Discover the concepts, applications, and the theory underlying AI.

CO2: Identify problems that are amenably solved by AI methods.

CO3: Analyze the issues of knowledge representation and search techniques.

CO4: Analyze the conceptual issues underlying the design of AI systems.

CO5: Discuss the uncertain knowledge on reasoning concepts in AI.

CO6: Apply AI techniques to develop programs to solve real life problems in different possible domains.

Course Title: **Software Engineering**	
Course Code: **CS31001**	Contact Hours: **L-T-P-Cr : 3-1-0-4**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the software engineering practice. To understand the software engineering process models and its implimentation. To understand design engineering and web applications. To gain knowledge of software testing. To understand software project management.

Course Contents:

UNIT I:

Introduction: Role of Software Engineer, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Quality Attributes.

Assessment: How Software Engineering Changes? Software Development Life Cycle (SDLC) Models: Waterfall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models, Choosing a social relevant problem, Summary Team Report.

UNIT II:

Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Designing the architecture.

Assessment: Impact of Requirement Engineering in problem solving, Decision Tables, SRS Document, IEEE Standards for SRS, Architectural Design, Component-Level Design, User Interface Design, Web Application Design, Submission of SRS Document for Team Project..

UNIT III:

Quality concepts, Review techniques, Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks.
Assessment: Framing SQA Plan, ISO 9000 Models, SEI-CMM Model and their relevance to project Management, Other emerging models like People CMM.

UNIT IV:

Testing: Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing, Software Testing Strategies, Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Testing conventional applications, object oriented applications, Web applications, Formal modeling and verification, Software configuration management, Product metrics.
Assessment: Team Analysis in Metrics Calculation.

UNIT V:

Project Management: Project Management Concepts, Process and Project Metrics, Estimation for Software Projects, Project Scheduling, Risk Management, Maintenance and Re-engineering.
Assessment: Preparation of Risk Mitigation Plan.

Textbooks:

1. Rajib Mall, "Fundamentals of Software Engineering", Fifth Edition, PHI Publication, 2009.
2. R.S. Pressman, "Software Engineering: A Practitioners Approach", Eighth Edition, McGraw Hill, 2010.
3. Pankaj Jalote, "Software Project Management in Practice", Pearson Education, New Delhi, 2002.

Reference Books:

1. Dr. Hitesh Mohapatra, Dr. Amiya Kumar Rath, 2nd edition, BPB publication, 2025.

Course Outcomes (CO):

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

CO1: Identify appropriate software process models for developing real life projects.

CO2: Assess each module given the overall software engineering practice.

CO3: Enhance the software project management skills.

CO4: Comprehend the systematic methodologies involved in software engineering.

CO5: Work ethically in a team as well as independently on software projects and adapt to the ever-changing dynamic real-world situations.

CO6: Design and develop a software product in accordance with software engineering principles.

Course Title: **Principles of Cryptography**	
Course Code: **CS30005**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To gain knowledge about the mathematics of the cryptographic algorithms .To get an insight into the working of different existing cryptographic algorithms. To learn how to use cryptographic algorithms in security.

Course Contents:

UNIT I:

Number Theory: Fermat's theorem, Cauchy's theorem, Group, Ring, Field, Chinese Remainder Theorem, Primality Testing Algorithm, Euclid's Algorithm for Integers, Extended Euclid's Algorithm, Quadratic Residues, Legendre Symbol, Jacobi Symbol

UNIT II:

Principles of Cryptography and Cryptanalysis, Classical Cryptography, Different Type of Attack: CMA, CPA, CCA etc., Shannon Perfect Secrecy, OTP, Pseudo Random Bit Generators, Block Ciphers, Stream Ciphers.

UNIT III:

Block ciphers: Modes of Operation, DES and its variants, Blowfish, RC4, AES, Linear and Differential Cryptanalysis.

UNIT IV:

One-way function, Trapdoor One-way Function, Public Key Cryptography, RSA Cryptosystem, Diffie-Hellman Key Exchange Algorithm, ElGamal Cryptosystem ECC (Elliptic Curve Cryptography)

UNIT V:

Message Authentication Code, Message Digest, Cryptographic Hash Functions, Secure Hash Algorithm (SHA, MD5), Digital Signature (RSA digital signature), Entity Authentication, KDC, Kerberos.

Textbooks:

1. W. Stallings, "Cryptography and Network Security: Principles and Practice", 8th Edition, Pearson Education Asia, 2023
2. D. Stinson, M. Paterson, Cryptography: Theory and Practice, 4th edition, CRC Press, 2018.

Reference Books:

1. Atul Kahate, Cryptography and Network Security, 4th Edition, McGraw Hill, 2019.
2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd edition, McGraw Hill, 2015.
3. J. Katz, Y. Lindell, Introduction to Modern Cryptography, 3rd Edition, CRC Press, 2025.

Course Outcomes (CO):

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

CO1: Understand the mathematics of cryptography.

CO2: Understand the basics concepts and goals of security.

CO3: Analyze the symmetric key cryptosystems and their applications.

CO4: Analyze the asymmetric key cryptosystems and their applications.

CO5: Assess the hash algorithms and their uses in message authentication.

CO6: Evaluate the different entity authentication schemes.

Course Title: **Principles of Economics**	
Course Code:	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type:	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The objective of this course is to teach students the principles of economics of aggregates so they can apply these ideas to their own lives and the world in which they live.

Course Contents:

UNIT I:

National Income and its measurement: Introduction to National Income, Concepts of GDP, GNP, GDP Gap, GDP Deflator and national income, Comparison of GDP deflator with CPI, Rules and Methods of Measurement of GDP (Income, expenditure and Out Put method), Circular Flow of Income and expenditure both in close and open economy.

UNIT II:

General Equilibrium: Introduction of AD & AS. Derivation of product market equilibrium (IS curve) and money market equilibrium (LM curve) – equilibrium in IS-LM Model, Effectiveness of Monetary and Fiscal Policy, Crowding-Out Effect.

UNIT III:

Inflation and Unemployment: Measuring Inflation rate and Unemployment rate; The Phillips relation – The expectation augmented Philips curve – The natural rate of unemployment hypothesis The Relation between GDP Gap, Inflation rate and unemployment Gap, Okun's Law.

UNIT IV:

Theories of consumption and Investment: Keynesian and Post Keynesian: Consumption function, Marginal Efficiency of Capital, theories of consumption –Absolute, relative, permanent and life cycle income hypothesis.

Keynesian and Post Keynesian theories: The decisions to invest-Autonomous and Induced investment, MEI schedule. Multiplier and accelerator theories of Investment. Neo-classical theory of investment (Jorgensen)

Textbooks:

1. N. Gregory Mankiw. Principles of Macro economics with course mate, 7th

edition, Cengage Publishers.

2. Andrew Abel and Ben Bernanke (2016), Macroeconomics, Publisher: Pearson.

Reference Books:

1. Branson W.A , Macroeconomic Theory and Policy (latest Edition, Harper and Row New York.
2. Dornbusch, Fischer and Startz, Macroeconomics, McGraw Hill, 11th edition, 2010.
3. Shapiro, E. (1996), Macroeconomic Analysis, Galgotia Publications, New Delhi.
4. Ackley, G. (1976), Macroeconomics: Theory and Policy, Macmillan Publishing Company.
5. S. N. V. Siva Kumar, Macro Economics and Policy for Managers: An Indian Perspective, Cengage publishers,2019.

Course Outcomes (CO):

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

CO1: Introduce themselves to the basic principles of macro economics.

CO2: Explain the circular flow model and use the concepts of aggregate demand and aggregate supply.

CO3: Understand the basic economic problems of inflation, unemployment, poverty and their remedies through macro insights.

CO4: Evaluate the relevance of macro variables in policy making.

CO5: Relate the corporate functioning to macroeconomic indicators.

CO6: Define fiscal and monetary policies and how these affect the economy.

Course Title: **Algorithms Laboratory**	
Course Code: **CS39001**	Contact Hours: **L-T-P-Cr : 0-1-2-2**
Course Type: **PC Lab**	Pre-requisites: **Data Structures**

Course Learning Objectives (CLO):

To learn how to analyze the complexity of algorithms. To compare and evaluate algorithms in terms of time and space complexity. To program brute force, divide and conquer, decrease and conquer, transform and conquer, greedy, and dynamic techniques.

List of Experiments:

1. Estimating worst-case/average-case complexity of algorithms via programs.
2. Determining machine constants.
3. Programs involving some advanced data structures.
4. Implementing example problems.
5. Illustrating the different paradigms of algorithm design.
6. Solving miscellaneous problems e.g. problems in string manipulation, graph theory, optimization.

Reference Books:

1. H. S. Wilf, "Algorithms and Complexity", CRC Press.
2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, "Introduction to Algorithms", Prentice Hall.(Foreign Book Available)

Course Outcomes (CO):

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

CO1: Solve and analyze general algorithms based on space and time complexity.

CO2: Implement and empirically compare fundamental algorithms and data structures to real-world problems.

CO3: Design, develop, and optimize algorithms in different paradigms.

CO4: Implement problems in string manipulation.

CO5: Develop solutions using graph theory.

CO6: Evaluate optimization techniques for real-world problems.

Course Title: **Full Stack Development Laboratory**	
Course Code: **CS39003**	Contact Hours: **L-T-P-Cr : 0-1-2-2**
Course Type: **PC Lab**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To implement efficient data storage and manipulation using the Java Collections Framework. To develop robust database-driven applications using DAO patterns and Object-Relational Mapping (ORM).To understand state management and server-side logic using Servlets and JSP. To design and build RESTful web services using the Spring Boot framework.

Full Stack Development Laboratory	
Week	**Experiment / Task**
1	**Interactive UI:** Fundamentals of HTML, CSS, and JavaScript, including webpage structure, basic styling, and introduction to DOM manipulation and event handling. Hands-on exercise: design and develop a simple interactive webpage (e.g., a personal profile page with styled layout and a button-triggered JavaScript action).
2	**Collections:** Implementation of a Student Information System using Array List and HashSet to manage unique records and ordered data.
3	**Collections:** Creating an Employee Ranking System using HashMap. Implementing Comparable and Comparator for multi-criteria sorting.
4	**JDBC Transaction Management:** Develop a Banking Application module using the DAO pattern and Prepared Statement to handle fund transfers.

Full Stack Development Laboratory	
Week	**Experiment / Task**
5	**Hibernate Fundamentals:** Configure Hibernate ORM to perform CRUD operations on an "Employee" entity using HQL.
6	**JPA Mapping:** Design a "Library System" database implementing One-to-Many and Many-to-Many mappings using JPA annotations.
7	**Servlet Basics:** Implement a User Registration module using Http Servlet to handle form data and server-side validation.
8	**Session Management:** Implement a Login/Logout System using HttpSession and Cookies to protect restricted pages.
9	**JSP Scripting:** Build a "Student Grade Calculator" using JSP scripting elements (Directives, Scriptlets, and Expressions).
10	**MVC with JSTL:** Refactor a Product Catalog application using the MVC pattern. Use JSTL and EL to remove Java code from JSPs.
11	**Core Spring:** Setup a Spring Boot project. Implement Dependency Injection (Autowired) for a multi-provider Notification Service.
12	**Spring Data JPA:** Develop a "Search Engine" for a Product database using Jpa Repository and derived query methods.
13	**REST API Development:** Build a "Task Management API" supporting GET, POST, PUT, and DELETE with Response Entity status codes
14	**Capstone Project:** Requirement analysis, Database design, Web interface integration, and Final Project Demonstration/Viva.

Textbooks:

1. Java: The Complete Reference, 12th Edition, Herbert Schildt, McGraw Hill.
2. Head First Servlets and JSP, Bryan Basham, Kathy Sierra, Bert Bates, O'Reilly Media.

Reference Books:

1. Spring Boot in Action, Craig Walls, Manning Publications.
2. Hibernate in Action, Christian Bauer and Gavin King, Manning Publications.

Course Outcomes (CO):

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

CO1: Utilize appropriate Collection classes to solve complex data processing problems.

CO2: Design and implement persistent data layers using JDBC and JPA/Hibernate.

CO3: Develop secure web applications with session tracking and authentication using Servlets.

CO4: Build and deploy scalable RESTful APIs using Spring Boot.

CO5: Create a complete integrated enterprise application following the MVC design pattern.

CO6: Deploy a fully functional scalable software for real-life applications.

Course Title: **High Performance Computing**	
Course Code: **CS30002**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the concept of advanced pipelining techniques. To understand the current state-of-the-art in memory system design. To know the working principle of I/O devices. To understand the memory management techniques.

Course Contents:

UNIT I:

Introduction, Classes of computers, Defining Computer Architecture, Trends in Technology, Trends in Power and Energy in Integrated Circuits, Trends in Cost, Dependability, Measuring, Reporting and Summarizing Performance, Quantitative Principles of Computer Design.

UNIT II:

Basic and Intermediate pipelining Concepts, The Major Hurdle of Pipelining, Pipeline Hazards, Pipelining Implementation, Implementation issues that makes Pipelining hard, Extending the MIPS Pipeline to Handle Multicycle Operations, The MIPSR4000 Pipe line.

UNIT III:

Instruction-Level Parallelism: Concepts and Challenges, Basic Compiler Techniques for Exposing ILP, Reducing Branch Costs with Prediction, Overcoming Data Hazards with Dynamic Scheduling, Dynamic Scheduling Hardware, Hardware-Based Speculation, Exploiting ILP Using Multiple Issue and Static Scheduling, Exploiting ILP, Advanced Techniques for Instruction Delivery and Speculation, Studies of the Limitations of ILP.

UNIT IV:

Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, Detecting and Enhancing Loop-Level Parallelism, Centralized Shared-Memory Architectures, Performance of Shared-Memory Multiprocessors, Distributed Shared Memory, Models of Memory Consistency, Multicore Processors and their Performance.

UNIT V:

Review of Memory Hierarchy Design, Cache Performance, Basic Cache Optimizations, Virtual Memory, Protection and Examples of Virtual Memory, Advanced Optimizations of Cache Performance, Memory Technology and Optimizations, Protection: Virtual Memory and Virtual Machines, Crosscutting Issues: The Design of Memory Hierarchies, Case Studies/Lab Exercises.

Textbook:

1. David. A. Patterson, JohnL. Hennessy, "Computer Architecture: A Quantitative approach", Sixth Edition, Morgan Kaufmann,2012.

Reference Books:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, McGraw Hill Inc, 2022.
2. William Stallings, "Computer Organization and Architecture", Eleventh Edition, Pearson Education,2006.

Course Outcomes (CO):

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

CO1: Choose performance metrics to find the performance of systems.

CO2: Identify the program block that requires parallelism for any program.

CO3: Comprehend the concept of different types of hazards along with their structural implementation and applications.

CO4: Elaborate the criteria to enhance the performance of pipelined processors.

CO5: Design algorithms for memory management techniques for multiprocessor systems.

CO6: Identify various parallel architectures like centralized and distributed memory architecture required for real-life applications.

Course Title: **Machine Learning**	
Course Code: **CS30004**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To provide a broad survey of different machine learning approaches and techniques. To understand the principles and concepts of machine learning. To understand neural networks concepts. To learn regression and reinforcement learning. To develop programming skills that helps to build real world applications based on machine learning.

Course Contents:

UNIT I:

Introduction: Introduction to Machine learning, Types of Machine Learning, Supervised Learning, Unsupervised Learning, Reinforcement Learning. The Curse of dimensionality, over fitting and under fitting, Model selection, Error analysis and validation, Parametric vs. non-parametric models.

UNIT II:

Regression and Classification: Linear Regression, Multiple Linear Regression, KNNmodel, Logistic Regression, Naïve Bayes Classifier, Decision trees, Support Vector Machines, Dimensionality reduction, Principal Component Analysis.

UNIT III:

Clustering: Clustering approaches, Mean Shift clustering, Clustering data points and features, Bi-clustering, Multi-view clustering,K-Means clustering,K-medians clustering, Expectation Maximization(EM).

UNIT IV:

Neural Networks: Neural networks, Biological motivation for Neural Network, Neural network Representation, Perception, Feed forward networks, Multilayer Networks and Back Propagation Algorithms, Hidden layer presentation, Application of neural network.

UNIT V:

Applications and Tools: Reinforcement Learning, Machine Learning Tools, like Scikit learn, PyTorch, TensorFlow, Kaggle competition, Engineering applications. Introduction to CNN, Basic idea on their working and structure Like Data Augmentation, Batch Normalization, Dropout.

Textbooks:

1. Madan Gopal, "Applied Machine Learning", TMH Publication.
2. Kevin P. Murphy, "Probabilistic Machine Learning", The MITPress, 2023.
3. Ethem Alpaydin, "Introduction to Machine Learning", Fourth Edition, MIT Press, 2010.

Reference Books:

1. Laurene Fausett, "Fundamentals of Neural Networks, Architectures, Algorithms and Applications", Pearson Education, 2008.
2. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
3. Simon Haykin, "Neural Networks and Learning Machines", Pearson Education, 2008.

Course Outcomes (CO):

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

CO1: Solve typical machine learning problems.

CO2: Compare and contrast different data representation to facilitate learning.

CO3: Apply the concept of regression methods, classification methods and clustering methods.

CO4: Suggest supervised / unsupervised machine learning approaches for any application.

CO5: Implement algorithms using machine learning tools.

CO6: Design and implement various machine learning algorithms in arrange of real-world applications.

Course Title: **Cloud Computing**	
Course Code: **CS30006**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To provide an in-depth and comprehensive knowledge of the deployment models in Cloud Computing. To understand the enabling technologies needed for establishing cloud environment. To motivate students to do programming and experiment with the various cloud computing environments. To shed light on the cloud providers and software platforms. To introduce about different programming models in cloud computing.

Course Contents:

UNIT I:

Introduction: Evolution: Clustering - Grid computing – Virtualization – Basic concepts - Benefits and Risks - Roles and Boundaries-Characteristics-XaaS based service offerings-Basic Deployment models.

UNIT II:

Enabling Technologies: Networks: ISPs, Connectionless Packet Switching, Router-based Interconnectivity, Technical and Business Considerations, Data Center: Standardization and Modularity, Automation, Remote Operation, High Availability, Hardware Virtualization: Hardware Independence, Server Consolidation, Resource Replication, OS and hardware based Virtualization, Web Technology, Multitenant Technology, Service Technology.

UNIT III:

Computing Mechanisms: Infrastructure: Logical Network Perimeter, Virtual Server, Storage Device, Usage Monitor, Resource Replication, Specialized: Automated Scaling Listener, Load Balancer, Monitors, Failover System, Hypervisor, Resource Cluster, Multi-Device Broker, State Management Database, Management: Resource, SLA, Billing, Remote Administration, Security.

UNIT IV:

Cloud Providers & Software Platforms: Globally available public clouds (Microsoft Azure, Amazon Web Services, Google Cloud Platform): Overview and Comparison, Instances, Images, Networking and Security, Storage, Monitoring and Automation, Introduction to Open-source softwares: Eucalyptus, Open Nebula, Open Stack, Apache Cloud Stack.

UNIT V:

Programming Models & Advances: Introduction to Map Reduce, Apache Spark, Tensor Flow, Inter cloud: Architecture, Resource Provisioning, Billing, Security, Mobile Cloud Computing: Resource Allocation, Security, Business Aspects, Application, Future Scope, Introduction to Edge and Fog Computing.

Textbooks:

1. Kai Hwang, Geoffrey C.Fox, Jack J. Dongarra, "Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier, 2012.
2. Cloud Computing, Sandeep Bhowmik, Cambridge University Press.

Reference Books:

1. Barrie Sosinsky, "Cloud Computing Bible", John Wiley & Sons, 2010.
2. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", O'Reilly, 2009.
3. James Turnbull, "The Docker Book : Containerization is the New Virtualization", E-Book, 2015.
4. Krishna P. Venkata, "Principles of grid computing: concepts and applications", 1st, Delhi Ane Books Pvt. Ltd., 2015.

Course Outcomes (CO):

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

CO1: Articulate the concepts, technologies, and applications of cloud computing.

CO2: Compare the various cloud services and cloud platforms

CO3: Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, Public cloud, Private cloud, Hybrid cloud.

CO4: Adopt suitable computing mechanisms for establishing a cloud environment

CO5: Examine various cloud applications and issues.

CO6: Provide the appropriate cloud computing solutions and recommendations according to the applications used.

Course Title: **DevOps Laboratory**	
Course Code: **CS39002**	Contact Hours: **L-T-P-Cr : 0-1-2-2**
Course Type: **PC Lab**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand and implement Linux Shell script for system administration, task automation, and environment configuration. To perform version control operations using Git and GitHub, including repository management, branching, merging, collaboration, and pull requests. To develop and automate CI/CD pipelines using industry-standard tools such as Jenkins and GitHub Actions. To build, manage, and deploy containerized applications using Docker and Docker Compose. To deploy and orchestrate applications using Kubernetes, including pods, deployments, services, scaling, and configuration management. To implement Infrastructure as Code (IaC) using Terraform and Ansible. To monitor and analyze application and infrastructure performance using tools such as Prometheus and Grafana. To apply DevSecOps practices by integrating basic security scanning and vulnerability assessment into CI/CD pipelines. To design and build an end-to-end DevOps workflow.

Week	Experiment / Task
1	**Introduction to DevOps & Linux Basics:** SDLC Models, Agile vs DevOps, DevOps Lifecycle, CI/CD Concepts, DevOps Toolchain, Linux architecture basics, Shell scripting introduction. **Hands-on Lab:** Install Ubuntu/Linux VM, Linux commands on user and permission management, BASH script basics **Practical Exercises:** Create users/groups; Automate file backup using shell script

DevOps Laboratory	
Week	**Experiment / Task**
2	**Git & GitHub:** Version Control Systems, Git Architecture, Branching & Merging, Git Workflows, GitHub collaboration. **Hands-on Lab:** Install Git, Create repositories, Commit, push, pull; Branch creation & merge conflit resolution, Pull requests **Practical Exercises:** Team collaboration using GitHub, Create a portfolio repository.
3	**Build Tools & CI/CD:** Build Automation, Maven/Gradle basics, Continuous Integration concepts, Continuous Deployment workflow. **Hands-on Lab:** Install Maven, Build Java/Python application, Unit testing, Configure GitHub Actions **Practical Exercises:** Automated build pipeline; CI workflow for Java/Python application
4	**Jenkins Pipelines:** Jenkins Architecture, Master-Agent concept, Freestyle Jobs, Declarative Pipelines, Pipeline as Code. **Hands-on Lab:** Install Jenkins, Create build jobs, Integrate Jenkins with GitHub; Creae CI/CD pipeline **Practical Exercises:** Build-test-deploy pipeline; Automated deployment pipeline.
5	**Docker & Containerization:** Virtualization vs Containers, Docker Architecture, Images & Containers, Docker Networking Docker Compose. **Hands-on Lab:** Install Docker, Create Docker images, Dockerfile creation **Practical Exercises:** Containerize a web application .
6	**Docker & Containerization:** Docker Networking, Docker Compose. **Hands-on Lab:** Multi-container , Push images to Docker Hub **Practical Exercises:** Deploy MySQL + App using Docker Compose.

DevOps Laboratory	
Week	**Experiment / Task**
7	**Kubernets:** Kubernetes Architecture; Pods, Deployments, Services; Scaling & Load Balancing; **Hands-on Lab:** Install Minikube/K3s; Deploy applications YAML configuration files **Practical Exercises:** Deploy containerized application on Kubernetes.
8	**Kubernets:** ConfigMaps & Secrets, Helm basics. **Hands-on Lab:** Deploy applications YAML configuration files; Auto-scaling practice **Practical Exercises:** Rolling updates & rollback.
9	**Infrastructure as Code (Terraform & Ansible):** Infrastructure as Code (IaC); Terraform Basics; Ansible Architecture; Configuration Management. **Hands-on Lab:** Provision infrastructure using Terraform Write Ansible playbooks; Automate server configuration **Practical Exercises:** Create EC2/VM instances; Configure Nginx using Ansible .
10	**Monitoring, Logging & DevSecOp:** Monitoring Concepts Logging systems; DevSecOps basics; Security in CI/CD. **Hands-on Lab:** Install Prometheus & Grafana; Basic dashboards, Vulnerability scanning using Trivy **Practical Exercises:** Monitor Docker containers; Configure alerts .
11	**Capstone Mini Project:** Build a complete DevOps pipeline: GitHub $->$ Jenkins $->$ Docker $->$ Kubernetes $->$ Monitoring. **Sample Projects:** Student Result Management System E-Commerce Web App Attendance Management System Online Examination Hedge Fund Management

Software and Platforms to be used in the Laboratory	
Category	**Tools**
Operating System	Ubuntu Linux
Version Control	Git, GitHub
CI / CD	Jenkins, GitHub Actions
Containers	Docker
Orchestration	Kubernetes
Infrastructure as Code (IaC)	Terraform
Automation	Ansible
Monitoring	Prometheus, Grafana
Cloud	AWS / Azure / GCP

Textbooks:

1. DevOps Tools from Practitiner's Viewpoint: Deepak Gaikwad, Viral Thakkar, 2019, Wiley Publication.
2. Jenkins: The Definitive Guide : John Ferguson Smart, 2011, O'Reilly Media
3. Ducker Deep Dive: Zero to Docker in a Single Book : Nigel Poulton, May 2025, Leanpub.

Reference Books:

1. The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations: 2nd Edition, 2021, It Revolution Press
2. Cloud Native DevOps with Kubernetes: Building, Deploying, and Scaling Modern Applications in the Cloud – John Arundel & Justin Domingus, 2019, O'Reilly
3. Terraform: Up and Running – Yevgeniy Brikman, 4th Edition, 2017, O'Reilly

Course Outcomes (CO):

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

CO1: Use Linux commands, shell scripting, understand DevOps culture, lifecycle, and CI/CD workflows.

CO2: Use Git and GitHub for source-code management to automate builds and deployments using Jenkins/GitHub Actions.

CO3: Build and manage containers using Docker and to deploy containerized applications using Kubernets.

CO4: Automate infrastructure using Terraform and Ansible.

CO5: Implement monitoring and logging solutions.

CO6: Build an end-to-end DevOps deployment workflow integrating monitoring and security practices.

Course Title: **Machine Learning Laboratory**	
Course Code: **CS39004**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **PC Lab**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Understand the basics of machine learning and Python. Learn simple linear regression for predictive analysis.

Week1: Basic Python Programming

Objective: Learn Python programming and its fundamental tools.

Experiment:

1. Write a Python program to demonstrate data preprocessing steps: handling missing values, encoding categorical data, and feature scaling.
2. Load a sample dataset using pandas (e.g., Iris or a custom dataset).
3. Plot the distribution of a feature using matplotlib.pyplot.hist().
4. Create scatter plots to understand relationships between features using seaborn.scatterplot().
5. Use a correlation heatmap to find the relationship between multiple features with seaborn.heatmap().

Week2: Regression Analysis

Objective: Learn simple linear regression for predictive analysis.

Experiment:

1. Implement simple linear regression to predict house prices based on features

such as area and number of rooms.

   (a) Evaluate the model using metrics such as meansquared_error and r2_score.
   (b) Visualize the regression line on a scatter plot of the data

Note: A common dataset we can explore is the "House Prices - Advanced Regression Techniques" dataset from kaggle. The UCI Machine Learning Repository has many datasets for classification, regression, and clustering tasks. A popular dataset related to housing is the "California Housing Prices" dataset.

Week3: Multiple Linear Regression

Objective: Extend regression analysis to handle multiple predictors.

Experiment:

1. Implement multiple linear regression to predict student performance based on study hours, class attendance, and assignment scores.
   (a) Calculate metrics like Mean Squared Error (MSE) and R^2 Score to assess performance.
   (b) Create a scatter plot comparing the actual vs. predicted values

Note: We can get Student Performance Dataset from kaggle.

Week4: Classification with Logistic Regression

Objective: Understand binary classification using logistic regression.

Experiment:

1. Build a logistic regression model to classify emails as spam or not spam.
   (a) Accuracy: A percentage indicating how many emails were correctly classified.
   (b) Assess model performance using accuracy, confusion matrix, and classification report (Classification Report: Precision, Recall, and F1-score for both spam and non-spam classes)

Note: We will use a publicly available dataset such as the SpamBase dataset from the UCI Machine Learning Repository or create a simple synthetic dataset for demonstration purposes.

Week5: Decision Trees

Objective: Learn decision tree classifiers for non-linear decision boundaries.

Experiment:

1. Develop a decision tree model to classify species in the Iris dataset.
   (a) Evaluate the model using accuracy and a detailed classification report with precision, recall, and F1-score for each species.
   (b) Use plottree() to visualize the decision tree. This helps understand how the model splits the data at different nodes.

Week6: Random Forests

Objective: Understand ensemble methods using random forests.

Experiment:

1. Implement a random forest classifier to predict customer churn in a telecom dataset.
   (a) Accuracy: Find overall prediction accuracy.
   (b) Confusion Matrix: Breakdown of true/false positives and negatives.
   (c) Classification Report: Includes precision, recall, and F1-score for both churned and retained classes.

Note: You can use a real-world dataset such as the Telco Customer Churn Dataset available on Kaggle or create a similar dataset for practice.

Week7: Support Vector Machines (SVM)

Objective: Explore SVM for linear and non-linear classification.

Experiment:

1. Build an SVM model to classify handwritten digits using the MNIST dataset.
   (a) Accuracy: Overall percentage of correct predictions.
   (b) Confusion Matrix: Provides a breakdown of correct/incorrect predictions for each digit.
   (c) Classification Report: Detailed precision, recall, and F1-score for each digit.

Note: The MNIST dataset consists of 70,000 grayscale images of handwritten digits (28×28 pixels) representing numbers from 0 to 9. We can use sklearn.datasets.fetch_openml to load the dataset.

Week8: K-Means Clustering

Objective: Learn unsupervised learning through clustering.

Experiment:

1. Apply K-Means clustering to group customers based on purchasing patterns.
   (a) Plot the clusters in 2D space (using scaled features) and mark the centroids.
   (b) Analyze each cluster to identify customer groups based on purchasing patterns, such as:
   (c) High-income, high-spending customers.
   (d) Low-income, low-spending customers

Note: We can use the Mall Customers Dataset. This dataset is available in .csv format, typically containing columns such as CustomerID, Gender, Age, Annual Income , and Spending Score (1-100).

Week9: Principal Component Analysis (PCA)

Objective: Reduce dimensionality using PCA.

Experiment:

1. Perform PCA on a high-dimensional dataset and visualize the results.
   (a) Displays the proportion of variance captured by each principal component.
   (b) 2D Plot: Projects data onto the first two principal components.
   (c) 3D Plot: Projects data onto the first three principal components.

Note: We can use the Wine Dataset from the sklearn library. It has 13 features (high dimensionality) related to chemical properties of wine samples, which can be reduced to 2 or 3 principal components for visualization.

Week10: Neural Networks with TensorFlow / Keras

Objective: Introduce deep learning basics with neural networks.

Experiment:

1. Build a simple neural network to classify handwritten digits using TensorFlow / Keras.
   (a) The images are flattened from 28×28 matrices into 1D vectors of length 784 to be fed into the neural network.
   (b) Input Layer: The input is a flattened vector of size 784 (28×28).

(c) Hidden Layer: A dense layer with 128 neurons and ReLU activation. This layer allows the model to learn complex patterns.

(d) Dropout Layer: A dropout layer with a rate of 0.2, which helps reduce overfitting by randomly setting some of the weights to zero during training.

(e) Output Layer: A softmax layer with 10 neurons for classifying the digits from 0 to 9.

(f) Show the Test Accuracy, model's performance over epochs(accuracy plot), loss plot indicates whether the model is converging

Note: We can use MNIST Dataset: The MNIST dataset contains 60,000 training images and 10,000 test images of handwritten digits (0-9).

Week11: Convolutional Neural Networks (CNN)

Objective: Learn image classification using CNNs.

Experiment:

1. Implement a CNN model to classify images from the CIFAR-10 dataset.
   (a) Show the Test Accuracy, Training vs Validation Accuracy, Training vs Validation Loss and Predictions

Note: CIFAR-10 Dataset: The CIFAR-10 dataset contains 60,000 32×32 color images in 10 classes. CIFAR-10 dataset can be loaded using cifar10.load_data().

Capstone Application: Any of the application must be deployed on the web and accessible through a browser.

Objective: Integrate learned concepts into a real-world application.

Experiment:

Hosting an ML application on the web with a front end that can be run in a browser including creating the machine learning model, developing a web interface (front end), setting up a back-end server, and hosting the entire application on the web.

Languages: Use HTML, CSS, and JavaScript (or frameworks like React, Angular, or Vue.js) to create the user interface.

Develop the Back-End (Server): Flask or FastAPI (for Python): These are lightweight web frameworks for serving machine learning models.

Connect the Front-End to the Back-End: Use AJAX or Fetch API in JavaScript to send user input to the back-end (Flask/FastAPI)

Course Outcomes (CO):

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

CO1: Understand and apply various supervised and unsupervised machine learning algorithms.

CO2: Build and evaluate models using Python and its libraries (e.g., NumPy, pandas, scikit-learn, TensorFlow).

CO3: Apply ML Models to different real-life problems for prediction purpose.

CO4: Select suitable ML model for any problem by performance measurement.

CO5: Optimize ML models and improve their performance with Deep Learn Techniques

CO6: Solve real-world problems using machine learning techniques.

Tools Required:

1. Python 3.x/ R
2. Libraries: NumPy, pandas, matplotlib, scikit-learn, TensorFlow/Keras, NLTK/Spacy, OpenCV

Course Title: **Engineering Professional Practices**	
Course Code: **ES40001**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Engineers are expected to perform their tasks responsibly and ethically, following professional standards and guidelines. This subject allows the students to understand the roles and responsibilities of engineers in society, learn professional standards, codes of ethics, issues concerning employment contracts and other legal matters, and skills of working in teams, and to effectively communicate. The subject will be offered jointly by the faculty members of various schools of technology and will be coordinated by the School of Mechanical Engineering.

Course Contents:

UNIT I:

Engineering and Engineer: Engineering as a discipline and a profession; Attributes and functions of a practicing engineer; and Engineer as problem solver, designer, and change agent.

UNIT II:

Selected Functions of Engineering: Designing for safety and reliability; Quality and productivity management; Dealing with problem complexity, uncertainty, risk, and ambiguity; Project management; and managerial functions such as planning, organizing, motivating, and accounting.

UNIT III:

Professional Aspects of Engineering: Accreditation, certification, and licensing; Ethical issues: Ethics and morality, ethical dilemmas, codes of ethics, professional conduct, nature and role of professional societies, engineering standards; Legal issues—Legal forms of business organizations, employment contracts, trademarks, patents, copyrights, trade secrets, professional liability, contractual agreements, environment and information technology laws, and international legal framework such as WTO.

UNIT IV:

Group Dynamics: Individual cognition; Dynamics of working in teams/groups; Interacting with stakeholders; Dealing with multicultural environments; Team and group communication; and Negotiation and conflict resolution.

Textbooks:

1. Shrestha, R. K. and Shrestha, S. K. (2020), Textbooks of Engineering Professional Practice, 3rd Edition, Heritage Publishers and Distributors Pvt. Ltd.

Reference Books:

1. Habash, R. (2019), Professional Practice in Engineering and Computing: Preparing for Future Careers, 1st Edition, Boca Raton: CRC Press.
2. Walesh, S. G. (2012), Engineering Your Future: The Professional Practice of Engineering, 3rd Edition, Wiley.
3. Subramaniam, R. (2017), Professional Ethics, 2nd Edition, Oxford University Press

4. Lectures note on Engineering Professional Practice provide by Concerned faculty members.

Course Outcomes (CO):

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

CO1: Know (a) the features of engineering as a profession, (b) the roles and responsibilities of engineers in society, and (c) the skills for working in teams.

CO2: Realize the use of professional standards, codes of ethics, legal provisions surrounding engineering functions.

CO3: Apply the above-stated standards, codes, legal provisions, and group communication skills in their decision-making situations.

CO4: Break down a complex problem into smaller manageable tasks.

CO5: Compare among alternatives in situations of uncertainty, risk, and ambiguity.

CO6: Design engineering solutions to industrial environmental and social problems.

Course Title: **Environmental Science**	
Course Code: **CH40001**	Contact Hours: **L-T-P-Cr : 2-0-0-2**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The objective of this course is to provide students with a comprehensive understanding of environmental systems, human impacts on the environment, and sustainable solutions to contemporary ecological challenges.

Course Contents:

UNIT I:

Overview of the environment and natural resources: Overview of the environment, Terminologies, Components of Earth: Lithosphere, atmosphere, hydrosphere and biosphere, Concept of black body radiation, albedo, and energy balance model, Renewable and non-renewable resources.

UNIT II:

Ecosystems, Biodiversity and its Conservation: Concept of ecosystem, Structure and function of ecosystem, components of biodiversity, Some specific ecosystem, Threats to biodiversity, conservation of biodiversity.

UNIT III:

Environmental Pollution and Control: Air pollution: Primary and Secondary air pollutants, CFC, Smog(oxidizing and reducing),controlling measures: Bag house filter, Cyclone separator, Electrostatic precipitator, Catalytic converter, and Scrubber.

Water Pollution: Types and sources of water pollutants, Wastewater treatment techniques: Aerobic and Anaerobic treatment, Reverse osmosis, Electro dialysis, Chlorination, Ozonization, Soil pollution: Sources of pollutants and mitigation measures. Types of solid waste: Heavy metal, Bio-medical and Radioactive waste, Toxic and biochemical effects of solid waste, and Solid waste management (land filling, incineration, composting).

UNIT IV:

Social Issues and the Environment: From unsustainable to sustainable development, Basic principles of green chemistry with examples, Matrices to explain greenness, Climate change, and important environmental issues: Depletion of the ozone layer, Acid Rain, Greenhouse effect and global warming, Water conservation and rainwater harvesting, Environmental protection act, Air and Water (prevention and control of pollution) Act, Wildlife and Forest Protection Act.

UNIT V:

Human Population and Environment: Environment and Human Health, Climate and health, Infectious disease, water-related diseases, Risk due to chemicals in food, Cancer and environment, Human rights, Value education: equitable use of resources, the role of information technology in environment and human health.

Textbooks:

1. A Textbook of Environmental Studies, D.Dave and S.S. Katewa, 3rd Edition Cengage Learning India Pvt. Ltd.
2. Environmental Science: Environmental Chemistry and Pollution Control, Benny Joseph, Mc Graw Hill Pvt. Ltd, 2025.

Reference Books:

1. A Textbook of Environmental Chemistry, V. Subramanian, I.K. International Pvt. Ltd, 2020 Edition
2. Environmental Studies, Sashi Chawal, Seven Seas Publications,1e, 2024.
3. Environmental Studies, S. K. Gargand R.Garg, Khanna Publishers, 5e,2020
4. Environmental Science, G.Tyler Miller and Scott E. Spoolman, Cengage Learning India Pvt. Ltd. 2017.
5. Fundamentals of Environment and Ecology, D.Deand D.De, S.Chand Publishing,2023.

Course Outcomes (CO):

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

CO1: Classify the components of the environment and differentiate between renewable and non-renewable Resources.

CO2: Explain the structure and function of ecosystems, evaluate biodiversity significance, and propose conservation strategies.

CO3: Identify major sources of pollution and analyze control measures and waste management techniques.

CO4: Assess global environmental issues (e.g., climate change, deforestation) and formulate sustainable solutions.

CO5: Apply principles of sustainable development and green chemistry in engineering practices.

CO6: Analyze the impact of environmental degradation on public health, including disease susceptibility and well- being.

Course Title: **Instrumentation and Automation**	
Course Code: **EE10005**	Contact Hours: **L-T-P-Cr : 2-0-0-2**
Course Type: **ES**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The objective of this course is to provide a comprehensive understanding of the principles and applications of various measuring instruments, including sensors and transducers. Additionally, the course focuses on the fundamentals and working of Programmable Logic Controllers (PLCs), along with their interfacing techniques with sensors and transducers to develop automated systems.

Course Contents:

UNIT I:

Analog and Digital Instruments: Basics of measuring instruments, Types of analog instruments, Measurement of voltage, current, power and energy in single and three phase circuits; Digital Instruments: Digital voltmeter, Digital multimeter, Timer/counter, and Time, phase and frequency measurements in oscilloscope.

UNIT II:

Sensors and Transducers: Optical sources and detectors: LED, photo-diode, light dependent resistor; Basics of fiber optic sensing, IR Sensors, Ultrasonic Sensors, Resistive, capacitive, inductive, piezoelectric, and Hall effect sensors, Temperature transducers: Thermocouple, RTD, and thermistor.

UNIT III:

Automation using PLC: PLC (Programmable logic controllers): Overview, operation and architecture, PLC programming, Application examples. Interface between PLC and Several I/O devices (eg: Switches, Sensors and Actuators).

UNIT IV:

Instruments in biomedical applications: ECG, Blood Pressure measurement, CT Scan, and Sonography.

Textbooks:

1. R. K. Rajput, Electrical and Electronic Measurements and Instruments, S Chand Publication, 4th Edition, 2015,William David Cooper, Electronic Instrumentation and Measurement Techniques, by PHI, 2010.
2. Programmable logic Controller by Vijay R. Jadhav KHANNA PUBLISHERS, Second Edition, 2012.

Reference Books:

1. A.K Sawhney, A course in Electrical and Electronics Measurements and Instrumentation Dhanpat Rai Publication, 10th Edition, 2012.
2. D Patranabis, Sensors And Tranducers, PHI Publication, 2nd Edition, 2017.
3. Programmable logic Controller: Programming methods and Applications By John R Hackworth and Frederick D. Hackworth Jr., Pearson Publication, 1st Edition, 2006.

Course Outcomes (CO):

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

CO1: Know the basics of measuring instruments.

CO2: Measure different electrical quantities.

CO3: Understand the working principles of optical and electrical transducers and sensors.

CO4: Familiarize with Programmable Logic Controller and its Programming Language.

CO5: Apply the interfacing between PLC, sensors and actuators for real time applications.

CO6: Use instruments in biomedical applications.

Course Title: **Basics of Civil Engineering**	
Course Code: **CE10001**	Contact Hours: **L-T-P-Cr : 2-0-0-2**
Course Type: **ES**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To provide an overview on different aspects of civil engineering profession involving surveying, materials and structural, geotechnical, hydraulics and water resources, environmental, and transportation engineering and their roles in the societal development.

Course Contents:

UNIT I:

Introduction: Role of civil engineers in providing infrastructure, improving quality of life and taking major role in Nation Building, different specializations in the civil engineering and its specific role.

UNIT II:

Surveying: Plans, maps, scales, divisions of surveying, classification of surveying, leveling, advanced methods of surveying.

UNIT III:

Construction Materials & Structural Engineering: Different construction materials and their uses, structural analysis and design philosophy.

UNIT IV:

Geotechnical Engineering: Overview on origin of soil, engineering properties and its classification; soil exploration; Foundations: their importance and purpose; factors to consider in foundation design and stability of slopes; improving site soils for foundation use.

UNIT V:

Hydraulics & Water Resources Engineering: Overview on fluid properties, open channel flow, surface and groundwater hydrology, irrigation infrastructures.

UNIT VI:

Environmental Engineering: Types of wastewater, principles of wastewater management, Types of solid waste, principles of solid waste management.

UNIT VII:

Transportation Engineering: Classification of highways, typical construction methods of roads, traffic surveys and their applications in traffic planning, Railways, Ports and Harbours.

Textbook:

1. Er. Shrikrishna A. Dhale and Er. Kiran M. Tajne, Basics of Civil Engineering, S. Chand & Company Pvt. Ltd., 1st Edition, 2014.

Reference Book:

1. S. S. Bhavikatti, Basic Civil Engineering, New Age International Publisher, 1st Edition, 2021.

Course Outcomes (CO):

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

CO1: Understand the importance and practical applications of different types of surveying.

CO2: Learn about the different construction materials and understand the philosophy of structural analysis and design.

CO3: Understand engineering behaviour of soil and types of foundations.

CO4: Understand different hydraulics, hydrological and water resources engineering applications.

CO5: Learn about the management strategies of wastewater and solid waste.

CO6: Understand the basics of different types of highways, railways, ports and harbours.

Course Title: **Biosensors and Instrumentation**	
Course Code: **EC10007**	Contact Hours: **L-T-P-Cr : 2-0-0-2**
Course Type: **ES**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The objective of this course is to introduce the fundamental concepts of bio-signals and their characteristics, and to develop an understanding of the instrumentation used in basic biomedical measurement systems. It covers the principles of transducers and their applications in physiological measurements, along with the fundamentals of medical imaging systems. The course also aims to familiarize students with the setup and measurement of key human body parameters.

Course Contents:

UNIT I:

Fundamentals of Biomedical Instrumentation: Human-Instrumentation system, Bio-signal acquisition systems, Bio-amplifiers (Op-Amp, Instrumentation amplifiers, Isolation amplifier, Feedback amplifiers), Filters, Signal processing, Data conversion and data presentation, Stability, Electrical safety & systems.

UNIT II:

Biosensor Technology: Fundamentals of sensor design, Transducer (Strain gauges, Accelerometers, Thermistor, Thermocouple, Capacitive, Inductive, Piezoelectric), Bio-sensors, Electrodes to measure bio-potentials (Pressure, Flow, Temperature, and Chemicalor pH), Heart, Brain and Respiratory measurements).

UNIT III:

Measurement System for Biosignals: Physiological systems, Action potentials, Generation of bio-signals, Noise/artifacts, Monitoring systems of biosignals (ECG, EEG, EMG, EOG and ERG), Measurement of Blood Pressure, Blood flow, Heart sounds, Plethysmography.

UNIT IV:

Medical Imaging System: Information content of image, X-ray, Computed tomography, Mammography, MRI, Ultrasonography, Endoscopy, PET-CT.

UNIT V:

Bio-devices and Electrical Safety: Therapeutic Devices (pacemakers, defibrillators, glucose meters, and wearable health technology), Patient monitoring system, Patient safety (Electric shock hazards, Leakage currents, Electrical safety analyzer, Optical electrical isolation techniques, Grounding & protection mechanisms, Standards for biomedical equipment safety.

Textbooks:

1. R. S. Khanpur, "Handbook of Biomedical Instrumentation", Tata McGrawHill, New Delhi, 1990.

Reference Books:

1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Second Edition, Boca Raton: CRC Press LLC, 2000.
2. John G. Webster, "Medical Instrumentation – Application and Design", John Wiley & Sons, Inc, Third Edition, 1999.
3. J. J. Carr and J. M. Brown, "Introduction to Biomedical Equipment Technology", John Wiley & Sons, Inc., 1981.
4. L. Cromwell, F. J. Weibell and E. A. Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice-Hall of India, 1995.

Course Outcomes (CO):

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

CO1: Explain the principles of biomedical instrumentation systems, including bio-signal acquisition, amplification, filtering, and data conversion.

CO2: Explain and classify different biosensors and transducers used for measuring physiological parameters such as pressure, temperature, and bio-potentials.

CO3: Analyze the characteristics and generation of biosignals, and interpret their significance in clinical diagnosis.

CO4: Analyze and evaluate measurement and monitoring techniques for biosignals (e.g., ECG, EEG, EMG) considering noise and artifacts.

CO5: Select and compare appropriate medical imaging techniques (e.g., X-ray, MRI, CT, ultrasound) for specific diagnostic applications.

CO6: Analyze and evaluate biomedical devices and patient safety mechanisms, including electrical hazards, isolation techniques, and safety standards.

Course Title: **Basics of Mechanical Engineering**	
Course Code: **ME10003**	Contact Hours: **L-T-P-Cr : 2-0-0-2**
Course Type: **ES**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The course is designed to give an overview of the fundamental aspects of mechanical engineering so that a student pursuing any branch of engineering will realize the possibilities that the branch of mechanical engineering offers.

Course Contents:

UNIT I:

Concepts of Thermodynamics: Systems, properties, state, and cycle, Thermodynamic equilibrium and quasi-static process, First law of thermodynamics for closed system, First law of thermodynamics for open/flow systems, Second law of thermodynamics, Kelvin Plank statement, Clausius statement, and Basic concept of entropy.

UNIT II:

Fluid Mechanics and Hydraulic Machines: Introduction to fluids, Properties of fluids, Pressure variation with depth, Bernoulli's equation and its applications, and Introduction to hydraulic turbines and pumps.

UNIT III:

Mechanics of Materials: Stress, Strain, Stress-Strain diagrams for ductile and brittle materials, Elastic constants, Hooks Law, Factor of Safety, One-dDimensional loading of members of varying cross sections.

UNIT IV:

Power Transmission: Gear, Belt, and Chain Drives, Shaft under varying loading conditions, Introduction to robots, Applications of robotics, Basic robot motions, Sensors and Actuators.

UNIT V:

Manufacturing Processes: Introduction to engineering materials, Types and classification of materials, Properties of materials, Introduction to casting, forming, forging, rolling, extrusion and welding, Introduction to machine tools, NC, CNC, and 3-D Printing

Textbook:

1. P. Kumar, Basic Mechanical Engineering, Pearson Education, 2nd Edition, 2018.

Reference Books:

1. J. K. Kittur and G.D. Gokak, Elements of Mechanical Engineering, Willey, 1st Edition, 2015.
2. B. Agrawal, C. M. Agrawal, Basic Mechanical Engineering, Willey, 1st Edition, 2011.

Course Outcomes (CO):

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

CO1: Explain the fundamental principles of thermodynamics and apply them to basic engineering systems.

CO2: Describe and compare various manufacturing processes and select suitable methods for engineering applications.

CO3: Analyze the working principles and evaluate the design aspects of power transmission and drive systems.

CO4: Explain and analyze the performance characteristics of fluid machines such as turbines and pumps.

CO5: Calculate and analyze stress and strain in components subjected to different loading conditions.

CO6: Select appropriate engineering materials based on properties and application requirements.

Course Title: **Nanoscience**	
Course Code: **CH10011**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This course aims to educate, inspire, and motivate young students about the fundamentals and emerging trends in Nanoscience and Nanotechnology along with their wide-ranging applications. The course provides a fundamental understanding of the synthesis, fabrication, processing, and characterization of nanomaterials. It also highlights the applications of nanomaterials in diverse fields such as electronics, energy, environmental science, healthcare, catalysis, and advanced materials. It also introduces students to risk assessment, environmental and health impacts, waste disposal practices, and ethical considerations associated with nanomaterials and nanotechnology.

Course Contents:

UNIT I:

Introduction to Nanoscience: Concept and Classifications based on dimensions (0, 1, 2 and 3-D nanomaterials) and compositions (Metal, Metal oxides, Graphene, Graphene oxide, CNT), Nanosize effects: Surface area to volume changes, Number of atoms at surface to volume ratio, Properties change with size (Reactivity, melting point, catalytic, electrical, optical such as surface plasmon effect, band gap), and Nanoscience in nature (Structural colouration-Butterfly effects, Lotus effects, Colour changing ability in Chameleon, IR sensing in Vipers).

UNIT II:

Preparation of nanomaterials: Top-down synthesis: Mechanical method-ball milling, Lithography-photolithography, chemical lithography, Laser ablation, sputtering, thermal evaporation), Bottom-up synthesis (pyrolysis, sol-gel, CVD) and Green Synthesis (metallic nanoparticles, metal oxides).

UNIT III:

Characterization of nanomaterials: Solid state chemistry(Miller Indices, interplanar spacing), X-ray Diffraction(X-ray generation, working principle, Bragg's law, peak broadening in nanomaterials (Scherrer formula), Scanning Electron Microscopy (Instrumentation, high energy electron generation, electron optics, secondary electron imaging, back scattered electron imaging, EDX), and Transmission Electron Microscopy (Instrumentation, bright field imaging, dark field imaging, Selected area Diffraction pattern), Atomic Force Microscopy (AFM) for nanofilm/nanoparticle.

UNIT IV:

Applications of Nanomaterials: In cosmetics: Silver, gold, ZnO, TiO_2

nanoparticles in skin care product, SiO2 TiO2 in toothpaste, In medical fields: magnetic nanoparticles as drug delivery system, and magnetic hyperthermia treatment, control drug release, Nanorobots in detection and diagnosis of different diseases, Nanomaterials in agriculture: Nano-pesticides, Nano-herbicides, and Food packaging, Nanomaterials in Aerospace and aviation industries: Carbon nanotubes (CNT)-nanocomposites, Metal nanoparticle-Polymer composites, SiC Nanoparticle reinforced alumina), Nanomaterials for Environmental Remediation (degradation/ removal of pollutant), Nanomaterials in energy, and Nanomaterials in electronics (sensors, flexible electronics).

UNIT V:

Safety and Regulation in Nanomaterials: Risk assessment-Hazard Identification, Exposure assessment (limit), Toxicology (potential health risk identification), Exposure route (Inhale, Ingestion, Dermal absorption), Safety Measure (Administrative control, Engineering control, Environmental monitoring, Personal Protective Equipment), Risk characterization and Regulatory framework.

Textbooks:

1. Murty, B. S., Shankar, P., Raj, R., Rath, B. B., and Murday, J. (2013), Textbook of Nanoscience and Nanotechnology (1st Edition), Universities Press (India), Springer, ISBN-13: 978-3662509128.

Reference Books:

1. Poole, C. P. Jr., and Owens, F. J. (2020), Introduction to Nanoscience and Nanotechnology (3 rd Edition), An Indian adaptation, Wiley, ISBN-13: 978-9354240201.
2. Pradeep, T., (2012), A Textbook of Nanoscience and Nanotechnology (1st Edition), New Delhi, Tata McGraw Hill Education, ISBN: 978-1-25-9007323.
3. Filipponi, L., and Sutherland, D. (2012), Nanotechnologies: Principles, Applications, Implications and Hands-on Activities, European Union, ISBN: 978-92-79-21437-0.
4. Linda Null, “Essentials of ComputerOrganizationandArchitecture”,5th, Jones andBartlettPublishers,2018

Course Outcomes (CO):

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

CO1: Understand fundamental aspect of Nanoscience.

CO2: Identify different types of nanomaterials.

CO3: Evaluate synthesis methodologies including ”Green Synthesis” routes for producing eco-friendly metallic and metal oxide nanoparticles.

CO4: Apply structural characterization techniques and interpret advanced microscopic data

CO5: Design solutions for diverse industrial applications

CO6: Evaluation of health risk and safety assessment of nanomaterials.

Course Title: **Molecular Diagnostics**	
Course Code: **LS10007**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Understand the core molecular and cellular principles that govern disease mechanisms and the principles underlying diagnosis and health monitoring. Explain the principles of key molecular and immune diagnostic techniques used in modern biomedicine. Familiarize students with how biological systems interface with electronic, optical, and computational components in diagnostic devices. Develop intuitive understanding of how electrical and signal processing concepts. Apply to detection, measurement, and interpretation of diagnostic signals. Encourage analytical and design thinking through case studies and provide a foundation for interdisciplinary innovation in healthcare technology, supporting future learning in bioinformatics, biomedical instrumentation, and health data analytics.

Course Contents:

UNIT I:

Biological foundation of molecular diagnostics: Central dogma (replication, transcription, translation) and information flow in cells; basic structure and function of information carriers (DNA,RNA, proteins); DNA polymorphism; mutations(genetic, chromosomal) and its effects; basic concepts of disease and types; biomarkers as diagnostic signals.

UNIT II:

Molecular Diagnostics: Principles, Performance Metrics, and Detection Technologies: Drawbacks of traditional diagnostics; basic of "omics" and its applications; concept of molecular diagnostics; advantages of molecular diagnostics; diagnostic performance metrics; nucleicacid-based tests (Southern and Northern blotting, PCR/qPCR; digital PCR as conceptual extension, DNA fingerprinting); antigen-antibody interaction assays (Western blotting, LFA, ELISA),

UNIT III:

Advanced Tools & Engineering Integration: Metabolite-based assays in molecular diagnostics; introduction to Next-Generation Sequencing (NGS), CRISPR-Based Diagnostics, Flow Cytometry and Imaging; Nanotechnology-based diagnostics; Biosensors in Diagnostics; Lab-on-a-Chip and Microfluidics concepts; Point-of-care testing (POCT); Microarrays.

UNIT IV:

Computational Tools in Molecular Diagnostics: Data interpretation; bioinformatics in molecular diagnostics: basics, tools, key applications, challenges and future directions, case study; AI in molecular diagnostics: basics, key applications, challenges and future directions, case study.

UNIT V:

Applications, Ethics, Quality Aspects and Design Strategy: Personalized medicine & diagnostics; public health & surveillance; genetic disorder and prenatal diagnosis; ethical and legal issues; quality assurance and lab management; design project.

Textbook:

1. Molecular Diagnostics: Fundamentals Methods, and Clinical Applications by Lela Buckingham (3rd ed., 2019).

Reference Books:

1. Nader Rifai, Andrea Rita Horvath and Carl T. Wittwer, Principles and Applications of Molecular Diagnostics (2018), ISBN 978-0-12-816061-9 (Publisher: Elsevier)
2. K G Ramawat & Shaily Goyal, Molecular Biology and Biotechnology, ISBN9788121935128 (Publisher: S Chand & Company)

3. Harvey Lodish, Arnold Ber, Molecular Cell Biology, ISBN-109781464187445 (Publisher: WH Freeman)
4. Benjamin A. Pierce, Genetics, ISBN-10:1-4292-3250-1 (Publisher: W. H. Freeman & Company)
5. Fundamentals of Molecular Diagnostics by David E. Brunsetal. (Elsevier, 2007)

Course Outcomes (CO):

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

CO1: Explain the fundamental biological concepts underlying molecular diagnostics and relate these to the idea of disease detection, public health monitoring and personalized therapy.

CO2: Distinguish between traditional and molecular diagnostic tests and describe the principles and working mechanisms of core molecular diagnostic techniques.

CO3: Describe the workings of advanced diagnostic technologies built by integration of electrical, optical, and computational systems.

CO4: Apply basic computational tools or algorithmic approaches for molecular test interpretation.

CO5: Analyze and interpret multi-omics data (genomics, proteomics, metabolomics) to identify potential biomarkers for disease diagnosis and prognosis.

CO6: Evaluate the role of molecular diagnostics in personalized medicine, public health surveillance, and point-of-care testing, and design integrated diagnostic solutions combining biology and engineering principles.

Course Title: **Computational Optimization**	
Course Code: **MA10013**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the fundamental concepts of optimization and formulate engineering problems as Linear Programming Problems (LPP). To apply various techniques such as Simplex, Big-M, Duality, and Dual Simplex methods for solving linear programming problems. To analyze and solve special optimization problems including transportation, assignment, travelling salesman, and game theory models. To understand the principles of nonlinear optimization and analyze nonlinear programming problems using appropriate optimality conditions.

Course Contents:

UNIT I:

Introduction to Linear Programming Problem (LPP): Requirements for a LPP, Assumptions in a Linear Programming Models, Applications of Linear Programming Methods, Areas of Application of Linear Programming, Formulation of LPP, Convex Sets, Graphical Method, Simplex Method, Big-M Method, Duality, Dual Simplex Method.

UNIT II:

Transporation Model: Definitions, Formulation, Unbalanced and balanced Transportation Problems, Initial basic feasible solution by North West Corner Method, Lowest Cost Entry Method, and Vogel's Approximation Method, Optimum Solution by MODI Method, Degeneracy in Transportation Problem, Maximization case, Assignment Model: Definitions, Formulation, Unbalanced and balanced Assignment Problems, Solution by Hungarian Method, Maximization Case, Travelling Salesmen Problem: Definitions, Formulation, and Solution.

UNIT III:

Game Theory: Characteristics of Games, Game Models, Definitions, Rules for Game Theory, Minimax Theorem, Two-person zero sum game with and without saddle point, Graphical Solution of $2 \times n$ and $m \times 2$ games, reduction to Linear Programming Problems.

UNIT IV:

Non-Linear Programming: Introduction to nonlinear programming problems, formulation examples, Local and global optimum, concave and convex functions, Lagrange's Multiplier Method, Kuhn - Tucker conditions, Wolfe's Method.

Textbooks:

1. Gupta, P. K., Hira, D. S. (2021). Operations Research. S. Chand Publishing. ISBN: 978-81-219-0281-6.

Reference Books:

1. Gupta, P. K., Swarup, K. & Mohan, M. (2004). Operations Research. Sultan Chand and Sons. ISBN 13: 9789351611837.
2. Kambo, N. S. (2008). Mathematical Programming Techniques (Revised Edition). East West Press. ISBN 13: 978-8185336473.
3. Fletcher, R. (1987). Practical Methods of Optimization (2nd Edition). John Wiley & Sons. ISBN: 9781118723203.
4. Bazarra, M. S., Jarvis, J. J. & Sherali, H. D. (1990). Linear Programming and Network Flows(4th Edition). A John Wiley & Sons, Inc., Publication. ISBN: 978-0-470-46272-0.

Course Outcomes (CO):

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

CO1: Formulate real-life engineering problems as linear programming models.

CO2: Apply graphical and simplex methods to obtain optimal solutions of linear programming problems.

CO3: Analyze linear programming problems using duality concepts and dual simplex method for optimal decision-making.

CO4: Solve structured optimization problems including transportation, assignment problems, and travelling salesman problems.

CO5: Apply game theory concepts such as minimax principle and solve rectangular games using graphical and linear programming approaches.

CO6: Solve nonlinear programming problems using Lagrange multipliers, Kuhn–Tucker conditions, and Wolfe's method.

Course Title: **Emerging Materials and Applications**	
Course Code: **PH10009**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The course is designed to provide students with a strong conceptual foundation and interdisciplinary understanding of emerging materials and their applications. It aims to develop critical thinking by introducing crystal structures, symmetry concepts, and classification of solids, while fostering analytical skills through the study of functional materials such as piezoelectric, shape memory alloys and superconductors. The course emphasizes application-based learning by connecting fundamental principles to real-world devices such as sensors, actuators, MRI, and SQUIDs. It also promotes innovation by exposing students to low-dimensional materials like graphene and quantum dots, encouraging them to explore modern advancements in materials science. Overall, the course seeks to equip learners with problem-solving abilities, scientific reasoning, and the competence to apply material physics concepts in engineering and emerging technologies.

Course Contents:

UNIT I:

Crystal structure and classifications of solids: Conventional vs Emerging materials, Structure and classification of solids, Primitive cell, Unit cell, Bravais Lattice, Centrosymmetric and Non-centrosymmetric crystal structure.

UNIT II:

Piezoelectrics- principles and applications: Types of Piezoelectric effect, Piezoelectricity in Perovskites, Polarization in Dielectrics, Piezoelectric Charge and Voltage coefficients, Applications: Piezoelectric Materials as Sensors, Actuators.

UNIT III:

Shape memory alloys and applications: Introduction to Shape Memory Effect, Martensite and Austenite phases, Stress-strain temperature diagram, Superelastic behavior, twinning and de-twinning effect, Transformation temperatures, One-way and Two-way Shape Memory effect, NiTinol, Applications of SMAs.

UNIT IV:

Low dimensional materials: 0-D, 1-D and 2-D materials, Light matter interaction, Absorption, Emission, Applications - Graphene and Quantum Dots.

UNIT V:

Superconductivity in solids: Conductors vs superconductors, Meissner effect and critical parameters, Type-I and type-II superconductors, High Tc Superconductors, Josephson effect, Applications- MAGLEV, MRI, SQUID.

Textbook:

1. Engineering Physics, B. K. Pandey and S. Chaturvedi, Cengage Publication, New Delhi, 2nd Edition 2022, ISBN-13: 978-81-953536-7-5.

Reference Books:

1. W. Callister and D. G. Rethwisch, Materials Science and Engineering- An Introduction, 9th edition, 2014, WILEY, ISBN: 978-1-118-32457-8.
2. M. Schwartz, Smart Materials, 1st Edition, 2008, CRC Press, ISBN 9781420043723.
3. C. Kittel, Introduction to solid state physics, 8th edition, John Wiley & Sons, 2004..
4. M. A. Wahab, Solid State Physics: Structure and Properties of Materials, Alpha Science International Limited, 3rd Edition 2017, ISBN-13: 978-1783323487.
5. Frank J Owens, The Physics of Low Dimensional Materials, World Scientific Publishing Co., 2017, ISBN-10: 9813225858.

Course Outcomes (CO):

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

CO1: Understand and analyze crystal structures and classifications of solids, in relation to conventional and emerging materials.

CO2: Understand piezoelectric materials, piezoelectric coefficients and apply these concepts to devices applications.

CO3: Understand the fundamentals of shape memory alloys and relate materials showing shape memory effect for various applications.

CO4: Understand and classify low-dimensional materials and explain their fundamental physical properties and light–matter interactions.

CO5: Analyze the optical phenomena of absorption and emission in low-dimensional systems and evaluate applications of graphene and quantum dots in modern devices.

CO6: Understand the fundamentals of superconductivity and evaluate their applications in various technologies.

Course Title: **Introduction to Quantum Technologies**	
Course Code: **PH10011**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Define the fundamental concepts of quantum mechanics and distinguish classical and quantum systems and their behaviours. Explain the principles of quantum mechanics and differentiate classical and quantum descriptions. Apply mathematical tools to represent and analyse quantum systems. Analyse quantum measurement processes, operator algebra, and multi-qubit systems including tensor products, entanglement, and quantum state transformations. Evaluate the functioning and advantages of quantum technologies including quantum computing, quantum communication and quantum sensing. Design simple quantum circuits using basic quantum gates to generate quantum states and generate foundational quantum algorithms.

Course Contents:

UNIT I:

Limitations of classical physics, Role of quantum Technologies in current era: motivation, Course overview. Wave particle duality: De-broglie relation, plane wave representation, delocalization, velocity paradox, quantum systems as wave packets (Qualitative idea), Wave functions, probabilistic interpretation, normalization, Heisenberg uncertainty principle. Closed and open quantum systems, time evolution of a closed system, Schrodinger equation: Time dependent and time independent, characteristics of Schrodinger equation and its solutions, Distinction in quantum description from classical description of a small system: particle in rigid potential box, Concepts on eigen states and superposition states, complete wave function as a complex function, Operators and observables

UNIT II:

Wave functions as vectors in Hilbert space, eigen states as basis vectors, state vectors, bra and ket vectors, their matrix representations, Inner Product, ortho-normality, Gram Schmidt ortho-gonalisation procedure, Outer product of vectors. Linear Transformations: Operators, linear operators, physical observables as operators, Hermitian operators, unitary operators, expectation values, algebra of operators, square matrix representation of operators using a basis, Outer product form of linear operators, eigen values and eigen vectors of linear operators. Measurement in quantum mechanics, collapsing of a wave function, projection operators and projective measurements, Stern-Gerlach experiment with reference to two spin state systems, spin operators, Pauli operators and their algebra, eigen states and eigen values of Pauli operators, Generalized measurements, Postulates of quantum Mechanics

UNIT III:

Classical bits Vs Qubits, Practical quantum systems as qubits, Bloch sphere, Hilbert space for two qubit and multi-qubit composite systems, Basis vectors in single and multi-qubi Hilbert space. Hadamard operator, Positive and Normal Operators, Tensor product of state vectors and operators in multi-qubit Hilbert space, separable states and entangled states. Entanglement, Bell states as basis states. Quantum Registers, Gates as unitary operators, simple single qubit gates: Pauli gates, Hadamard gate, Phase gate, Rotation gates, Square of NOT gate, two qubit gates: CNOT, CH, CZ and CY, simple quantum circuits, Simple quantum circuit to generate Bell states, Power of quantum computing: Parallelism and Entanglement, No cloning theorem, Quantum Algorithm: Deutsch problem concept

UNIT IV:

Classical vs quantum communication, Quantum Key Distribution (BB84 protocol), Entanglement in communication, Quantum teleportation, Introduction to quantum sensing: Role of superposition and entanglement, Examples: atomic clocks, magnetometers, Advantages over classical sensing, Introduction to quantum materials: Band theory (qualitative approach), Superconductors and topological materials (introduction), Applications.

Textbook:

1. Anirban Pathak: Elements of Quantum Computation and Quantum Communication: Taylor & Francis Group Boca Raton, CRC Press (2015).

Reference Books:

1. David McMahon: Quantum computing explained: Wiley (2008).
2. Mostafizur Rahaman L. & Richa Goel: Ket Zero and Ket One: Goyal Publishers and Distributors (2026).

3. Hiu Yung Wong, Introduction to Quantum Computing: From a Layperson to a Programmer in 30 Steps: Springer-Nature Switzerland AG (2022).

Course Outcomes (CO):

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

CO1: Define the fundamental concepts of quantum mechanics and distinguish classical and quantum systems and their behaviours.

CO2: Explain the principles of quantum mechanics and differentiate classical and quantum descriptions.

CO3: Apply mathematical tools to represent and analyse quantum systems.

CO4: Analyse quantum measurement processes, operator algebra, and multi-qubit systems including tensor products, entanglement, and quantum state transformations.

CO5: Evaluate the functioning and advantages of quantum technologies including quantum computing, quantum communication and quantum sensing.

CO6: Design simple quantum circuits using basic quantum gates to generate quantum states and generate foundational quantum algorithms.

Course Title: **Geology and Geohazards**	
Course Code: **CH10013**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The course aims to develop an understanding of minerals, rocks, geological structures, and their engineering properties relevant to construction and infrastructure projects. It also introduces various geohazards, their causes, impacts on society and infrastructure, and appropriate hazard assessment and mitigation techniques. Furthermore, the course emphasizes structural geology concepts, including the evaluation of rock strength and geological considerations in engineering practice, enabling students to analyze and address geological challenges in civil engineering projects.

Course Contents:

UNIT I:

Introduction to Earth Science: Origin and structure of the Earth, Interior of the Earth, Earth processes and geological cycle, Definition and properties of minerals, Physical properties and identification of common minerals, Classification of rocks: igneous, sedimentary, and metamorphic rocks, Engineering properties and uses of rocks in construction.

UNIT II:

Structural Geology: Geological structures: folds, faults, joints, unconformities, Dip and strike measurement, Geological maps and cross-sections, Structural controls on engineering projects, Rock mass characterization and discontinuities.

UNIT III:

Engineering Properties of Rocks and Soils: Weathering and erosion processes, Determination of rock strength, Classification of rock masses, Engineering behavior of geological materials, Applications in foundations, tunnels, dams, and slopes.

UNIT IV:

Geohazards and Their Impacts: Earthquakes and seismic hazards, Landslides and slope instability, Floods, coastal erosion, and subsidence, Volcanic hazards and tsunamis, Impacts of geohazards on infrastructure and society.

UNIT V:

Hazard Assessment and Mitigation: Hazard zonation and risk assessment, Geological investigation techniques, Monitoring and early warning systems, Hazard mitigation and disaster management strategies, Sustainable engineering practices in hazard-prone regions.

Textbook:

1. Dr. B.P.Verma, Engineering Geology and Rock Mechanics, Khanna Publishers, New Delhi, 4th Edition 2017, ISBN-978-9387394155.

Reference Book:

1. K.R Saxena and V.S. Sharma, In-situ Characterization of Rocks, A A Balkema Publishers; 1st edition,2002, ISBN-978-9058092373.

Course Outcomes (CO):

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

CO1: Understand the fundamentals of Earth Science and geological processes.

CO2: Identify common minerals, rocks, and geological structures.

CO3: Evaluate the engineering significance of geological materials.

CO4: Understand various geohazards and their effects on infrastructure.

CO5: Apply hazard assessment and mitigation techniques in engineering practice.

CO6: Interpret geological data for civil and geotechnical engineering applications.

Course Title: **Citizen Science and Open Data**	
Course Code: **ID10001**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **BS**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This course is designed to equip learners with interdisciplinary knowledge and practical competencies at the interface of Physics, Open Science and Data, Sensing Fundamentals, Participatory and Citizen Science, Digital Society, SDG and public policy. It aims to develop a strong conceptual foundation in thermodynamics, atmospheric physics, wave physics and sensor-based instrumentation while fostering an understanding of open science policy, citizen science frameworks, open data to action and digital society research practices. The course emphasizes learning through participatory sensing, real-time environmental monitoring (air quality, temperature and noise) and data-driven analysis using low-cost sensors and mobile technologies. Learners will be trained to interpret environmental data using principles such as light scattering, heat transfer and acoustics. The curriculum further encourages innovation, co-creation, and the translation of scientific knowledge into scalable solutions for sustainable development goals (SDGs), startups and public systems.

Course Contents:

UNIT I:

Citizen Science & Open Science: Open Science Policy, Citizen science frameworks in global research, Participatory sensing and co-creation, Open data, Science for SDGs, Digital Society, Tech-policy interface, Human–Machine Interfaces (HMI), Ethics and inclusivity.

UNIT II:

Heat Transfer, Solar Radiation, & Urban Heat (Thermodynamics): Solar radiation and terrestrial (longwave) radiation, Conduction, Convection, Atmospheric stbility, Solar Radiation and Photophysics, Thermodynamics.

UNIT III:

Atmospheric Physics (Pollution Dispersion) and Optical Physics (PM sensing via Scattering): Light Scattering, PM detection, Diffusion, Fluid Dynamics, Low-cost PM 2.5 sensors using laser scattering, Mobile AQI mapping using smartphones + GPS, Community calibration against reference stations.

UNIT IV:

Acoustics, Noise Pollution Mapping (Wave Physics): Sound Waves, Decibel Scale, Smartphone decibel meter apps, City-wide noise maps crowd sourced by citizens, Temporal analysis of noise peaks (traffic, festivals).

UNIT V:

Sensors, Instrumentation, Data Analysis & Modeling: Photoelectric effect, Optical absorption reflection), Smart Sensors and IoT-based Sensors, Decibel Sensors, Analog and Digital Instrumentation, Correlation of environmental variables, Optimization Techniques.Types of data (experimental, sensor-based, discrete/continuous), Basics of data acquisition from sensors, Error analysis (absolute, relative, standard deviation), Data pre-processing, Curve fitting and least squares method, Mathematical modeling of physical systems, Concept of modeling, Linear vs non-linear models, Data visualization.

Textbooks:

1. Atmospheric Chemistry and Physics, From Air Pollution to Climate Change, Third Edition, 2016, John H. Seinfeld, Spyros N. Pandis, Wiley.
2. Citizen Science: Innovation in Open Science,Society and Policy, Edited by Susanne Hecker, Muki Haklay, Anne Bowser, Zen Makuch, Johannes Vogel & Aletta Bonn, 2018, UCL Press.
3. Young and Freedman University Physics 15th Edition, 2018, Pearson.
4. Bevington, P. R., & Robinson, D. K., Data Reduction and Error Analysis for the Physical Sciences, 3rd Edition, McGraw-Hill Education.
5. Gordon, S. I., Introduction to Modeling and Simulation with MATLAB and Python, CRC Press.

Course Outcomes (CO):

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

CO1: Explain open science principles, citizen science frameworks, and participatory approaches , emphasizing ethics, inclusivity and the role of science in achieving Sustainable Development Goals (SDGs).

CO2: Explain the fundamental concepts of thermodynamics, heat transfer mechanisms, and solar radiation and analyze their role in urban heat dynamics and atmospheric stability.

CO3: Apply principles of atmospheric Physics, fluid dynamics, and light scattering to understand air pollution dispersion and particulate matter (PM) sensing techniques.

CO4: Interpret the Physics of sound waves and acoustics to analyze environmental noise levels and utilize digital tools for noise pollution mapping and temporal analysis.

CO5: Understand the working principles of various environmental sensors (temperature, optical and acoustic) and demonstrate their application in real-time environmental monitoring systems.

CO6: Analyze and correlate environmental datasets using appropriate data visualization and modeling techniques and evaluate their implications for policy-making,community engagement and technology solution.

Course Title: **Analog Electronics**	
Course Code:	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Learn the concepts of load line analysis and biasing techniques. Learn the concepts of high frequency analysis of transistors. Learn the concepts of small signal analysis of BJT and FET amplifiers and biasing techniques. To familiarize the Concept of feedback in amplifiers so as to differentiate between negative and positive feedback.

Course Contents:

UNIT I:

BJT Biasing: Transistor Biasing and Stabilization - Operating point, Need for biasing, DC Load line, Biasing - Fixed Bias, Self Bias, Bias Stability, Bias Compensation using Diode. Analysis of Small Signal Low Frequency BJT Amplifiers: Transistor Hybrid model, Analysis of single stage transistor amplifier using h-parameters: voltage gain, current gain, Input Impedance and Output impedance. Comparison of transistor configurations in terms of Ai, Ri , Av ,and Ro.

UNIT II:

BJT Amplifiers-Frequency Response: Frequency response of an amplifier, Analysis at low and High Frequencies, Hybrid-pi π common emitter transistor model, Derive the hybrid-π model parameters, Millers theorem and it's dual. Multistage Amplifiers: Distortion in amplifiers, Analysis of cascaded BJT amplifier, Darlington pair and derive their input impedance(Ri) and current gain(Ai), coupling schemes-RC coupled amplifier, Transformer coupled amplifier, and Direct coupled Amplifier.

UNIT III:

FET-Biasing and FET Amplifiers: FET biasing: fixed bias and self bias. FET Amplifiers: Analysis of Common source (C.S), Common Drain (C.D) JFET Amplifiers, comparison of performance with BJT Amplifiers, Basic Concepts of MOSFET Amplifiers.

UNIT IV:

FEEDBACK AMPLIFIERS: Concept of Feedback and types, Effects of negative feedback on amplifiers characteristics, voltage series, current series, current shunt, and voltage shunt feedback amplifiers.

UNIT V:

OSCILLATORS: Classification of oscillators, Barkhausen criterion, RC phase Shift oscillator, Wien-bridge oscillator, LC oscillators- Hartley and Colpitts oscillator.

Textbooks:

1. Jacob Millman, Christos C Halkias -Integrated Electronics, McGraw Hill Education.
2. Robert L. Boylestead, Louis Nashelsky -Electronic Devices and Circuits theory,11th Edition,2009, Pearson

Reference Books:

1. David A. Bell – Electronic Devices and Circuits, 5th Edition, Oxford.
2. Adel S. Sedra, Kenneth C. Smith- Microelectronic Circuits Theory and Applications, Oxford.
3. Chinmoy Saha, Arindam Halder, Debaati Ganguly -Basic Electronics-Principles and Applications,

Course Outcomes (CO):

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

CO1: Design the amplifiers with various biasing techniques.

CO2: Understanding of various types of amplifier circuits.

CO3: Design single stage amplifiers using BJT and FET amplifier.

CO4: Design multistage amplifiers and understand the concepts of High Frequency Analysis of BJT.

CO5: Design an oscillators at different frequencies.

CO6: Utilize the Concepts of negative feedback to improve the stability of Amplifiers and Positive feedback to sustained oscillations and Analysis of oscillators at different frequencies.

Course Title: **Data Analytics**	
Course Code: **CS20010**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the basic principles of Data Analytics. To learn the various Data Analytic methods. To understand the various clustering algorithms and its application on data. To work with stream data model and computing.

Course Contents:

UNIT I:

Introduction to Data Analytics: Types of Data Analytics - Predictive Analytics - Simple linear regression - Multiple linear regression - Auto regression - Moving Average - Autoregressive Integrated Moving Average - Data Pre-processing - Data Cleaning - Data Integration and Transformation - Data Reduction - Descriptive data analytics - measures of central tendency - measures of location of dispersions.

UNIT II:

Basic Analysis Techniques: Normal Probability Curve and its Applications, Statistical hypothesis generation and testing (type I and type II errors), Inferential statistics (Standard errors, confidence limits), Chi-Square test, t-Test, Analysis of variance (ANOVA), Correlation analysis, Maximum likelihood test, Test of significance, two tailed and one tailed tests.

UNIT III:

Introduction to Streams Concepts: Stream data model and architecture - Stream Computing - Sampling data in a stream - Filtering streams - Counting distinct elements in a stream - Estimating moments - Counting oneness in a window - Decaying window - Real Time Analytics Platform (RTAP) applications - case studies - real time sentiment analysis - stock market predictions.

UNIT IV:

Using Graph Analytics for Big Data: Graph Analytics - The Graph Model - Representation as Triples - Graphs and Network Organization - Choosing Graph Analytics - Graph Analytics Use Cases - Graph Analytics Algorithms and Solution Approaches – Centrality Analysis-degree centrality, closeness centrality, and between ness centrality - Community detection algorithms-Girvan-Newman Algorithm -Label Propagation Algorithm -Fast Greedy Algorithm - Graph QL

UNIT V:

NoSQL Databases: Schema-less Models - Increasing Flexibility for Data Manipulation - Key Value Stores - Document Stores - Tabular Stores - Object Data Stores - Graph Databases Hive-Sharding-Hbase - Analyzing big data with twitter - big data for E-Commerce - Big data for blogs - Review of Basic Data Analytic Methods using R.

Textbooks:

1. A. Rajaraman, J. Ullman, “Mining Massive Data Sets”, 3rd Edition, Cambridge University Press, 2020.
2. David Loshin, “Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, No SQL, and Graph”, 2013.

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of

Statistical Learning, Data Mining, Inference, and Prediction", 2nd ed. 2009, Corr. 9th printing 2017, Springer.

2. G James, D. Witten, T Hastie, R. Tibshirani, "An Introduction to Statistical Learning: With Applications in R", 2nd Edition, Springer, 2021.
3. Mohammed J. Zaki, Wagner Meira, "Data Mining and Analysis: Fundamental Concepts and Algorithms", Second Edition Cambridge, 2020.
4. E. Alpaydin, "Introduction to Machine Learning", 4th Edition, MIT Press, 2020.

Course Outcomes (CO):

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

CO1: Understand the fundamental concepts of data analytics, data preprocessing, and descriptive statistical measures used in big data analysis.

CO2: Apply predictive analytics techniques for data-driven forecasting and decision making.

CO3: Analyze and interpret data using statistical and inferential techniques.

CO4: Understand knowledge of stream data processing concepts and implement real-time analytics techniques.

CO5: Evaluate and apply graph analytics models for solving complex network-based problems.

CO6: Explore and utilize NoSQL databases and big data technologies for handling large-scale unstructured data analytics using R.

Course Title: **Real Time Systems**	
Course Code: **CS20012**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To study issues related to the design and analysis of systems with real-time constraints. To learn the features of Real time OS. To study the various Uniprocessor and Multiprocessor scheduling mechanisms. To learn about various real time communication protocols. To study the difference between traditional and real time databases.

Course Contents:

UNIT I:

Introduction to Real-time systems: Introduction to real time computing, Concepts, Example of real-time applications, Structure of a real time system, Characterization of real time systems and tasks, Hard and Soft timing constraints, Design Challenges, Performance metrics, Prediction of Execution Time: Source code analysis, Micro–architecture level analysis, Cache and pipeline issues, Programming Languages for Real-Time Systems.*

UNIT II:

Task Assignment and Scheduling: Real time OS, Threads and Tasks, Structure of Microkernel, Time services, Scheduling Mechanisms, Communication and Synchronization, Event Notification and Software interrupt, Uniprocessor scheduling algorithms, Task assignment, Mode changes, Fault tolerant scheduling.*

UNIT III:

Real–Time Communication: Network topologies and architecture issues, Protocols, Contention-based, token–based, Polled bus, Fault tolerant routing.*

UNIT IV:

Real–Time Databases: Transaction priorities and aborts, Concurrency control issues, Scheduling algorithms, Two-phase approach to improve predictability.*

UNIT V:

Programming Languages and Tools: Hierarchical decomposition, Run–time error handling, Overloading, Timing specification, Recent trends and developments.*

Note: * *Programming Assignments are mandatory.*

Textbooks:

1. Jane Liu, “Real–Time Systems”, First Edition, Pearson, 2002.

Reference Books:

1. Rajib Mall, “Real–Time Systems: Theory and Practice”, First Edition, Pearson Education, 2012.

Course Outcomes (CO):

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

CO1: Classify the features of Real time OS.

CO2: Identify issues related to the design and analysis of systems with real-time constraints.

CO3: Analyze scheduling problems.

CO4: Appreciate and apply Real–time programming environment tasks for solving practical problems.

CO5: Develop real time systems.

CO6: Compare basic multi-task scheduling algorithms.

Course Title: **Mobile Application Developments**	
Course Code: **CS20014**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To facilitate students to understand android SDK. To help students to gain a basic understanding of Android application development. To inculcate working knowledge of Android Application development.

Course Contents:

UNIT I:

Fundamentals: Basic Building blocks – Activities, Services, Broadcast Receivers and Content providers, UI Components – Views and notifications Components for communication –Intents and Intent Filters.

UNIT II:

Application Structure: AndroidManifest.xml, user-permission – sdk, Resources and R.java, Assets, Layouts and Drawable Resources, Activities and Activity lifecycle.

UNIT III:

Emulator-Android Virtual Device: Launching emulator, Editing emulator settings, Emulator short cuts, Logcat usage, Introduction to DDMS.

UNIT IV:

Basic UI design: Form widgets, Text Fields, Validation of EditText, Layouts, [dip, dp, sip, sp] versus px. Different UI design patterns **Preferences:** Shared

Preferences, Preferences from xml.

Menu: Option menu, Context menu, menu from xml, menu via code.

Intents: Explicit Intents, Implicit intents

UNIT V:

UI design: Time and Date, Images and media, Android Adapter and ListView, Composite, Alert Dialogs and Toast, Popup, Fragments, Navigation drawer.

Tabs, Tab Activity Styles & Themes: styles.xml, drawable resources for shapes, gradients (selectors), style attribute in layout file, Applying themes via code and manifest file.

Content Providers: SQLite Programming, SQLite Open Helper, SQLite Database, Cursor, Reading and updating Contacts, Reading bookmarks

Note: * *Programming Assignments are mandatory.*

Textbooks:

1. Roto Meier, Professional Android Application Development, Wiley.
2. Lauren Darcey, Shane Condor, "Android, Wireless Application Development", Pearson Education, 3rd Edition.

Reference Books:

1. Joseph Annuzzi Jr, Lauren Darcey, Shane Condor, "Advanced Android Application Development, Developers Library", Pearson Education, 4th Edition (2015).
2. Lauren Darcey, Shane Condor, "Android, Wireless Application Development", Pearson Education, 3rd Edition.
3. Paul Deitel, Harvey Deitel, Alexander Wald, "Android 6 for programmers, An AppDriven Approach", Pearson Education.
4. Rap Payne, "Beginning App Development with Flutter: Create Cross-Platform Mobile Apps", Apress (2019).

Course Outcomes (CO):

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

CO1: Identify various concepts of mobile programming.

CO2: Critique mobile applications on their design pros and cons.

CO3: Understand both the basic and advanced concepts Android OS, gradle, Android Studio.

CO4: Debug Android Application, Design and develop an application using Database.

CO5: Develop UI based Mobile Application using Android Studio.

CO6: Design application, Deploy the application on Google Play.

Course Title: **Image Processing and Applications**	
Course Code:	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The objective of this course is to provide fundamental knowledge of digital image processing and modern computer vision techniques. The course emphasizes image representation, feature extraction, object detection, segmentation, deep learning-based vision models, and advanced vision applications to enable students to develop intelligent vision systems.

Course Contents:

UNIT I:

Fundamentals of Digital Image Processing: Digital image formation and representation, Image sampling and quantization, Point processing and histogram techniques, Spatial filtering, Edge detection and image enhancement, Color image processing.

UNIT II:

Fundamentals of Computer Vision: Image features and descriptors, Corner detection, SIFT, SURF and ORB features, Feature matching, Geometric transformations.

UNIT III:

Classical Computer Vision: Image segmentation, Thresholding and region-based segmentation, Hough transform, Motion estimation, Optical flow, Object tracking.

UNIT IV:

Deep Learning for Computer Vision: Convolutional Neural Networks, Transfer learning, Object detection (R-CNN, Fast R-CNN, YOLO), Semantic segmentation (FCN, U-Net, DeepLab), Instance segmentation (Mask R-CNN), Vision Transformers.

UNIT V:

Advanced Computer Vision Applications: Face recognition, Human pose estimation, Action recognition, Image captioning and multimodal vision, Foundation models in vision (CLIP, SAM), Applications in autonomous driving, medical imaging and remote sensing.

Textbooks:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2022.
2. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson, 2018.

Reference Books:

1. David A. Forsyth and Jean Ponce, Computer Vision: A Modern Approach, Pearson.
2. Simon J.D. Prince, Computer Vision: Models, Learning and Inference, Cambridge University Press.
3. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press.
4. Adrian Kaehler and Gary Bradski, Learning OpenCV 4, O'Reilly Media.

Course Outcomes (CO):

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

CO1: Explain the principles of digital image processing and image representation.

CO2: Apply feature extraction and image transformation techniques for computer vision tasks.

CO3: Implement segmentation, motion analysis, and object tracking algorithms.

CO4: Analyze deep learning architectures for object detection and image segmentation.

CO5: Evaluate the performance of computer vision models for real-world applications.

CO6: Develop intelligent computer vision solutions using modern deep learning and foundation models.

Course Title: **Cyber Physical System**	
Course Code: **CS20016**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To develop the student's ability to understand the concept of cyber physical systems' characteristics, requirements and architecture. To provide the students with some knowledge and analysis skills associated with the principles of memory organisation and bus structure of cyber physical systems. To develop the student's ability to understand the concepts of cyber physical system software with special emphasis on real time operating system and particularly real time job scheduling. To provide basic knowledge of power aware architecture & hardware software design and AI enabled Secure CPS.

Course Contents:

UNIT I:

Fundamentals of Cyber Physical Systems Motivation and examples of CPS e.g. Energy, Medical and Transportation Cyber Physical Systems - Key design drivers and quality attributes of CPS - Cyber-Physical Systems (CPS) in the real world - Basic principles of design and validation of CPS - Industry 4.0 AutoSAR - IIOT implications - Building Automation.

UNIT II:

Platform Components for Cyber Physical Systems CPS HW platforms - Processors, Sensors, Actuators - CPS Network – WirelessHart - CAN, Automotive Ethernet Scheduling Real Time CPS tasks: Table-driven and Event driven schedulers - Hybrid schedulers. Tutorials: Truetime/Jittertime, CAN tools, WSN-CPS simulation.

UNIT III:

Principles of Dynamical Systems and Stability - Controller Design Techniques - Performance under Packet drop and Noise. Tutorials: System modeling, Control design and stability using $Z3$ solver.

UNIT IV:

CPS Implementation Issues From features to automotive software components - Mapping software components to ECUs - CPS Performance Analysis: Effect of scheduling, bus latency, sense and actuation faults on control performance - network congestion.

UNIT V:

Intelligent and Secure CPS Safe Reinforcement Learning: Robot motion control - Autonomous Vehicle control - Gaussian Process Learning: Smart Grid Demand Response - Building Automation - Security of CPS: Motivation - Basic Techniques - Cyber Security Requirements - Attack Model - Attack detection and mitigation in CPS – Countermeasures. Tutorials: Use of OpenAI-gym, Carla, Matlab for safe-RL/MPC based autonomous driving, Ventos/SUMO for Cooperative driving, Matlab for power system loop modelling.

Textbooks:

1. R. Rajkumar, D. de. Niz and M. Klein, “Cyber Physical Systems”, Addision-Wesely, 2017.
2. Suh, Sang C., U. John Tanik, John N. Carbone, and Abdullah Eroglu, eds. “Applied cyberphysical systems”. Springer New York, 2014.

Reference Books:

1. Alur, Rajeev. “Principles of cyber-physical systems”. MIT Press, 2015.
2. Colombo, Armando W., Thomas Bangemann, StatmatisKarnouskos, Jerker Delsing, Petr Stluka, Robert Harrison, Francois Jammes, and Jose L. Lastra. “Industrial cloud-based cyber-physical systems.” The Imc-aesop Approach 22 (2014): 4-5.
3. Andrew M Sloss, Dominic Symes, Chris Wright, “ARM System Developers Guide: Designing optimizing System Software” (Online resource)

Course Outcomes (CO):

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

CO1: Understand the fundamental concepts, architecture, and real-world applications of Cyber Physical Systems (CPS).

CO2: Analyze the hardware and networking components of CPS.

CO3: Apply real-time scheduling techniques and simulation tools for designing and evaluating time-critical CPS applications.

CO4: Model and analyze dynamical systems, evaluate system stability, and design controllers for CPS.

CO5: Evaluate CPS implementation challenges including software-to-hardware mapping, performance analysis, fault handling, and network.

CO6: Develop Secure and Safe AI enabled CPS for real world applications.

Course Title: **Quantum Communication**	
Course Code:	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type:	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This course introduces students to basic laws of quantum mechanics and provides an introduction to the revolutionary quantum technologies. This course is about the potential for quantum technologies, a field that promises to revolutionize the way we compute by using the dynamics of quantum mechanics. The boundary between classical and quantum physics, quantization of EM field and its consequences, quantum electromagnetic and atomic physics and their applications in quantum communication, quantum computations and quantum sensing are discussed. The course aims to develop conceptual understanding of quantum phenomena and identifies engineering challenges of various quantum technologies.

Course Contents:

UNIT I:

Overview of Quantum Technologies: Quantum Engineering, Motivation: Quantum Computing, Quantum Communication, Motivation: Quantum sensing, Fundamentals of Quantum Mechanics

UNIT II:

Essential Concepts in Quantum Mechanics: The Birth of quantum mechanics, Postulates of quantum mechanics, Hamiltonian and Schrodinger Equation, Dirac notation, Density operator

UNIT III:

Quantum Resources: EM waves: Quantum EM fields, Polarization of optical fields, EM resonators, Single photon detection, E-field detection, Quantum light. Atoms: Two- level atom, Introduction to light-atom interactions, Trapping and cooling atoms, Three-level atoms, Rydberg atoms, Trapped ions Super conducting Devices: Fundamentals super conductors, Super conducting two-level systems, Super conducting qubits, Super conducting qubits and challenges

UNIT IV:

Quantum Sensing and Communication: Light interferometry-LIGO, Particle interferometry- Ramsey measurement, Sensing via defects in diamond, Quantum cryptography, Quantum teleportation, Quantum Memory, Entanglement distribution

UNIT V:

Quantum Computing: Introduction to classical computing, Introduction to quantum computing, Experimental implementation.

Textbooks:

1. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press.
2. Ivan B. Djordjevic, Quantum Communication, Quantum Networks, and Quantum Sensing, Academic Press (Elsevier).

Reference Books:

1. David J. Griffiths and Darrell F. Schroeter, Introduction to Quantum Mechanics, Cambridge University Press.
2. Mark Fox, Quantum Optics: An Introduction, Oxford University Press.
3. Dirk Bouwmeester, Artur K. Ekert, and Anton Zeilinger, The Physics of Quantum Information: Quantum Cryptography, Quantum Teleportation, Quantum Computation, Springer.

Course Outcomes (CO):

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

CO1: Identify fundamental differences between quantum and classical technologies.

CO2: Analyze mathematically simple quantum phenomena.

CO3: Explain quantum signature sin experimental data.

CO4: Discuss quantum errors and error correction methods.

CO5: Analyze engineering challenges of quantum technologies.

CO6: Discuss methods of fault-tolerant quantum computation.

Course Title: **Computational Intelligence**	
Course Code: **CS30007**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the basic concepts and characteristics of soft computing. To understand and analyse fuzzy rules, fuzzy reasoning, and various fuzzy inference systems. To be able to know derivative free optimization and apply genetic algorithms to optimization problems. To apply neural networks to various classification problems. To know some hybrid models such as adaptive Neuro-fuzzy inference systems.

Course Contents:

UNIT I:

Introduction: Introduction, Soft Computing constituents and Conventional AI, Neuro-Fuzzy and Soft Computing characteristics

UNIT II:

Artificial Neural Networks: Introduction to ANN, Perceptrons and MLP, Adaline and Madaline, Back-propagation Multilayer Perceptrons (BPMLP), Radial Basis Function Networks (RBF), Kohonen Self-Organizing Networks, Learning Vector Quantization, Hebbian Learning, Hopfield networks

UNIT III:

Fuzzy Set Theory: Fuzzy sets, Basic Definition and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, More on Union, Intersection and Complement, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Adaptive Neuro-Fuzzy Inference Systems(ANFIS), ANFIS Architecture, Hybrid Learning Algorithm

UNIT IV:

Particle Swarm Optimization: PSO Model, Global Best, Local Best, Velocity Update Equations, Position Update Equations, Velocity Clamping, Inertia Weight, Constriction Coefficients, Synchronous and Asynchronous Updates, Binary PSO.

UNIT V:

Differential Evolution: DE as modified GA, generation of population, operators and their implementation.

UNIT VI:

Ant Colony Optimization: Basic Concepts, Ant System, Application.

UNIT VII:

Artificial Bee Colony: Historical Development, Types of Bees and Their Role in the Optimization Process.

Textbook:

1. Neuro-Fuzzy and Soft Computing, Jang, Sun, Mizutani, Pearson Education.

Reference Books:

1. Swarm Intelligence Algorithms: A Tutorial, Adam Slowik, Ed: CRC Press, 2020
2. Neural Networks: A Comprehensive Foundation, Simon Haykin, Pearson Education
3. Genetic Algorithms, David E. Goldberg, Pearson Publication, 2003.

Course Outcomes (CO):

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

CO1: Identify the basic concepts and characteristics of soft computing and also its associated methodologies.

CO2: Apply various set theoretic operations in fuzzy sets.

CO3: Analyze fuzzy rules, fuzzy reasoning and various fuzzy inference systems.

CO4: Choose derivative free optimization and apply genetic algorithms to optimization problems.

CO5: Assess concepts of artificial neural networks and apply neural networks to various classification problems.

CO6: Analyze some hybrid models such as adaptive neuro-fuzzy inference systems.

Course Title: **Distributed Operating Systems**	
Course Code: **CS30009**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the fundamentals of distributed system. To be able to know the basic concepts of shared memory architecture. To be able to understand various implementation difficulties of distributed operating systems. To be able to understand transparency in distributed operating systems.

Course Contents:

UNIT I:

Fundamentals of Distributed Systems: Introduction to distributed systems, Goals of Distributed Systems, Hardware Concepts, Software Concepts, Design Issues, Network Operating Systems, True Distributed System and Time sharing Multiprocessor Operating System, System Architectures.

UNIT II:

Communication in Distributed Systems: Basics of Communication Systems, Layered Protocols, ATM Models, Client Server Model, Blocking Primitives and Non Blocking Primitives, Buffered Primitives and Unbuffered Primitives, Reliable and Unreliable primitives, Message Passing, Remote Procedure Call.

UNIT III:

Synchronization and Processes: Clock Synchronization, Mutual Exclusion, Election Algorithm, Atomic Transactions, Deadlock in Distributed Systems, Process and Threads, System Models, Processor Allocation, Process Scheduling.

UNIT IV:

Consistency, Replication and Fault Tolerance: Data Centric Consistency Models, Client-Centric Consistency Models, Replica Management, Consistency protocols, Fault Tolerance, Process Resilience, Distributed Commit, Reliable Client Server Communication, Reliable Client Server Communication.

UNIT V:

Overview of shared memory: Architecture, Algorithm, Protocols, Design Issues, consistency model, Page based Distributed Shared Memory, Shared variable Distributed shared Memory, and Object based Distributed Shared

Memory.

Textbook:

1. Andrew S. Tanenbaum, “Distributed Operating Systems”, Pearson Education, 1995.

Reference Books:

1. G. Coulouris, J. Dollimore, and T. Kindberg, “Distributed Systems: Concepts & Design”, Pearson Publication, 4th Edition,2005.
2. Pradeep K. Sinha, “Distributed Operating Systems Concepts and Design”, PHI, 1998.

Course Outcomes (CO):

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

CO1: Assess the concept of Distributed Operating Systems.

CO2: Enlist the communication techniques in Distributed Operating Systems.

CO3: Determine the clock synchronous concepts and algorithms.

CO4: Examine the distributed system that fulfills requirements with regards to key distributed systems properties.

CO5: Discuss distributed shared memory architectures and algorithms.

CO6: Analyze the distributed files systems.

Course Title: **Information Theory and Coding**	
Course Code: **CS20008**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To define and apply the basic concepts of information theory (entropy, channel capacity etc. To learn the principles and applications of information theory in communication systems. To study various data compression methods and describe the most common such methods. To understand the theoretical framework upon which error-control codes.

Course Contents:

UNIT I:

Information theory: Concept of amount of information, Information units Entropy: marginal, Conditional, joint and relative entropies, Relation among entropies Mutual information, Information rate, Channel capacity, Redundancy and efficiency of channels Discrete channels, Symmetric channels, Binary Symmetric Channel, Binary Erasure Channel, Noise-Free Channel, Channel with independent I/O, Cascaded channels, Repetition of symbols, Binary asymmetric channel, Shannon theorem.

UNIT II:

Source coding, Encoding techniques, Purpose of encoding, Instantaneous codes, Construction of instantaneous codes, Kraft's inequality, Coding efficiency and redundancy, Source coding theorem. Construction of basic source codes, Shannon Fano coding, Shannon Fano Elias coding, Huffman coding, Minimum variance Huffman coding, Adaptive Huffman coding, Arithmetic coding, Dictionary coding, Lempel Ziv coding, Channel coding theorem for DMC.

UNIT III:

Codes for error detection and correction, Parity check coding, Linear block codes, Error detecting and correcting capabilities, Generator and Parity check matrices, Standard array and Syndrome decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming codes, Applications of Block codes for Error control in data storage system.

UNIT IV:

Cyclic codes, Generator polynomial, Generator and Parity check matrices, Encoding of cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes, BCH codes, RS codes, Burst error correction, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

UNIT V:

Convolutional codes, Encoding and State, Tree and Trellis diagrams, Maximum likelihood decoding of convolutional codes, Viterbi algorithm, Sequential decoding, Stack algorithm. Interleaving techniques, Block and convolutional interleaving, Coding and interleaving applied to CD digital audio system, CIRC encoding and decoding, Interpolation and muting.

Textbooks:

1. T. M. Cover, J. A. Thomas, "Elements of Information Theory", 2nd Edition,

Wiley.

2. Ranjan. Bose, Information Theory Coding and Cryptography, Third Edition, McGraw Hill.

Reference Books:

1. Norman Abramson, Information Theory and Coding, McGraw Hill.
2. Shu Lin and Daniel J . Costello, Error Control Coding: Fundamentals and Applications, Second Edition, Pearson.
3. Robert G. Gallager, Information Theory and Reliable Communication, John Wiley and Sons.

Course Outcomes (CO):

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

CO1: Solve problems on measurement of information and errors.

CO2: Explain the significance of quantitative measure of information in the communications systems.

CO3: Design various source codes and channel codes.

CO4: Differentiate between lossy and lossless compression techniques.

CO5: Model encoders and decoders for block and cyclic codes.

CO6: Discuss the significance of codes in various applications.

Course Title: **Big Data Analytics**	
Course Code: **CS30011**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the Big Data Platform and its Use cases. To Provide an overview of Apache Hadoop. To Provide HDFS Concepts and Interfacing with HDFS. To understand NoSQL database.

Course Contents:

UNIT I:

Introduction to Big Data: Big Data - Characteristics of Big Data - Big data management architecture - Examining Big Data Types - Big Data Technology

Components - Big data analytics - big data analytics examples - Web Data Overview - Web Data in Action.

UNIT II:

Hadoop: History of Hadoop - Hadoop Ecosystem - Analyzing data with Hadoop - Hadoop Distributed File System - Design - HDFS concepts - Hadoop filesystem - Data flow - Hadoop I / O - Data integrity - Serialization - Setting up a Hadoop cluster - Cluster specification - cluster setup and installation - YARN.

UNIT III:

MapReduce: Understanding MapReduce functions - Scaling out - Anatomy of a MapReduce Job Run - Failures - Shuffle and sort - MapReduce types and formats - features - counters - sorting - MapReduce Applications –Configuring and setting the environment - Unit test with MR unit - local test.

UNIT IV:

Spark: Installing spark - Spark applications - Jobs - Stages and Tasks - Resilient Distributed databases - Anatomy of a Spark Job Run - Spark on YARN - SCALA: Introduction - Classes and objects - Basic types and operators - built-in control structures - functions and closures - inheritance.

UNIT V:

NoSQL Databases: Introduction to NoSQL - MongoDB: Introduction - Data types - Creating - Updating and deleing documents - Querying - Introduction to indexing - Capped collections - HBase: Concepts - HBase Vs RDBMS - Creating records - Accessing data - Updating and deleting data - Modifying data - exporting and importing data. USE CASES: Call detail log analysis - Credit fraud alert - Weather forecast.

Textbook:

1. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, No SQL, and Graph", Morgan Kaufmann/Elsevier Publishers, 2013.

Reference Books:

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2014.
2. Kim H. Pries, Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers", CRC Press, 2015.

Course Outcomes (CO):

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

CO1: Understand the characteristics of big data and concepts of Hadoop ecosystem.

CO2: Understand the concepts of Scala programming.

CO3: Apply Mapreduce programming model to process big data.

CO4: Analyze Spark and its uses for big data processing.

CO5: Create, optimize, and deploy Spark applications using Scala to perform data processing tasks such as data transformation, aggregation, and analysis on large-scale datasets.

CO6: Apply best practices for data storage, retrieval, and management in distributed systems, ensuring efficient and reliable Big Data workflows.

Course Title: **Data Warehousing and Data Mining**	
Course Code: **CS30013**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Understand the fundamentals of data mining, KDD process, and data preprocessing techniques. Analyze data warehousing architecture, ETL processes, and OLAP operations. Apply frequent pattern mining methods and generate association rules. Implement and evaluate clustering techniques and perform outlier detection. Explore and apply advanced data mining techniques in web, spatial, temporal, and text data domains.

Course Contents:

UNIT I:

Introduction to Data Mining: Basics of Data Mining (DM), Data Mining Functionalities, Basic Data Mining Tasks, Knowledge mining from databases, Knowledge Discovery Process (KDD), DM Vs KDD, DM Metrics, DM Applications, Social implications. Data Objects and attribute types, Statistical description of data. Descriptive Data Summarization, Smoothing of data, Cleaning, Integration, Reduction, Transformation and discretization, Data

Visualization, Data similarity and dissimilarity measures.

UNIT II:

Data Warehousing and Online Analytical Processing: Difference between Operational Database and Data warehouse, 3-tier Data Warehousing Architecture, Data Marts, Extraction-Transformation-Loading (ETL), Data Warehouse Schema (Star, Snow-Flake, and Fact Constellation), Fact Table, Dimension Table, Multidimensional Data Model (tables to data Cubes), Building a Data Warehouse, Efficient computation of DATA Cubes, Characteristics of OLAP Systems, OLAP and OLTP, Metadata repository.

UNIT III:

Mining Frequent Patterns: Mining Frequent Patterns, Market Basket Analysis, Finding Frequent Item-sets Using Candidate Generation, Closed itemsets, Association Rules from Frequent Item-sets, Finding Frequent Itemsets (Apriori Algorithm, FP Growth), Mining Frequent Item-sets without Candidate Generation, Measuring the Quality of Rules, Association Mining to Correlation Analysis.

UNIT IV:

Cluster Mining: A Categorization of Major Clustering Methods - Partitioning Methods - K-means clustering, K-medoids, Hierarchical clustering-Agglomerative Divisive Algorithm, Density-Based Methods The DBSCAN Algorithm, Center-Based Approach, Strengths and Weaknesses, Model-Based Methods-Gaussian Mixture Models (GMM), Outlier Detection.

UNIT V:

Advanced Data Mining: Web content Mining, Web Structure Mining, Web usage mining. Spatial Mining: Spatial DM primitives, Generalization and Specialization, Spatial rules, spatial classification and clustering algorithms. Multimedia Data Mining, Text Mining, Temporal Mining, Modeling Temporal Events, Times series, Pattern Detection, Sequences.

Textbooks:

1. J. Han and M. Kamber, "Data Mining: Concepts and Techniques", 4 th Edition, Morgan Kaufman, 2022.

Reference Books:

1. M. H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson

Education, 2006.

2. I. H. Witten and E. Frank, "Data Mining: Practical Machine Learning Tools and Techniques," Morgan Kaufmann, 2000.
3. D. Hand, H. Mannila and P. Smyth. Principles of Data Mining. The MIT Press. 2001.

Course Outcomes (CO):

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

CO1: Explain data mining concepts, KDD process, functionalities, and applications.

CO2: Apply data preprocessing, statistical analysis, and similarity measures.

CO3: Analyze data warehousing architecture, ETL processes, and OLAP operations.

CO4: Apply frequent pattern mining techniques and generate association rules.

CO5: Implement and compare clustering algorithms and perform outlier detection.

CO6: Analyze and apply data mining techniques to web, spatial, temporal, and text data.

Course Title: **Sensors and Devices**	
Course Code:	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To introduce the terminology, technology and its applications. To introduce the concept of M2M (machine to machine) with necessary protocols. To introduce the Python Scripting Language which is used in many IoT devices. To introduce the Raspberry PI platform, that is widely used in IoT applications. To introduce the implementation of web-based services on IoT devices.

Course Contents:

UNIT I:

Introduction to Internet of Things: Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT, IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.

UNIT II:

IoT and M2M: Software defined networks, network function virtualization, difference between SDN and NFV for IoT, Basics of IoT System Management with (NETCONF, YANG- NETCONF, YANG, SNMP NETOPEER.

UNIT III:

IoT Physical Devices and Endpoints: Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Controlling Hardware: Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors.

UNIT IV:

Sensors: Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor.

UNIT V:

IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs Web Server, Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API.

Textbooks:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547.

Reference Books:

1. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.
2. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895
3. Peter Waher, "Learning Internet of Things", Packt Publishing, 2015 3. Editors Ovidiu Vermesan.

4. Peter Friess, "Internet of Things – From Research and Innovation to Market Deployment", River Publishers, 2014.
5. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

Course Outcomes (CO):

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

CO1: Access IoT value chain structure (device, data cloud), application areas and technologies involved.

CO2: Comprehend IoT sensors and technological challenges faced by IoT devices.

CO3: Analyze with a focus on wireless, energy, power, and sensing modules

CO4: Market forecast for IoT devices with a focus on sensors.

CO5: Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi.

CO6: Deploy applications to hand-held devices.

Course Title: **Wireless Mobile Communication**	
Course Code: **EC30002**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: Analog and Digital Communication

Course Learning Objectives (CLO):

Wireless mobile communication includes different types of channel allocation strategies, propagation path loss and fading in cellular environment. The course is intended to learn design aspects of cellular networks and cellular system where cell splitting, power control, cell sectoring and handoff. Equalization and diversity techniques, multiple access techniques, multicarrier communications and multiple antenna techniques for understanding and design of cellular networks are parts of this course. Applications of most recent wireless mobile communication techniques like, MIMO, Massive MIMO, LTE, advanced support technologies, cognitive radio, mobility management, IEEE 802.11, Bluetooth are also included in the course.

Course Contents:
UNIT I:
Cellular Communication System: Cellular concept, System architecture, Spectrum allocation, Frequency reuse, Channel assignment Strategies, Co-channel

interference & System capacity. Hand off, Hand off structure, Practical Hand off consideration, Prioritizing Handoff, Power control, Near – far problem, System capacity, Improvement techniques : Cell splitting, Sectoring, Micro cell zone concept

UNIT II:

RF Propagation and Fading: Free space propagation model, propagation mechanism, Large scale fading, Diffraction Scattering by high – raise structures, shadowing and path loss. Small scale fading, Doppler and time-delay spread, Coherence bandwidth and Coherence-time, Types of Small scale Fading

UNIT III:

RF Propagation and Fading: Free space propagation model, propagation mechanism Large Scale fading, Diffraction & Scattering by high – raise structures, shadowing and path loss. Small Scale Fading, Doppler and time-delay spread, coherence Bandwidth and coherence-Time, Types of Small – Scale Fading.

UNIT IV:

Equalization and Diversity principles: Fundamentals of Equalization, Adaptive equalizer. Concept of diversity, Types of diversity (space, time, frequency, polarization, Rake receiver

UNIT V:

Different Multiple access Techniques and Spread Spectrum modulation: Multiplexing and multiple access, TDD and FDD techniques, Description of FDMA, TDMA, CDMA systems. Architecture and special features of GSM. Spread Spectrum Modulation and principle, PN sequence and its properties. Direct sequence SS and frequency – hopped SS (DS – SS and FH – SS), TH – SS.

UNIT VI:

OFDM and Multi-carrier Communication: Data transmission using multiple carriers, multi carrier modulation with overlapping sub channels, mitigation of sub carrier fading. Discrete Implementation of multi carrier modulation, DFT and its properties, OFDM Principle, The Cyclic Prefix. Matrix representation of OFDM, Multi-carrier Communication with OFDM.

UNIT VII:

Technological Trends in Wireless and Mobile Communication: Concept of Multi input multi output Antenna system, Narrow band MIMO model. MIMO channel capacity, MIMO Diversity gain, Space time Modulation & Coding, LTE and LTE Advanced support technologies, Cognitive radio, mobility management, IEEE 802.11, Bluetooth.

Textbooks:

1. T.S.Rappaport ,Wireless Communication, Pearson, Second Edition
2. Andrea Goldsmith, Wireless Communication, Cambridge University Press, 2009

Reference Books:

1. C. Y. Lee, Wireless and Cellular Communication, MGH, 3rd Edition.
2. Schillar , Mobile Communication, Pearson, 2nd Edition.
3. Harri Holma, Antti Toskala , LTE for UMTS, Evolution to LTE Advanced, Wiley, 2018.
4. Ranjan Bose, Information Theory, Coding Cryptography, MGH India 3rd Edition, 2016.

Course Outcomes (CO):

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

CO1: Comprehend the significance of terminology associated with cellular architecture and determine the performance parameters of cell splitting, sectoring, and microcell zone techniques.

CO2: Solve problems associated with basic propagation models like two ray reflection model, Knife edge propagation model etc and able to analyze signal degradation in wireless out door propagation models.

CO3: Analyse the concepts and solve problems on various modulation schemes like QPSK, Off set QPSK, $\pi/4$ QPSK, MSK, GMSK, QAM used in present day mobile communication.

CO4: Comprehend and analyse the concepts of channel equalization and various diversity techniques.

CO5: Comprehend and analyse the concepts of Spread Spectrum and its applications along with different types of multiple access techniques and able to solve related numerical associated with this.

CO6: Comprehend and analyse the concepts of MC-CDMA and OFDMA modulation and the concepts of MIMO antenna systems along with different technological trends in wireless and mobile communication.

Course Title: **Human Computer Interaction**	
Course Code: **CS30008**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To provide an overview of the concepts of human-computer interfaces. To understand the theoretical dimensions of human factors involved in the acceptance of computer interfaces. To understand the implementation of human-computer interfaces. To identify the various tools and techniques for interface analysis, design and evaluation.

Course Contents:

UNIT I:

HCI Foundations: Input–output channels, Human memory, Thinking: reasoning and problem solving, Emotion, Individual differences, Psychology and the design of interactive systems, Text entry devices, Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, Sensors and special devices, Paper: Printing and scanning.

UNIT II:

Designing, Programming Interactive systems, Models of interaction, Frameworks and HCI, Ergonomics, Interaction styles, Elements of the WIMP interface, The context of the interaction, Experience, Engagement and fun, Paradigms for interaction. Cantered Design and testing, Interaction design basics, The process of design, User focus, Scenarios, Navigation design, Screen design and layout, Iteration and prototyping.

UNIT III:

HCI in the software process, Iterative design and prototyping, Design rules, Principles to support usability, Standards and Guidelines, Golden rules and heuristics, HCI patterns. Implementation support, Elements of windowing systems, Programming the application, Using toolkits, User interface management systems.

UNIT IV:

Evaluation techniques, Evaluation through expert analysis, Evaluation through user participation, Universal design, User support. Models and Theories, Cognitive models, Goal and task hierarchies, Linguistic models, The challenge of display- based systems, Physical and device models, Cognitive architectures.

UNIT V:

Collaboration and communication, Face-to-face communication, Conversation, Text-based communication, Group working, Dialog design notations, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and design Human factors and security, Groupware, Meeting and decision support systems, Shared applications and artifacts, Frameworks for groupware, Implementing synchronous groupware, Mixed, Augmented and Virtual Reality.

Textbooks:

1. Alan Dix, Janet Finlay, G D Abowd, R Beale, “Human, Computer Interaction”, Third Edition, Pearson Publishers, 2008.
2. Shneiderman, Plaisant, Cohen, Jacobs, “Designing the User Interface: Strategies for Effective Human Computer Interaction”, Fifth Edition, Pearson Publishers, 2010.

Course Outcomes (CO):

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

CO1: Describe the Human Computer Interaction and its fundamentals.

CO2: Design and Develop processes and life cycle of Human Computer Interaction.

CO3: Analyze product usability evaluations and testing methods.

CO4: Apply the interface design standards/guidelines for cross cultural and disabled users

CO5: Categorize, Design and Develop Human Computer Interaction in proper architectural structures.

CO6: Build the application oriented human computer interface for solving real life problems.

Course Title: **Computer Vision**	
Course Code: **CS30010**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand image formation and camera calibration. To understand stereo vision and stereo camera geometry. To be able to know structures from motions. To know machine learning for computer vision.

Course Contents:

UNIT I:

Image formation and camera calibration: Introduction to computer vision, Geometric camera models, Orthographic and perspective projections, Weak perspective projection, Intrinsic and extrinsic camera parameters, Linear and nonlinear approaches of camera calibration.

UNIT II:

Feature detection and matching: Edge detection, Interest points and corners, Local image features, Feature matching and Hough transform, Model fitting and RANSAC, Scale invariant feature matching.

UNIT III:

Stereo Vision: Stereo camera geometry and epipolar constraints, Essential and fundamental matrix, Image rectification, Local methods for stereo matching: Correlation and multi-scale approaches, Global methods for stereo matching: Order constraints and dynamic programming, Smoothness and graph-based energy minimization, Optical flow.

UNIT IV:

Shape from Shading: Modeling pixel brightness, Reflection at surfaces, The Lambertian and specular model, Area sources, Photometric stereo: Shape from multiple shaded images, Modeling inter-reflection, Shape from one shaded image.

UNIT V:

Structure from motion: Camera self-calibration, Euclidean structure and motion from two images, Euclidean structure and motion from multiple images, Structure and motion from weak-perspective and multiple cameras.

UNIT VI:

Machine Learning for Computer Vision: Introduction to Machine Learning, Image Classification, Object Detection, Semantic Segmentation, Case study on computer vision and machine learning for applied research.

Textbooks:

1. Forsyth, D. A. and Ponce, J., "Computer Vision: A Modern Approach", 2nd Ed., Pearson Education.

Reference Book:

1. Hartley, R. and Zisserman, A., "Multiple View Geometry in Computer Vision", Cambridge University Press.

Course Outcomes (CO):

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

CO1: Categorizing of image formation and camera calibration

CO2: Apply the concepts of feature detection, Feature reduction, and matching.

CO3: Analyze the concepts of stereo vision and stereo camera geometry.

CO4: Design the concepts of generating shapes from shading.

CO5: Identifying the concepts of structures from motions.

CO6: Determine the concepts of machine learning for computer vision for applied research.

Course Title: **Natural Language Processing**	
Course Code: **CS30012**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the steps involved in Natural language processing. To learn about the lexical, syntactic and semantic analysis of natural language processing. To explore the various parsing techniques for natural languages. To understand the statistical models for Natural language processing. To learn about the various applications involved in Natural language processing.

Course Contents:

UNIT I:

Lexical Analysis: Lexical Analysis, Regular expression and Automata for string matching, Words and Word Forms, Morphology fundamentals, Morphological Diversity of Indian Languages, Morphology Paradigms, Finite State Machine, Transducers Based Morphology, Automatic Morphology Learning, Parts of Speech, N-gram Models, Hidden Markov Models.*

UNIT II:

Speech Processing: Biology of Speech Processing, Place and Manner of Articulation, Word Boundary Detection, Argmax based computations, HMM and Speech Recognition, Text to Speech Synthesis, Rule based, Concatenative based approach.

UNIT III:

Parsing: Theories of Parsing, Parsing Algorithms, Earley Parser, CYK Parser, Probabilistic Parsing, CYK, Resolving attachment and structural ambiguity, Shallow Parsing, Dependency Parsing, Named Entity Recognition, Maximum Entropy Models, Conditional Random Fields.*

UNIT IV:

Lexical Knowledge Networks Meaning: Lexical Knowledge Networks, Wordnet Theory, Indian Language Wordnets and Multilingual Dictionaries, Semantic Roles, Word Sense Disambiguation, WSD and Multilinguality, Metaphors, Coreference and Anaphora Resolution.*

UNIT V:

Applications: Sentiment Analysis, Text Entailment, Machine Translation, Question Answering System, Information Retrieval, Information Extraction Cross Lingual Information Retrieval (CLIR).*

*** :** *Programming Assignments are mandatory.*

Textbooks:

1. Foundations of Statistical Natural Language Processing, Christopher Manning, Schutze Heinrich, MIT Press, 1999.
2. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Daniel Jurafsky.2nd Edition,Pearson Education.

Reference Books:

1. Allen James, "Natural Language Understanding", Second Edition, Benjamin Cumming, 1995.

Course Outcomes (CO):

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

CO1: Evaluate different computing architectures for natural language processing for various parameters.

CO2: Justify the various steps necessary for processing natural language.

CO3: Suggest appropriate lexical and parsing techniques for a given natural language

CO4: Apply appropriate statistical models for a given natural language application.

CO5: Modify existing algorithms to suit any natural language for processing.

CO6: Suggest appropriate pre-processing steps essential for the various applications involving natural language processing.

Course Title: **Privacy and Security in IoT**	
Course Code: **CS30014**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To impart knowledge on the state-of-the-art methodologies and Security in Internet of Things (IoT). To understand the Privacy Preservation and Trust Models in Internet of Things (IoT). To study the Internet of Things (IoT) Security protocols and Security framework.

Course Contents:

UNIT I:

Security in IoT: IoT security, Vulnerabilities, Attacks and Countermeasures - Security Engineering for IoT development - IoT security lifecycle.

UNIT II:

Network Robustness and Malware Propagation Control in IoT: Network Robustness - Fusion Based Defense Scheme - Sequential Defense Scheme - Location Certificate Based Scheme - Sybil node detection scheme -

Formal Modeling and Verification -Sybil Attack Detection in Vehicular Networks - Performance evaluation of various Malware Dynamics Models - Analysis of Attack Vectors on Smart Home Systems.

UNIT III:

Blockchain Technology in IoT: Technical Aspects - Integrated Platforms for IoT Enablem Intersections between IoT and Distributed Ledger - Testing at scale of IoT Blockchain Applications - Access Control Framework for Security and Privacy of IoT - Blockchain Applications in Healthcare.

UNIT IV:

Privacy Preservation in IoT: Privacy Preservation Data Dissemination: Network Model, Threat Model – Problem formulation and definition - Baseline data dissemination - Spatial Privacy Graph based data dissemination -Experiment Validation - Smart building concept-Privacy Threats in Smart Building - Privacy Preserving Approaches in Smart Building - Smart Meter Privacy Preserving Approaches.

UNIT V:

Privacy Protection in IoT: Lightweight and Robust Schemes for Privacy Protection in IoT Applications: One Time Mask Scheme, One Time Permutation Scheme - Mobile Wireless Body Sensor Network - Participatory Sensing.

UNIT VI:

Trust Models for IoT: Trust Model Concepts - Public Key Infrastructures Architecture Components - Public Key Certificate Formats - Design Considerations for Digital Certificates - Public Key Reference Infrastructure for the IoT - Authentication in IoT - Computational Security for IoT.

UNIT VII:

Security Protocols for IoT Access Networks: Time Based Secure Key Generation -Security Access Algorithm: Unidirectional, Bidirectional Transmission - Cognitive Security - IoT Security Framework - Secure IoT Layers – Secure Communication Links in IoT - Secure Resource Management, Secure IoT Databases.

Textbooks:

1. Hu, Fei. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, 2016, 1st edition, CRC Press, USA.

Reference Books:

1. Russell, Brian and Drew Van Duren. Practical Internet of Things Security, 2016,1st edition, PACKT Publishing Ltd, UK
2. Kim, S., Deka, G. C., & Zhang, P. (2019). Role of blockchain technology in IoT applications. Academic Press.
3. Whitehouse O Security of things: An Implementers' guide to cyber-security for internet of things devices and beyond, 2014, 1 st edition, NCC Group, UK.

Course Outcomes (CO):

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

CO1: Identify different Internet of Things technologies and their applications.

CO2: Assess the need for Privacy and security model for the Internet of Things.

CO3: Explore various Trust Model for IoT and customize real time data for IoT applications.

CO4: Design security framework and solve IoT security issues.

CO5: Customize real time data for IoT applications.

CO6: Build security systems using elementary blocks.

Course Title: **Fundamentals of Cybersecurity**	
Course Code: **CS30016**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Basic knowledge of Networking**

Course Learning Objectives (CLO):

To provide students with a strong foundation in cybersecurity concepts and practices, develop the skills to identify and mitigate cyber threats, protect data and IT infrastructure, manage identities and access, assess and manage security risks, implement appropriate security controls, and understand cybersecurity governance, compliance, and industry best practices for securing organizational information systems.

Course Contents:

UNIT I:

Introduction to Cybersecurity: Fundamentals of Cybersecurity, Cyber Safety, Cyber Crime, Cyber Forensic, Ethical Hacking, Application Security, Information Security, Transaction Security, Cloud Security, Security Architecture, Basics of Cyber–Attack and its implications, Unauthorized access of Computer, Password Sniffing, Denial-of-Service (DOS) Attack, DDOS, Backdoor and Malware and its types, E-mail Bombing, Salami Attack, Software Piracy, Industrial Espionage, Intruder attacks, Security Policies Violations, Crimes Related to Social Media, ATM, Online and Banking Frauds, Intellectual Property Frauds.

UNIT II:

Identity & Access Management: Identity and Access Management Approach, IAM Service Components (Manage Access, Enforce Access, Report Access), IAM Reference Architecture and Strategy, AAA Security Services and Protocols, Authentication: Kerberos V4 and V5, X.509 Authentication Service, IEEE 802.1x protocol, PKI, key distribution, LDAP, OCSP, Single Sign-On (SSO), Privileged Identity Management (PIM), Identity Life Cycle Management, RBAC, Directory Services (Azure AS/Active directory).

UNIT III:

Data Protection: Identifying Critical Assets / Data Classification (Data Elements, PII, Process), Data Loss Prevention (Data in Transaction, Data at Source, and Data at Destination), Data Privacy (Privacy Laws, Data Flow, Data Inventory, Integrated Framework), Database Security: Database Encryption, Database Access Control, Database Backup, Logging Application Security Measures for Web Systems, Secure Programming, Buffer Overflow, Cross-Site Scripting, SQL injection.

UNIT IV:

Risk Governance, Compliance & Audit:

Governance: Cyber espionage, cyber sabotage, cyber warfare, Security Policies & Adherence, Developing and Presenting Business case, Cadence Reporting, Governance Metrics.

Risk type: loss of property, loss of responsibility, loss of net earnings, human cost, operational risk, supply chain risk, risk involved in usage of external service, risk involved in distribution of information by SNS, moral hazard, estimated annual loss, scoring method, cost factor.

Risk analysis: probability, impact, prioritization. **Risk Management:** risk control, risk hedge, risk financing, risk avoidance, risk sharing (risk transfer, risk distribution), risk retention, risk aggregation, residual risk, risk response plan, risk directory, risk communication, Risk appetite, Risk mitigation.

Risk Assessment: risk standards (risk acceptance standard, standard for implementing information security risk assessment), risk level, risk matrix, risk owner, risk source, risk assessment process (risk identification, risk analysis, risk evaluation), risk avoidance, risk appetite, qualitative risk analysis technique, quantitative risk analysis technique.

Compliance & Audit: Audit Life Cycle Initiation – Commencement, Discovery Stage, Maturation Stage, Predictive Stage, PDCA – Cycle Plan, Do, Check, Act, Types of Audit – Internal assessments, External–Mandatory and Statutory, Third Party Risk Management (TPRM), Introduction and Applicability: ISMS 27001 ISO Standards, SOX, HIPAA (Health Insurance Portability & Accountability Act), GDPR (General Data Protection Regulation), Oversight and Introduction to Common Risk Infrastructure, CCPA – California Consumer Privacy Act, PIA - Privacy Impact Assessment, PCI (Payment Card Industry) DSS.

UNIT V:

Security Monitoring and Management: Incident Response Life–Cycle (Prepare, Identify, Assess, Contain, Investigate, Resolve, Learn), Business Continuity Planning.

Security Measures: Anti–Cracking Measures, Measures Against – Unauthorized Access, Malware and Malicious Programs, Outlet Measures, Inlet Measures, Defence, Privatization, Access Control, Vulnerability Management, Network Monitoring, Network Access Rights, Intrusion Detection, Intrusion Prevention, DMZ (Demilitarized Zone), Quarantine Network, E-mail/web security (measures against spam, SPF, URL filtering, content filtering), Security of Personal Digital Assistance (ex. Cell Phone, Smartphone, Tablet, Terminal, etc.), wireless LAN security (WPA (Wi-Fi Protected Access) / encryption of wireless LAN by WPA2, SSID (Service Set Identifier), SSID Stealth, etc.), Cloud Service Security, Digital Watermarking, Digital Forensics (Preservation of Evidence, etc.)

Infrastructure Security: Anti-virus software, DLP (Data Loss Prevention), SSL accelerator, MDM (Mobile Device Management), Cloud Security Challenges, Cloud Application Security, Cloud Infrastructure Security.

UNIT VI:

Vulnerability Management: Introduction to Vulnerability Management, Vulnerability Patching, Security Evaluation , CVSS (Common Vulnerability Scoring System), Vulnerability Assessment, Vulnerability Analysis, Vulnerability Inspection, Vulnerability Investigation, Vulnerability Management Tools, Penetration Testing, Types of Penetration Testing, Methodologies for Penetration Testing, Tools for Penetration Testing, Types of Vulnerabilities like Privilege Escalation, Remote Code Execution etc., Understanding of CIS Benchmark.

Textbooks:

1. The Hacking Guide for Beginners: A Step by Step Guide for you to Learn the Basics of CyberSecurity and Hacking - Ramon A. Nastase, Kindle Edition.
2. Cyber Security by Nina Godbole, Sunit Belapure, 2011, Wiley
3. Information Security: Principles and Practice - Mark Stamp, 3rd Edition, Wiley
4. Computer Security: Principles and Practice – William Stallings & Lawrie Brown, 5th Edition, Pearson

Reference Books:

1. Blue Team Handbook: A Condensed Field Guide for the Cyber Security Incident Responder: Incident Response Edition: A condensed field guide for the Cyber Security Incident Responder.
2. Cyber Security – Attack and Defense Strategies: Counter modern threats and employ state-of-the-art tools and techniques to protect your organization against cybercriminals, 2nd Edition
3. Network Security Essentials: Applications and Standards – William Stallings
4. The Web Application Hacker's Handbook- Dafydd Stuttard, Marcus Pinto

Course Outcomes (CO):

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

CO1: Understand the landscape of cyber threats, including malware, phishing, and DoS attacks.

CO2: Learn to implement the Confidentiality, Integrity, and Availability (CIA) triad to secure digital assets.

CO3: Gain awareness of cyber laws, data protection regulations and governance

CO4: Evaluate the cyber security needs of an organization and conduct vulnerability and risk assessments.

CO5: Operate information assurance, security monitoring, and penetration testing software.

CO6: Formulate and execute incident response plans to troubleshoot breaches and restore compromised systems.

Course Title: **Data Modeling and Visualization**	
Course Code: **CS30018**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Gain a comprehensive understanding of the fundamental principles and theories of data visualization, including visual perception, data types, and the importance of clarity and accuracy in visual representations. Learn to use a variety of data visualization tools and software, such as Tableau, Power BI, D3.js, Matplotlib, and Plotly, to create compelling and interactive visualizations. Develop the ability to design effective and aesthetically pleasing visualizations by choosing appropriate chart types, color schemes, and layouts based on the nature of the data and the intended audience. Understand how to apply visualization techniques to explore and analyze data, uncover patterns, trends, and insights, and effectively communicate findings to stakeholders. Acquire skills in data preprocessing, including cleaning, transforming, and aggregating data, to ensure it is in a suitable format for visualization. Learn to critically evaluate and critique visualizations, both their own and others', to identify strengths and weaknesses and make informed improvements.

Course Contents:

UNIT I:

Introduction: Purpose, Scope, Intended readers, Content preview, Communication style. Different Roles of Tables and Graphs Quantities and categories, Choosing the best medium of communication, Tables defined, when to use tables, Graphs defined, A brief history of graphs, When to use graphs.

UNIT II:

Visual Perception and Graphical Communication: Mechanics of sight, Attributes of pre-attentive processing, Applying visual attributes to design, Gestalt principles of visual perception

Fundamental Variations of Graphs: Encoding data in graphs, Relationships in graphs, Graph design solutions

General Design for Communication: Highlight, Organize, Integrate tables, graphs, and text

UNIT III:

General Graph Design: Maintain visual correspondence to quantity, Avoid 3D Component Level Graph Design Primary data component design, Secondary data component design, Non-data component design.

UNIT IV:

Displaying Many Variables at Once: Combining multiple units of measure, Combining graphs in a series of small multiples, Other arrangements of multi-graph series, Correlation Analysis.

Textbook:

1. Stephen Few, Show Me the Numbers: Designing Tables and Graphs to Enlighten, Second Edition, Analytics Press, 2012.

Reference Books:

1. Stephen Few, Now You See It: Simple Visualization Techniques for Quantitative Analysis, Analytics Press; First Edition, 2009.
2. Tamara Munzner, Visualization: Analysis and Design, CRC Press, 2014.
3. Edward Tufte, The Visual Display of Quantitative Information, Graphics Press, 2001.

Course Outcomes (CO):

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

CO1: Demonstrate proficiency in using various data visualization tools and software such as Tableau, Power BI, D3.js, Matplotlib, and Plotly to create effective and interactive visualizations.

CO2: Apply principles of visual storytelling to communicate data-driven insights clearly and persuasively to diverse audiences, tailoring visualizations to the needs of specific stakeholders.

CO3: Design aesthetically pleasing and functional visualizations by selecting appropriate chart types, color schemes, and layouts, and critically evaluate visualizations for clarity, accuracy, and effectiveness.

CO4: Perform data preprocessing tasks, including cleaning, transforming, and aggregating data, to prepare datasets for visualization and ensure they accurately represent the underlying information.

CO5: Conduct exploratory data analysis using visualization techniques to identify patterns, trends, and anomalies in data, thereby deriving meaningful insights for decision-making.

CO6: Demonstrate an understanding of key principles and theories of data visualization, including visual perception, cognitive load, and data ethics, and apply these principles to create impactful visualizations.

Course Title: **Compiler Design**	
Course Code: **CS30015**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To introduce the major concept areas in compiler design and know the various phases of the compiler. To understand the various parsing algorithms and comparison of the same. To provide practical programming skills necessary for designing a compiler. To gain knowledge about the various code generation principles. To understand the necessity for code optimization.

Course Contents:

UNIT I:

Introduction to Compilation: Compilers, Analysis of the source program, Phases of a compiler, Cousins of the Compiler, Grouping of Phases, Lexical Analysis, Role of Lexical Analyzer, Input Buffering, Specification of Tokens, Compiler construction tools.

Lab Component: Tutorial on LEX / FLEX tool, Tokenization exercises using LEX.

UNIT II:

Syntax Analysis: Role of the parser, Writing Grammars, Context-Free Grammars, Top-Down parsing: Recursive Descent Parsing, Predictive Parsing, Bottom-up parsing: Shift Reduce Parsing, Operator Precedent Parsing, LR Parsers, SLR Parser, Canonical LR Parser, LALR Parser.

Lab Component: Tutorial on YACC tool, Parsing exercises using YACC tool.

UNIT III:

Intermediate Code Generation: Intermediate languages, Declarations, Assignment Statements, Boolean Expressions, Case Statements, Back patching, Procedure calls.

Lab Component: A sample language like C-lite is to be chosen. Intermediate code generation exercises for assignment statements, loops, conditional statements using LEX/YACC.

UNIT IV:

Code Optimization and Run Time Environments: Introduction, Principal Sources of Optimization, Machine dependent and independent optimization, Peephole Optimization, Loop Optimization, Basic Blocks, DAG representation of Basic Blocks, Optimization of Basic Blocks, Introduction to Global Data Flow Analysis, Runtime Environments, Source Language issues, Storage Organization, Storage Allocation strategies, Access to non-local names, Parameter Passing, Error detection and recovery.

Lab Component: Local optimization to be implemented using LEX/YACC for the sample language.

UNIT V:

Code Generation: A simple Code generator, DAG based code generation, Issues in the design of code generator, Runtime Storage management, Basic Blocks and Flow Graphs, Next-use Information.

Lab Component: DAG construction, Simple Code Generator implementation, DAG based code generation using LEX/YACC for the sample language.

Textbook:

1. Alfred V. Aho, Jeffrey D Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education, 2012.

Reference Books:

1. Allen I. Holub, "Compiler Design in C", Prentice Hall of India, 2003.

2. C. N. Fischer, R. J. LeBlanc, “Crafting a compiler with C”, Benjamin Cummings, 2003.
3. Henk Alblas, Albert Nymeyer, “Practice and Principles of Compiler Building with C”, PHI, 2001.
4. Kenneth C. Louden, “Compiler Construction: Principles and Practice”, Thompson Learning, 2003.

Course Outcomes (CO):

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

CO1: Identify the phases of a compiler to translate from source code to executable code.

CO2: Apply the knowledge of LEX & YACC tool to develop a scanner and parser.

CO3: Suggest the necessity for appropriate code optimization techniques.

CO4: Conclude the appropriate code generator algorithm for a given source language.

CO5: Identify the effectiveness of optimization and learn various machine independent and machine dependent optimization techniques.

CO6: Design a compiler for any programming language.

Course Title: **Optical Satellite Communication**	
Course Code:	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type:	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This course aims to provide students with a fundamental understanding of optical fiber and satellite communication systems. Upon completion, students will be able to explain the principles of light transmission in optical fibers, analyze the performance of optical communication components and links, and understand the operation of satellite communication systems, including satellites, earth stations, and transponders. Students will also be able to evaluate factors affecting system performance, perform basic link analysis, and compare optical and satellite communication technologies. The course develops the knowledge and skills required to apply these technologies in modern telecommunication, broadcasting, navigation, and remote sensing applications.

Course Contents:

UNIT I:

Principles of Optical Communication and Wave Propagation in Optical Fiber: Optical frequencies used in optical fibers, Principle of light propagation in optical fibers, Advantages of optical fiber communication. Basic structure of optical fibers and ray diagram of optical path in an optical fiber, Acceptance angle, Numerical aperture. Concept of modes, Different types of modes in optical fibers, Cut-off condition for guided modes, Boundary conditions, single mode/multi-mode fibers, Concept of V number and its importance.

UNIT II:

Lossesin Fiber and Dispersion: Intrinsic/Extrinsic losses, Material or impurity losses, Rayleigh scattering loss, Absorption loss, Bending loss. Loss versus wavelength plot, Concept of dispersion, Intermodal dispersion, Intramodal dispersion, Wave guide and material dispersion, minimization of dispersion.

UNIT III:

Optical Sources, Detectors, Fiber Optic Links & Optical Networks: Characteristics of optical sources, Principle of operation of LED and LASER diode, Intensity modulation circuits for LED and Laser diode. Principle of operation of PIN diode and APD, Basic structures, Current characteristics, SNR calculation and Noise equivalent power, Bit error rate, fiber optic links - power budget, rise-time budget. SONET/SDH, FDDI, WDM networks, wavelength-routed metro and wide- area networks, passive optical networks for access segment.

UNIT IV:

Introduction to Satellite & Orbital Mechanics: Overview of Satellite Communications, GEO, MEO and LEO satellite systems, frequency bands, Orbit Equations, Locating the satellite w.r.t. the earth, Orbital elements, look Angles, Orbital perturbation, Effects of earth's oblateness, moon and sun, Satellite eclipse, sun transit outage, Coverage angle, slant range, satellite launching.

UNIT V:

Satellite Subsystems & Link Design: Attitude and Orbit Control System

(AOCS), Telemetry, Tracking and Command System (TT&C), Power System, Satellite antennas, Communications subsystem, transponders Basic transmission theory, System noise temperature and G/T ratio, CNR, CIR, ACI, IMI, down link design, up link design, System design examples.

UNIT VI:

Multiple Access Schemes: FDM/FM/FDMA, TDMA, Frame structure, frame acquisition, synchronization, TDMA in VSAT network, On-board processing, CDMA, Spread spectrum transmission and reception, DS-SS CDMA capacity, VSAT Systems: Overview of VSAT systems, Network architectures, Access control, multiple access selection.

Textbooks:

1. G. Kaiser, Optical Fiber Communication, McGrawHill, 5th edition, 2013
2. Pratt, Bostien Allnut, Satellite Communication, John Willey Publications, 2nd edition, 2013.

Reference Books:

1. J.C.Palais, Optical Fiber ommunication, Pearson Education, 2022, Reprint.
2. Denish Roddy, Satellite Communication, McGrawHill, 3rd Edition, 2001.

Course Outcomes (CO):

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

CO1: Explain the significance of terminology associated with optical communication, analyze the principle of light propagation through optical fiber with concept of modes.

CO2: Analyze various types of losses and dispersion in optical fiber and solve related problems associated with the concept.

CO3: Analyze the structure, principle of operation and the characteristics of optical sources and detectors, optical link design and Networking .

CO4: Describe the architecture and operation of satellite communication systems, including orbital mechanics, satellite subsystems, and earth station components.

CO5: Analyze satellite link design parameters such as link budget calculations, multiple access techniques, noise considerations, and propagation effects.

CO6: Apply theoretical concepts to solve practical problems related to optical fiber and satellite communication systems using appropriate engineering tools and techniques.

Course Title: **Reinforcement Learning**	
Course Code: **CS30022**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the principles of reinforcement learning and its capabilities. To understand the basic concepts of reinforcement learning, including agents, environments, states, actions, rewards, and policies. Learn about various RL algorithms such as Q-learning, SARSA (State-Action-Reward-State-Action), Deep Q-Networks (DQN), Policy Gradients, Actor-Critic methods, and their respective advantages and disadvantages. Develop the skills to implement RL algorithms from scratch using programming languages like Python, and libraries such as TensorFlow, PyTorch, and OpenAI Gym. Evaluate the performance of RL models, understand concepts of exploration vs. exploitation, and improve models through techniques like hyper parameter tuning, reward shaping, and handling environment variability.

Course Contents:

UNIT I:

Introduction: Reinforcement Learning, Examples, Elements of Reinforcement Learning, Limitations and Scope, An Extended Example: Tic-Tac-Toe.

Multi-armed Bandits: K-armed Bandit Problem, Action-value Methods, the 10-armed Testbed, Incremental Implementation, tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandit Algorithms.

Finite Markov Decision Processes: The Agent–Environment Interface, Goals and Rewards, Returns and Episodes, Unified Notation for Episodic and Continuing Tasks, Policies and Value Functions, Optimal Policies and Optimal Value Functions, Optimality and Approximation .

UNIT II:

Dynamic Programming: Policy Evaluation (Prediction), Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic

Programming, Generalized Policy Iteration, Efficiency of Dynamic.

Monte Carlo Methods: Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy Prediction via Importance Sampling, Incremental Implementation.

Temporal-Difference Learning: TD Prediction, Advantages of TD Prediction Methods, Optimality of TD, Sarsa: On-policy TD Control, Q-learning: Off-policy TD Control, Expected Sarsa, Maximization Bias and Double Learning, Games, After states, and Other Special Cases.

UNIT III:

n-step Bootstrapping: n-step TD Prediction, n-step Sarsa, n-step Off-policy Learning, Off-policy Learning Without Importance Sampling, The n-step Tree Backup Algorithm. Planning and Learning with Tabular Methods: Models and Planning, Dyna: Integrated Planning, Acting, and Learning, When the Model Is Wrong, Prioritized Sweeping, Prioritized Sweeping, expected vs. Sample Updates, Trajectory Sampling, Real-time Dynamic Programming, Planning at Decision Time, Heuristic Search, Rollout Algorithms, Monte Carlo Tree Search.

UNIT IV:

On-policy Prediction with Approximation: Value-function Approximation, The Prediction Objective, Stochastic-gradient and Semi-Gradient Methods, Linear Methods, Feature Construction for Linear Methods, Polynomials, Fourier Basis, Coarse Coding, Tile Coding, Radial Basis Functions, Selecting Step-Size Parameters Manually, Nonlinear Function Approximation: Artificial Neural Networks, Least-Squares TDOn-policy Control with Approximation: Episodic Semi-Gradient Control, Semi-gradient n-step Sarsa, Average Reward: A New Problem Setting for Continuing Tasks, Deprecating the Discounted Setting, Differential Semi-gradient n-step Sarsa.

UNIT V:

Policy Gradient Methods: Policy Approximation and its Advantages, The Policy Gradient Theorem, REINFORCE: Monte Carlo Policy Gradient, REINFORCE with Baseline, Actor–Critic Methods, Policy Gradient for Continuing Problems, Policy Parameterization for Continuous Actions.

Textbook:

1. Richard S. Sutton and Andrew G. Barto; Reinforcement Learning: An

Introduction; 2nd Edition, MIT Press, 2020, Available online.

Reference Books:

1. Andrew G. Barto and Sridhar Mahadevan; Recent Advances in Hierarchical Reinforcement Learning; Discrete Event Dynamic Systems, vol. 13, pp. 341–379, 2003.
2. Vincent Francois-Lavet, Peter Henderson, Riashat Islam, Marc G. Bellemare and Joelle Pineau; An Introduction to Deep Reinforcement Learning; ArXive Print, 2018.
3. Kaiqing Zhang, Zhuoran Yang, Tamer Başar; Multi-Agent Reinforcement Learning: A Selective Overview of Theories and Algorithms; ArXive Print, 2021.

Course Outcomes (CO):

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

CO1: Demonstrate a thorough understanding of the theoretical underpinnings of reinforcement learning.

CO2: Implement key reinforcement learning algorithms, such as Q-learning, Deep Q-Networks (DQN), Policy Gradients, and Actor-Critic methods.

CO3: Design, develop, and train RL models using popular frameworks and tools (e.g., Tensor Flow, PyTorch, Open AI Gym).

CO4: Apply reinforcement learning to solve complex, real-world problems in various domains, such as robotics, game playing, autonomous vehicles, and recommendation systems.

CO5: Evaluate the performance of RL models using appropriate metrics and methodologies, and enhance their effectiveness through techniques like reward shaping, hyper parameter tuning, and handling stochastic environments.

CO6: Recognize and address ethical, practical, and safety considerations in the deployment of RL systems, including the potential for unintended consequences and the importance of robust and interpretable models.

Course Title: **Industrial IoT**	
Course Code: **CS30024**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To provide students with a good depth of knowledge of Designing Industrial IOT Systems for various applications.

Course Contents:

UNIT I:

Introduction To Industrial Internet and Use-Cases: Industrial Internet- Key IIoT Technologies- Innovation and the IIoT -Key Opportunities and Benefits -The Digital and Human Workforce - Logistics and the Industrial Internet- IOT Innovations in Retail.

UNIT II:

The Technical and Business Innovators of The Industrial Internet: Cyber Physical Systems (CPS), – IP Mobility – Network Virtualization - SDN (Software Defined Networks)- The Cloud and Fog – Role of Big Data in IIOT - Role of Machine learning and AI in IIOT.

UNIT III:

IIOT Reference Architecture: Industrial Internet Architecture Framework (IIAF) -Industrial Internet Viewpoints - Architectural Topology: The Three-Tier Topology- Key System Characteristics- Data Management- Advanced data analytics.

UNIT IV:

Protocols for Industrial Internet Systems: Legacy Industrial Protocols - Modern Communication Protocols-Proximity Network Communication Protocols- Wireless Communication Technologies- Gateways: industrial gateways - CoAP (Constrained Application Protocol)- NFC.

UNIT V:

Middleware Software Patterns and IIOT Platforms: Publish/Subscribe Pattern: MQTT, XMPP, AMQP, DDS- Middleware Architecture- SigFox- LoRaWAN Augmented reality- Real-World Smart Factories, Application of IIOT: Case study: Health monitoring, IoT smart city, Smart irrigation, Robot surveillance.

Textbooks:

1. Gilchrist, Alasdair, "Industry 4.0 The Industrial Internet of Things", Apress, 2017.

Reference Books:

1. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, "Industrial Internet of Things: Cyber manufacturing Systems" (Springer), 2017.
2. Introduction to industrial Internet of Things and industry 4.0, Sudip Misra, Chandana Roy, Anandarup Mukherjee, CRC Press
3. Zaigham Mahmood, The Internet of Things in the Industrial Sector: Security and Device connectivity, smart environments and Industry 4.0 (Springer), 2019.
4. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor)
5. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
6. Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642- 19157-2, Springer

Course Outcomes (CO):

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

CO1: Analyze IIoT Foundations and Market Drivers.

CO2: Evaluate Enabling Technologies and Compute Paradigms for real-time industrial data processing.

CO3: Design Architectural Frameworks for complex industrial ecosystems.

CO4: Implement Industrial Communication Protocols to ensure seamless connectivity across industrial gateways.

CO5: Deploy Middleware and Messaging Patterns to manage data flow and device interoperability within an IIoT platform.

CO6: Formulate Solutions for Real-World IIoT Applications.

Course Title: **Machine Learning Operations**	
Course Code: **CS30026**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Machine Learning**

Course Learning Objectives (CLO):

To introduce Machine Learning Models, Architectures and Patterns. To learn MLOPs Infrastructures and different tools for implementation. To get a deep understanding of MLOPs packaging process and deployment in different environments. To integrate ML models through CI/CD/CT pipelines and their developments. To deploy the ML models in different scenarios for monitoring, testing, evaluation, and improvement.

Course Contents:

UNIT I:

Introduction to MLOPs: Principles of MLOPs, Best Practices, MLOPs Strategy, Enterprising MLOPs, Challenges; Architecture and Components – Components (Data source, data versioning, data analysis, code repository, Pipeline orchestration, Model training and storage, Model deployment and serving, Monitoring, Feature processing); Architecture (Minimum, Production, Enterprise); Deployment patterns; Combining Developments, Staging and Production environment. Git and GitHub Fundamentals.

UNIT II:

MLOPs Infrastructure and Tools: Storage, Computer, Containers, Orchestration, Machine Learning Platforms; MLOPs-based Machine Learning Systems (Initial, Transition, Operations), Machine Learning Development (Cookiecutter, Repository structure). ML Life Cycle, Management of ML Life Cycle.

UNIT III:

Packaging ML Models: MLOPs Code Repository, Data Sourcing, Data Analysis, Model Development, Machine Learning Systems, Data Preparation, Model Development, Model Evaluation, Model Versioning, Developing the Package; Deploying ML Models on different platforms – Heroku, Microsoft Azure, Google Cloud Platform, Amazon Web Services (Basic Concepts).

UNIT IV:

MLflow – Platform to Manage the ML Life Cycle: MLflow tracking, Projects, Models, Model Registry; Continuous Integration, Continuous Deployment, and Continuous Testing (CI/CD/CT) Pipelines using Jenkins, GitHub Actions, Continuous Training, Retraining, and Delivery;

Continual Learning: Requirements, Principles, Stateless and Stateful Training, Challenges; ML Life Cycle, Dockers for ML, Building ML Web Apps using API, Building ML Native Apps

UNIT V:

Deployment of ML Models: CI/CD for ML, Deploying ML Models on different platforms – Heroku, Microsoft Azure, Google Cloud Platform, Amazon Web Services (Implementation); Monitoring and debugging the deployed models. Deployment Strategies (Single, Silent, Canary, Multi-armed bandits), Model Inference and Serving.

Post Productionizing ML Models: Continuous Monitoring – Principles of Model Drift, Model Transparency, Significance of Monitoring; MLOPs Workflow – Logging, Model Evaluation, testing, and evaluation; Frameworks for Model Monitoring, Integrating with Tools. Model Security.

Textbooks:

1. SuhasPote, Machine Learning in Production: Master the art of delivering robust Machine Learning solutions with MLOPs– BPB Publication, First Edition, 2023.
2. Chip Huyen, Designing Machine Learning Systems: An Iterative Process for Production-Ready Applications (Grayscale Indian Edition), O'Reilly.

Reference Books:

1. Andrew McMahon, Machine Learning Engineering with Python - Second Edition: Manage the lifecycle of machine learning models using MLOps with practical examples, Packt Publication.
2. Mark Treveil , Nicolas Omont, Introducing MLOps: How to Scale Machine Learning in the Enterprise (Grayscale Indian Edition), O'Reilly.
3. YaronHaviv and Noah Gift, Implementing MLOps in the Enterprise: A Production-First Approach (Grayscale Indian Edition), SPD Publication.
4. Raman Jhajj, Mastering MLOPs Architecture : From Code to Deployment – BPB Publication, First Edition, 2024.

Course Outcomes (CO):

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

CO1: Assess MLOPs process and environments.

CO2: Learn the usage of ML tools during the life cycle of ML Models.

CO3: Develop ML models and learn their packaging for deployment.

CO4: Acquainted with different platforms for ML Model deployment and their life cycle.

CO5: Generate prototypes of ML models through continuous retraining, testing, evaluating, and improvements.

CO6: Analyze and ensure the ML Model security for production.

Course Title: **Cloud Security**	
Course Code: **CS30028**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Cloud Computing**

Course Learning Objectives (CLO):

Identify the security and privacy issues in the cloud computing. Understand the auditing and compliance process. Build secure cloud computing Environment.

Course Contents:

UNIT I:

Introduction to cloud computing; Infrastructure security; and storage; Security-as-a-(cloud) service.

UNIT II:

Security Management on the Cloud, Privacy, Audit and Compliance.

UNIT III:

Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Identity and Access Management.

UNIT IV:

Health Care Infrastructure Security, Health Care Network-level security, Cloud Access: authentication, authorisation and accounting.

Textbooks:

1. Tim Mather, Subra Kumaraswamy and Shahed Latif, Cloud Security and Privacy, O'Reilly, 2009.

Reference Books:

1. Rajkumar Buyya, Christian Vecchiola and S. ThamaraiSelvi, Mastering Cloud Computing: Foundations and Applications Programming, Morgan Kaufmann, 2013.
2. Barrie Sosinsky, Cloud Computing Bible, Wiley Publishing, 2011.

Course Outcomes (CO):

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

CO1: Analyze the security and privacy issues in the cloud computing.

CO2: Understand the auditing and compliance process.

CO3: Build security as a cloud service for secure cloud computing.

CO4: Implement various case studies.

CO5: Analyze the security and privacy issues in the cloud computing.

CO6: Understanding Health care Privacy and Security.

Course Title: **ARM and Advanced Microprocessors**	
Course Code: **EC30007**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The objective of this course is to teach the higher-level concepts of Advanced Microprocessors (like 80286, 80386 and Pentium) and ARM to the students. The students learn about Multitasking, Virtual memory, Memory management, Paging, TLB, RISC features, Pipelining and Branch Prediction like concepts. They develop skills for writing programs on ARM to solve simple problems as well as some real time applications.

Course Contents:

UNIT I:

Introduction: Overview of Intel higher level Processors, Concept of Multitasking, Virtual memory & Memory management.

UNIT II:

Intel 80286 & 80386: Brief outline of Processor Architecture, Mode of operation, Segment descriptor, Privilege level & protection and Task switching in 80286, Virtual 86 mode, Paging and TLB in 80386.

UNIT III:

80486 & Pentium Processor: Enhanced features of 80486, Cache Memory Mapping, Replacement Techniques, Features of RISC processors & Implementation of RISC features in Pentium, Architecture of Pentium Processor, Pipelining, Superscalar execution Branch prediction Technique.

UNIT IV:

ARM & Interfacing: ARM design, ARM Processor fundamentals: Registers, CPSR, Memory map, Pipelines, Exceptions, Interrupt Vector Table, Introduction to ARM Instruction set and Thumb instructions, Interfacing – LCD, ADC, DAC, Stepper motor, UART.

UNIT V:

ARM Programming: Addressing Mode, Introduction to ARM Instruction set, Data Transfer Instructions, Arithmatic Instructions, Logical Instructions, Thumb instructions, Sample Programs.

Textbooks:

1. K. Ray and K. M. Bhurchandi - Advanced Microprocessor and Peripherals - Architecture, Programming and Interfacing, McGraw Hill Education Pvt Ltd - 3rd Edition.
2. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Shujen Chen - ARM Assembly Language Programming & Architecture - Micro Digital Ed, ISBN: 9780997925906 - 2nd Edition.

Reference Books:

1. B.B. Brey - The Intel Microprocessors 8086/8088, 80186/80188, 80386, 80486, Pentium and Pentium Pro - Processor - PHI - 8th Edition
2. D.V. Hall - Microprocessors Interfacing, Programming & Hardware - TMH - 3rd Edition.
3. William Hohl, Chirstopher Hinds - ARM Assembly Language: Fundamentals and Techniques - Taylor & Francis - 2nd Edition.
4. M A Mazidi & others, ARM System Developers Guide Design & Optimizing

System Software - Andrew N. Sloss & others – Elsevier.

Course Outcomes (CO):

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

CO1: Appraise the concepts implemented in higher level Processors like Multitasking, Virtual Memory, Memory Management etc.

CO2: Examine the mode of Operation of 80286, Concept of program invisible registers, Segment Descriptors etc.

CO3: Analyze Segment Descriptors, Privilege level and Protection, Virtual '86 Mode and Paging in 80386, enhanced features incorporated in 80486

CO4: Analyze the RISC features implemented in the design of Pentium Processors, Parallel processing through U V Pipelines / Superscalar Execution and Branch Prediction Techniques.

CO5: Acquire the knowledge of a 32-bit ARM Processor, its RISC features, Registers, Pipelining and Interrupts

CO6: Evaluate the 32-bit ARM instruction set, 16-bit Thumb instructions and Interfacing.

Course Title: **Augmented and Virtual Reality**	
Course Code: **CS30032**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To know basic concepts of virtual reality. To understand visual computation in computer graphics. To understand interaction between system and computer. To know application of VR in Digital Entertainment. To know basic concepts of augmented reality

Course Contents:

UNIT I:

Introduction of Virtual Reality: Fundamental Concept and Components of Virtual Reality, Primary Features and Present Development on Virtual Reality, Multiple Models of Input and Output Interface in Virtual Reality: Input, Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D

Menus & 3DScanner, Output, Visual /Auditory / Haptic Devices.

UNIT II:

Visual Computation in Virtual Reality: Fundamentals of Computer Graphics, Software and Hardware Technology on Stereoscopic Display, Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering.

UNIT III:

Interactive Techniques in Virtual Reality: Body Track, Hand Gesture, 3D Manus, Object Grasp. Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3D Standard; Vega, MultiGen, Virtools.

UNIT IV:

Application of VR in Digital Entertainment: VR Technology in Film & TV Production, VR Technology in Physical Exercises and Games, Demonstration of Digital Entertainment by VR.

UNIT V:

Augmented and Mixed Reality: Taxonomy, Technology and features of augmented reality, Difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, Visualization techniques for augmented reality, Wireless displays in educational augmented reality applications, Mobile projection interfaces, Marker-less tracking for augmented reality, Enhancing interactivity in AR environments, Evaluating AR systems.

Textbooks:

1. Burdea, G. C., P. Coffet., “Virtual Reality Technology”, Second Edition, Wiley-IEEE Press, 2003/2006.
2. Alan B. Craig, “Understanding Augmented Reality, Concepts and Applications”, Morgan Kaufmann, 2013.

Reference Book:

1. Alan Craig, William Sherman, Jeffrey Will, “Developing Virtual Reality Applications, Foundations of Effective Design”, Morgan Kaufmann, 2009.

Course Outcomes (CO):

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

CO1: Discuss the fundamentals and I/O components of the augmented and virtual reality system.

CO2: Evaluate different computing architectures for virtual reality.

CO3: Provide opportunity to explore the research issues in Augmented Reality and Virtual Reality (AR & VR).

CO4: Apply the different modeling concepts to visual virtualization.

CO5: Explore the role of virtual reality in traditional & emerging applications.

CO6: Develop prototypes using the concepts for virtual reality.

Course Title: **Drone System Engineering**	
Course Code:	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the basics of drone concepts. To learn and understand the fundaments of design, fabrication and programming of drone. To impart the knowledge of flying and operation of the drone. To know about the various applications of drone. To understand the safety risks and guidelines of flying.

Course Contents:

UNIT I:

Introduction & Modelling: Introduction to Drones and Basic components – Aerodynamic and Flight dynamics – Drone Design – Calculations and Assumptions–Propulsion and Energy Management–Anti-vibration and Noise reduction in UAV – Multi Copter Flight Control Models.

UNIT II:

Perception: Introduction to Autonomous Navigation–Sensor Perception on UAV–Artificial Intelligence and Machine Learning – Localization and Mapping.

UNIT III:

Mission Decision–Making: Obstacle detection and Avoidance – Mission Planning and Path Planning – Wireless Communication on UAV – Multi UAV Systems.

UNIT IV:

Drone Building Activities: Configuring and Calibrating DroneComponents–Thrust stands and Motor/ Propeller performance testing – ROS.

UNIT V:

Regulations & Applications: Safety risks- Guidelines to fly safely-specific aviation regulation and standardisation - Drone license. Design of drones for applications such as medical and agriculture.

Textbooks:

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", John Wiley & Sons, Inc., 2021.
2. Terry Kilby and Belinda Kilby, "Make: Getting Started with Drones", Maker Media, Inc, 2016.

Reference Books:

1. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.
2. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001.
3. Reg Austin, "Unmanned aircraft systems UAV design, development and deployment", Wiley, 2010.
4. Robert C.Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.

Course Outcomes (CO):

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

CO1: Comprehend Hardware components and software programming requirements of drones.

CO2: Know about a various type of drone technology.

CO3: Select appropriate sensors and actuators for Drones.

CO4: Use navigation and communication systems in UAVs.

CO5: The drone building activities for different scenarios for deployment.

CO6: Control, monitor and to regulate the drone in mission critical applications.

Course Title: **Deep Learning**	
Course Code: **CS30036**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Machine Learning**

Course Learning Objectives (CLO):

To introduce building blocks of deep neural network architecture. To learn deep learning algorithms and its problem settings. To understand representation and transfer of knowledge using deep learning. To learn to use deep learning tools and framework for solving real-life problems. It also aims to develop practical skills for designing deep learning solutions.

Course Contents:

UNIT I:

Deep Networks: Deep Feedforward Networks, Learning XOR, Gradient Based learning, Hidden Units, Back-propagation and other Differential Algorithms, Regularization for Deep Learning, Optimization for training Deep Models.

UNIT II:

Convolutional Networks: Convolution operation, Motivation, Pooling, Convolution and Pooling as strong prior, Efficient convolution algorithms, Unsupervised features, Sequence Modeling: Recurrent and Recursive Nets, LSTM Networks, Applications, Computer Vision, Speech Recognition, Natural Language Processing.

UNIT III:

Linear factor Models: Probabilistic PCA and Factor Analysis, Independent Component Analysis (ICA), Auto encoders, Regularized Auto encoders, Representational Power, Layer size and Depth, Stochastic Auto encoders, Applications.

UNIT IV:

Representation Learning: Greedy Layer-wise Unsupervised Pre-Training, Transfer learning and Domain Adaptation, Deep Generative Models.

UNIT V:

Deep Learning with Python: Introduction to Keras and Tensor flow, Deep Learning for computer vision, convnets, Deep Learning for Text and Sequences, Generative Deep Learning, Text Generation with LSTM, DeepDream, Neural

Style Transfer, Generating images with variational auto encoders, Generative Adversarial Networks (GAN).

Textbooks:

1. "Deep Learning", Ian Goodfellow, Yoshua Bengio, Aaron Courville, The MIT Press, 2016.
2. Deep Learning: Foundation and Concepts by Christopher M. Bishop & Hugh Bishop, Springer.

Reference Books:

1. Francois Chollet, "Deep Learning with Python", Manning Publications, 2017.
2. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", First Edition, O'Reilly Media, 2017.
3. Josh Patterson, "Deep Learning: A Practitioner's Approach", First Edition, O'Reilly Media.

Course Outcomes (CO):

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

CO1: Explain deep feed forward networks, back propagation, regularization, and optimization techniques.

CO2: Apply convolutional neural networks for computer vision and related applications.

CO3: Apply recurrent neural networks and LSTM models for sequence, speech, and NLP tasks.

CO4: Analyze PCA, ICA, factor analysis, and auto encoders for representation learning.

CO5: Evaluate transfer learning, domain adaptation, pre-training, and generative models.

CO6: Develop deep learning applications using Python, Keras, and TensorFlow.

Course Title: **Agile Software Development**	
Course Code: **CS40001**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Software Engineering**

Course Learning Objectives (CLO):

To develop an understanding on agile software development. To learn about the principles, planning and requirement in agile software development. To understand the testing methodologies in agile software development. To explore the metrics and measurement in agile software development.

Course Contents:

UNIT I:

Introduction: Agile Software Development: Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, Stakeholders, Challenges Lean Approach: Waste Management, Kaizen and Kanban, Add process and products add value, Roles related to the lifecycle, Differences between Agile and traditional plans, Differences between Agile plans at different lifecycle phases, Testing plan links between testing, Roles and key techniques, principles, Understand as a means of assessing the initial status of a project / How Agile helps to build quality.

UNIT II:

Principles: Agile and Scrum Principles: Agile Manifesto, Twelve Practices of XP, Scrum Practices, Applying Scrum, Need of scrum, Working of scrum, Advanced Scrum Applications, Scrum and the Organization, Scrum values.

UNIT III:

Planning and Product Management: Agile Product Management: Communication, Planning, Estimation, Managing the Agile approach, Monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issue, Quality, Risk, Metrics and Measurements.

UNIT IV:

Requirements and Testing: Agile Requirements: User Stories, Backlog Management, Agile Architecture: Feature Driven Development, Agile Risk Management: Risk and Quality Assurance, Agile Tools, Agile Testing: Agile Testing Techniques, Test- Driven Development, User Acceptance Test, Agile Review: Agile Metrics and Measurements, The Agile approach to estimating and project variables.

UNIT V:

Measurement: Agile Measurement, Agile Control, Control parameters, Agile approach to Risk, The Agile approach to Configuration Management, The Atern Principles, Atern Philosophy, Rationale for using Atern, Refactoring, Continuous integration, Automated Build Tools, Scaling Agile for large projects: Scrum of Scrums, Team collaborations, Scrum, Estimate a Scrum Project, Track Scrum Projects, Communication in Scrum Projects, Best Practices to Manage Scrum.

Textbooks:

1. Robert C. Martin, "Agile Software Development, Principles, Patterns, and Practices", First Edition, Pearson Education India, 2002.
2. Mike Cohn, "Succeeding with Agile: Software Development Using Scrum", Pearson Education, 2010.

Reference Book:

1. Robert C Martin, Micah Martin, "Agile Principles, Patterns and Practices in C#", Pearson Education, 2007.

Course Outcomes (CO):

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

CO1: Assess principles, planning and requirement in agile software development.

CO2: Distinguish between agile software development and traditional software development.

CO3: Identify Agile Requirements.

CO4: Suggest agile software development approaches for any real-time problem.

CO5: Provide measurement, metrics necessary for problems involving agile software development.

CO6: Inference best practices of traditional and agile software development and use in real-time problem solving.

Course Title: **Cognitive Radio and Cooperative Communications**	
Course Code: **EC30002**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PE**	Pre-requisites: **Principle of Communication**

Course Learning Objectives (CLO):

The Objective of the course is to learn the concepts of advanced wireless communication techniques like Spectrum Management, Cognitive Radio and Cooperative Communication . Also students will be able to analyze and develop the problem solving abilities related to this domain.

Course Contents:

UNIT I:

Introduction to Wireless Spectrum Management: Evolution of wireless communication systems, Spectrum scarcity problem, Fixed spectrum allocation policies, Inefficient spectrum utilization, Need for dynamic spectrum access, Software Defined Radio (SDR) concept ,Introduction to intelligent wireless systems

UNIT II:

Fundamentals of Cognitive Radio: Definition of Cognitive Radio ,History of cognitive radio, Cognitive cycle, Cognitive engine Primary users and secondary users, Architecture of cognitive radio systems, Characteristics of cognitive radio networks ,Spectrum opportunities

UNIT III:

Spectrum Sensing Techniques: Spectrum sensing fundamentals, Energy detection, Matched filter detection, Cyclostationary feature detection, Waveform detection, Cooperative spectrum sensing, Hidden terminal problem.

Performance metrics: Probability of detection, Probability of false alarm, Receiver operating characteristics

UNIT IV:

Spectrum Management and Dynamic Spectrum Access: Spectrum decision, Spectrum mobility, Spectrum sharing, Dynamic spectrum access models, Game theoretic spectrum allocation, Interference management, MAC protocols for cognitive radio networks.

UNIT V:

Introduction to Cooperative Communication: Wireless fading and diversity techniques, Diversity methods: Time diversity, Frequency diversity, Spatial diversity, Need for cooperative diversity, Virtual antenna arrays, Cooperative communication architecture, User cooperation concept.

UNIT VI:

Relay-Based Cooperative Communication: Relay channel model, Relay node functionality, Cooperative protocols: Amplify and Forward (AF), Decode and Forward (DF), Compress and Forward (CF) ,Fixed relaying, Selective relaying, Incremental relaying.

UNIT VII:

Cooperative Diversity and Network Coding: Cooperative diversity gain, Space-Time coding in cooperative systems, Distributed Space-Time Coding, Network coding principles, Throughput improvement, Error probability analysis ,Resource allocation in cooperative networks

UNIT VIII:

Applications and Emerging Trends: Cognitive radio in 5G and beyond, Device-to-Device communication (D2D), Vehicular communication systems, Cooperative communication in IoT, Security issues in cognitive radio, AI-enabled spectrum management, Future research directions in 6G.

Textbooks:

1. Kwang-Cheng Chen & Ramjee Prasad, Cognitive Radio Networks,Wiley
2. K. J. Ray Liu et al. Cambridge University Press.

Reference Books:

1. Simon Haykin et al., Fundamentals of Cognitive Radio.
2. Andrea Goldsmith, Wireless Communications, Cambridge University Press
3. Theodore S. Rappaport, Wireless Communications: Principles and Practice, Pearson Education.

Course Outcomes (CO):

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

CO1: Understand spectrum management challenges in wireless communication.

CO2: Explain architecture and operation of cognitive radio systems.

CO3: Analyze spectrum sensing and dynamic spectrum allocation techniques.

CO4: Understand cooperative diversity and relay communication protocols.

CO5: Evaluate cooperative communication performance and coding techniques.

CO6: Apply cognitive radio and cooperative communication concepts in modern wireless networks.

Course Title: **Generative AI and Large Language Models**	
Course Code: **CS40003**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PE**	Pre-requisites: **AI & NLP**

Course Learning Objectives (CLO):

To introduce a generative foundation model. To learn custom applications using large language models (LLMs). To employ advanced techniques to generate models. To enhance software development through artificial intelligence and deep learning advancements. To use Python and its tools for model building.

Course Contents:

UNIT I:

Generative AI Fundamentals: "Drawing" Data from Models, Applications of AI, Probability Rules and Bayes' Theorem, Requirements of Generative Models, Style Transfer and Image Transformation, Challenges of Generative Models. Building Blocks of Deep Neural Networks: Perceptrons, Multi-layer Perceptrons and Back propagation, Convolution and Recursive Networks for Seeing, Convolutional Architectures, CNNs, AlexNet and its Architecture, CNN Innovations, RNNs and LSTMs, Optimization Algorithms – Gradient Descent, ADAM, AdaGrad, Nesterov Momentum, Xavier Initialization.

UNIT II:

Teaching Networks to Generate Digits: Retrieving and Loading Database, Modeling data with uncertainty, Boltzmann Machines, Hopefield Networks, Deep Belief Networks, Creating RBM, Creating DBN.

Painting Pictures with Neural Networks Using VAEs: Variational Auto encoders (VAEs), Encodings of Images, Reparameterization Tricks, Inverse Auto regression, Importing Some Benchmark Dataset (CIFAR), Creating Networks using TensorFlow2.

UNIT III:

Image Generation with GANs: Generative Adversarial Networks (GANs)-Taxonomy, the discriminator model, the generator model, Training GANs. Vanilla GAN, Deep Convolutional GAN, Conditional GAN, Wasserstein GAN, Progressive GAN, Challenges.

Style Transfer with GANs: Paired style transfer using pix2pix GAN – The

U-Net generator, The Patch-GAN discriminator, Loss, Training pix2pix GAN, Use cases. Unpaired style transfer using Cycle GAN–Adversial loss, Cycle loss, Identity loss, Overall loss. DiscoGAN, DualGAN.

Deep fakes with GANs: Overview, Facial Action Coding System (FACS), 3D Morphable Model, Facial Landmarks detection, Workflow, Replacement using auto-encoders, Re-enactment using pix2pix, Ethical and Technical Challenges.

UNIT IV:

Methods for Text Generation: Representing Text – Bag of Words, Distributed representation, Word2vec, GlovVe, FastText. LSTMs and Language Modeling (Character-level), Decoding Strategies – Greedy decoding, Beam Search, Sampling. Stacked LSTMs, Bidirectional LSTMs. Transformers, GPT.

UNIT V:

Composing Music with Generative Models: Music generation using LSTMs, GANS; Polyphonic music generation – Jamming model, Composer model, Hybrid model, Temporal model. Composing Video with Generative AI and Applications: Reinforcement learning, Inverse reinforcement learning, Adversarial learning. Recent research in generative AI, spanning biotechnology, fluid mechanics, video, and text synthesis.

Textbooks:

1. Generative AI with Python and TensorFlow2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models, Joseph Babcock and Raghav Bali, Packt Publishing Limited (2021),
2. Introduction to Large Language Models Generative AI for Text, Tanmoy Chakraborty,Wiley India.

Reference Books:

1. Altaf Rehmani, Generative AI for everyone: Understanding the essentials and applications of this breakthrough technology, Bluerose Publishers Pvt. Ltd., 2024.
2. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems, Third Edition, O'Reilly Publisher, 2022.

Course Outcomes (CO):

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

CO1: Assess the fundamentals of Deep Neural Networks.

CO2: Learn the models to generate digits and photographs using GANs.

CO3: Use GANs to generate Images and videos with different types.

CO4: Implementing generation models, and integrate different features to it.

CO5: Generate texts, and paragraphs for certain specific situations.

CO6: Represent GANS using Python and Deep Learning tools.

Course Title: **Blockchain Technology**	
Course Code: **CS40005**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PC**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the fundamentals and design principles of blockchain. To understand building a distributed application. To understand blockchain consensus mechanism.

Course Contents:

UNIT I:

Blockchain Fundamentals: Fundamental of Blockchain Technology, Distributed Versus Centralized Versus Decentralized, Cryptographic Hash Functions and Properties, Hash Pointer, Merkle Tree, Digital Signatures, Evolution of the Blockchain Technology, Chain of Blocks, Components of Blockchain, Types: Public, Private, and Consortium, Achieving Consensus.

UNIT II:

Cryptocurrency Fundamentals: Basic Cryptocurrency System, Cryptocurrency Wallets, UTXO Model, Bitcoin Cryptographic Keys, Bitcoin Transactions, Bitcoin Mining, Mining Difficulty, Forks and its Resolution, Permissioned and Permissionless Consensus, Proof of Work, Proof of Stake, Proof of Burn, Proof of Elapsed Time.

UNIT III:

Distributed Consensus: Permissioned Blockchain: Design issues for Permissioned blockchains, Key Characteristics, State Machine Replication, Consensus Algorithms for Permissioned Blockchain - PAXOS, RAFT, Practical Byzantine Fault Tolerance (PBFT).

UNIT IV:

Altchains and Applications: Ethereum and its Components, Ethereum Virtual Machine (EVM), Smart Contracts, Introduction to Hyperledger and Hyperledger Fabric, Chaincode, Transaction in Hyperledger Fabric. Bitcoin Vs Ethereum Vs Hyperledger. Application of Blockchain in Supply Chain Management, Healthcare, Environment, IoT and Smart Cities, Finance, Education, E-Governance.

Textbooks:

1. Imran Bashir. Mastering Blockchain, third edition, Packt Publishing, 2020.
2. Chandramouli Subramanian, Asha A George. Blockchain Technology, Universities Press,2020.

Reference Books:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, Bitcoin and cryptocurrency technologies: a comprehensive introduction, Princeton University Press, 2016.
2. Lorne Lantz & Daniel Cawrey, Mastering Blockchain Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, O'REILLY Publications.
3. Asharaf S, Franlik John. Blockchain Technology: Algorithms and Applications, Wiley, 2023.
4. Andreas M. Antonopoulos, Gavin Wood, Mastering Ethereum, Building Smart Contract and Dapps, O'reilly.

Course Outcomes (CO):

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

CO1: Explain the basic concepts and design principles of blockchain.

CO2: Explore the working principles of bitcoin.

CO3: Apply permissionless consensus mechanism in a distributed environment.

CO4: Assess the potential benefits and challenges of integrating blockchain in specific use cases.

CO5: Analyze consensus algorithms for permissioned blockchain systems.

CO6: Apply blockchain technologies to design secure applications.

Course Title: **Software Testing and Automation**	
Course Code: **CS40007**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the criteria for test cases. To Develop and design test cases. To Analyse test management and test automation techniques. To Assess test metrics and measurements. To Design and validate website testing.

Course Contents:

UNIT I:

Introduction: Testing as an Engineering Activity, Testing as a Process, Testing Maturity Model, Testing axioms, Basic definitions, Software Testing Principles, The Tester‘s Role in a Software Development Organization, Origins of Defects, Cost of defects, Defect Classes, The Defect Repository and Test Design, Defect Examples, Developer/Tester Support of Developing a Defect Repository.

UNIT II:

Test Case Design Strategies: Test case Design Strategies, Using Black Box Approach to Test Case Design, Boundary Value Analysis, Equivalence Class Partitioning, State based testing, Cause-effect graphing, Compatibility testing, User documentation testing, Domain testing, Random Testing, Requirements based testing, Using White Box Approach to Test design, Test Adequacy Criteria, Static testing vs. Structural testing, Code functional testing, Coverage and Control Flow Graphs, Covering Code Logic, Paths, Code complexity testing, Additional White box testing approaches, Evaluating Test Adequacy Criteria.

UNIT III:

Levels of Testing: The need for Levels of Testing, Unit Test, Unit Test Planning, Designing the Unit Tests, The Test Harness, Running the Unit tests and Recording results, Integration tests, Designing Integration Tests, Integration Test Planning, Scenario testing, Defect bash elimination System Testing, Acceptance testing, Performance testing, Regression Testing, Internationalization testing, Ad-hoc testing, Alpha Beta Tests, Testing OO systems, Usability and Accessibility testing, Configuration testing, Compatibility testing, Testing the documentation, Website testing.

UNIT IV:

Test Management: People and organizational issues in testing, Organization structures for testing teams, Testing services, Test Planning, Test Plan Components, Test Plan Attachments, Locating Test Items, Test management, Test process, Reporting Test Results, Introducing the test specialist, Skills needed by a test specialist, Building a Testing Group, The Structure of Testing Group, The Technical Training Program.

UNIT V:

Test Automation: Software test automation, skills needed for automation, Scope of automation, Design and architecture for automation, Requirements for a test tool, Challenges in automation, Test metrics and measurements – project-progress and productivity metrics.

Textbooks:

1. Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing: Principles and Practice", Pearson Education, 2006.
2. Ron Patton, "Software Testing", Second Edition, Second Edition, Sams Publishing, 2007.

Reference Books:

1. Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2003.
2. Edward Kit, "Software Testing in the Real World – Improving the Process", O'Reilly(Sams), 1995.
3. Boris Beizer, "Software Testing Techniques", Second Edition, Wiley, 1990.
4. Aditya P. Mathur, "Foundations of Software Testing Fundamental Algorithms and Techniques", Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

Course Outcomes (CO):

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

CO1: Identify suitable tests to be carried out.

CO2: Design test cases suitable for a software development for different domains.

CO3: Prepare test planning based on the document.

CO4: Document test plans and test cases designed.

CO5: Apply automatic testing tools.

CO6: Develop and validate a test plan.

Course Title: **Time Series Data Analysis**	
Course Code: **CS40009**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **PE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To introduce the fundamentals of time series analysis, stationary processes, and ARMA/ARIMA models. It aims to understand spectral analysis, seasonal models, multivariate time series, and state-space models. It also enables students to apply suitable forecasting algorithms to solve practical forecasting problems.

Course Contents:

UNIT I:

Introduction to time series: Introduction: Examples of time series, Stationary models and auto correlation function, Estimation and elimination of trend and seasonal components. Stationary Process and ARMA Models: Basic properties and linear processes, Introduction to ARMA models, Properties of sample mean and autocorrelation function, Forecasting stationary time series, ARMA (p, q) processes, ACF and PACF, Forecasting of ARMA processes.

UNIT II:

Spectral Analysis: Spectral densities, Time-invariant linear filters, the spectral density of an ARMA process. Modeling and Forecasting with ARMA Processes: Preliminary estimation, Maximum likelihood estimation, Diagnostics, Forecasting, Order selection.

UNIT III:

Non-stationary and Seasonal Time Series Models: ARIMA models, Identification techniques, Unit roots in time series, Forecasting ARIMA models, Seasonal ARIMA models, Regression with ARMA errors.

UNIT IV:

Multivariate Time Series: Second-order properties of multivariate time series, Estimation of the mean and covariance, Multivariate ARMA processes, Best linear predictors of second-order random vectors, Modeling and forecasting.

UNIT V:

State-Space Models: State-space representations, The basic structure model, State-space representation of ARIMA models, The Kalman Recursions, Estimation for state-space models.

Forecasting Techniques: The ARAR algorithm, The Holt-Winter algorithm, The Holt-Winter seasonal algorithm.

Textbooks:

1. Brockwell, Peter J. and Davis, Richard A. (2002). Introduction to Time Series and Forecasting, 3rd edition. Springer-Verlag, New York.
2. Box, G. E. P., Jenkins, G.M. and Reinsel, G. C. (1994). Time Series Analysis: Forecasting and Control, Third Edition, Prentice Hall, New Jersey.

Reference Books:

1. Chatfield, C. (1996). The Analysis of Time Series, 5th edition, Chapman and Hall, New York.
2. Shumway, R.H., Stoffer, D.S. (2006). Time Series Analysis and Its Applications (with R examples). Springer-Verlag, New York.
3. James D. Hamilton (1994). Time Series Analysis, 1st Edition, Princeton University Press.
4. GalitShmueli and Kenneth C. Lichtendahl Jr (2016). Practical Time Series Forecasting with R: A Hands-On Guide, 2nd Edition, Axelrod Schnall Publishers.

Course Outcomes (CO):

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

CO1: Explain basic concepts of time series and ARMA models.

CO2: Apply spectral analysis for stationary time series modeling.

CO3: Analyze ARIMA and Seasonal ARIMA models.

CO4: Evaluate multivariate time series forecasting models.

CO5: Apply state-space models and Kalman recursions.

CO6: Develop forecasts using ARAR and Holt-Winter algorithms.

Course Title: **Fundamentals of Software Engineering**	
Course Code: **CS40002**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **Minor**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the software engineering practice. To understand the software engineering process models. To understand design engineering and web applications. To gain knowledge of software testing. To understand software project management.

Course Contents:

UNIT I:

Introduction & Process Models: Software Engineering: Role, Characteristics, Software Crisis in Software Processes & SDLC Process Models: Waterfall, Prototyping, Spiral, Iterative. Quality Attributes of Software.

Assessment: Selection of a real-world problem + brief SDLC model justification (team-based)

UNIT II:

Requirements & Design: Requirement Engineering: Elicitation, Analysis, Documentation SRS (IEEE standards overview) Modeling: Data Flow Diagrams. Introduction to Software Design Architecture.

Assessment: SRS Document submission for team project.

UNIT III:

Software Quality & Testing Quality Concepts & SQA basics Verification vs Validation Testing: Unit, Integration, System, Acceptance Black-box & White-box testing (intro level) Basic testing strategies.

Assessment: Test case design for project.

UNIT IV:

Project Management & Metrics Project Planning & Estimation (basic models) Scheduling (Gantt basics) Risk Management Introduction to Software Metrics Software Maintenance (overview)

Assessment: Mini project plan + risk mitigation report

Textbooks:

1. Rajib Mall, "Fundamentals of Software Engineering", Fifth Edition, PHI Publication, 2009.
2. R. S. Pressman, "Software Engineering : A Practitioners Approach", Eighth Edition, McGrawHill, 2010.

Reference Books:

1. Pankaj Jalote, "Software Project Management in Practice", Pearson Education, New Delhi, 2002.

Course Outcomes (CO):

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

CO1: Identify appropriate software process models for developing real life projects.

CO2: Assess each module given the overall software engineering practice.

CO3: Enhance the software project management skills.

CO4: Comprehend the systematic methodologies involved in software engineering.

CO5: Work ethically in a team as well as independently on software projects and adapt to the ever-changing dynamic real-world situations.

CO6: Design and develop a software product in accordance with software engineering principles.

Course Title: **Python Programming**	
Course Code: **CS49002**	Contact Hours: **L-T-P-Cr : 0-1-2-2**
Course Type: **Minor**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To familiarise students with the Python programming, including variables, strings, lists, and control flow structures. To develop problem-solving skills using loops (FOR and WHILE) and logical operators. To introduce fundamental data structures like lists and dictionaries, and their practical applications in data handling and storage. To provide hands-on experience with object-oriented programming concepts, file handling, and database creation in Python.

UNIT I:

Setting up Python environment and learn how to use it. Handling strings, input() and print() statements. Variables, assignment, and string concatenation. Introduction to List methods, List slicing, and IF/ELSE constructs.

UNIT II:

Introduction to FOR loop. FOR loop with IF/ELSE statement. Handling integer, floats, and introduction to arithmetic operations. Introduction to the Python module RANDOM, finding the probability distribution of the outcomes of throwing two or more dice.

UNIT III:

The WHILE loop and the logical operators AND, OR, NOT, NOT IN. Introduction to the data type Boolean. Lists and arithmetic operations, nested FOR loops , list FLATTENING.

UNIT IV:

Introduction to the data type DICTIONARY and list of dictionaries. Application of dictionaries. User defined FUNCTION and DATABASE creation.

UNIT V:

Working with files: reading from a file, working with a file's contents, writing to a file , storing data. Creating and using a CLASS.

Textbooks:

1. Serena Bonaretti, Learn Python with Jupyter, www.learnpythonwithjupyter.com
2. Eric Matthes, Python Crash Course, no starch press, 2023.

Reference Books:

1. Allen B. Downey, Think Python, O'Reilly, 2024
2. Zed A. Shaw, Learn Python the Hard Way, Pearson Education, 2024.

Course Outcomes (CO):

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

CO1: Set up a Python environment and effectively use basic programming constructs.

CO2: Demonstrate proficiency in using loops (FOR, WHILE) and conditional statements.

CO3: Implement Python's built-in data structures and apply them in real-world scenarios.

CO4: Gain the ability to design user-defined functions, create and use classes, and manage file operations.

CO5: Design and develop different models to usable in day to day applications.

CO6: Create applications to solve daily tasks for individuals as well as en enterprise level.

Course Title: **Organizational Behaviour**	
Course Code: **HS 20220**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This course shall guide the students to learn the basic concepts of Organizational Behaviour and its applications in contemporary organizations. Further, it help them to describe how people behave under different conditions and understand why people behave as they do. The students would be in a position to synthesize related information and evaluate options for the most logical and optimal solution such that they would be able to predict and control human behaviour and improve results. Lastly, this course would help the students to understand how individual, groups and structure have impacts on the organizational effectiveness and efficiency.

Course Contents:

UNIT I:

Introduction to Organizational Behaviour: Organizational Behaviour-nature and scope; Need for studying OB; contributing disciplines to OB; evolution of OB; OB approaches and models; OB opportunities and disruptions.

UNIT II:

Individual Perspective Part 1: Introduction to Individual behaviour; Personality- concept, determinants, types and theories/models; Personality and OB; Perception- meaning, perceptual process, factors affecting perception; perception and its application in OB; Attitude- nature, components, formation and types; Values- concepts, types and formation; attitude, values and behaviour.

UNIT III:

Individual Perspective Part 2: Learning- meaning, determinants, theories and principles; learning and behaviour; Motivation- nature, importance, process and theories; managerial implication of motivation- job design, quality of work life and employee engagement; organizational citizenship behaviour- meaning, theoretical perspective, determinants and predictors.

UNIT IV:

Group Perspective: Foundation of group behaviour; meaning and characteristics of group; why do people form and join groups; types and groups; stages of group development; group decision making; Team building- meaning and types of team; team building process; Meaning, sources and types of conflict; conflict management and negotiation strategies; Leadership- meaning and importance; differentiating between leader and manager; leadership styles; leadership theories.

UNIT V:

Organizational Perspective: Organizational structure- meaning and elements; Organizational culture- meaning, types and functions of culture; creating, sustaining and changing a culture; Organizational change- meaning and need; ; managing resistance to change; Organizational development- meaning, objectives, models and interventions.

Textbook:

1. Organizational behaviour texts and cases, Dr. S..S. Khanka, Sultan Chand, OB text and cases S.S. Khanka, S chand, 2022.
2. Organizational Behaviour, Stephen P. Robbins, Timothy A. Judg, Neharika Vohra Pearson, 18th edition, 2018.

Reference Books:

1. Organizational Behaviour and Work, Fiona M. Wilson, Oxford University Press, 2014.
2. Organizational Behaviour, K. Aswathappa, Himalaya Publishing House, 2013.

Course Outcomes (CO):

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

CO1: Know about organization, organizational behaviour, it's nature, scope and significance.

CO2: Develop their personality as per industry requirement.

CO3: Apply motivational techniques to make the employees work with confidence and satisfaction.

CO4: Develop different leadership styles to adjust themselves in different organizational situations.

CO5: Improve the knowledge of group behaviour and techniques of group decision making.

CO6: Apply the concepts for managing changes in organization as well as the development of an organization's human resources.

Course Title: **Human Resource Management**	
Course Code: **HS 20222**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This course aims at providing conceptual knowledge on human resource management that will be useful for a manager of an organization. It also understands employer and employee relationship in order to achieve organizational objectives effectively. It starts with hiring and continues till retention. It also focuses on enabling the students to integrate the understanding of various HR concepts along with the domain concept in order to take correct business decisions.

Course Contents:

UNIT I:

Introduction to HRM: Introduction, scope, objectives; Managerial and operational functions of Management; HRM as a source of competitive advantage; Qualities and role of HR managers.

UNIT II:

Planning and Acquiring Manpower: Human resource planning-Introduction, objectives, need, importance; Factors, Process and barriers of HRP; Job analysis- concept, objective and Process; Meaning, process and sources of recruitment; Factors of effective recruitment; Meaning and process of selection; Competency mapping for selection decision; Induction and socialization; recent trends in recruitment and selection.

UNIT III:

Developing Manpower: Training- nature, need, objectives, importance; areas of training; training process- identifying training need, designing a training program; methods and techniques of training; evaluating training effectiveness; Role specific and competency based training; career planning and development-meaning, objective and process.

UNIT IV:

Managing Performance and Compensation: Performance appraisal-concept, objectives and importance of performance appraisal; Process of performance appraisal; Methods of performance appraisal; Problems in performance appraisal; Potential Appraisal; Components of compensation; objectives and factors affective Wage and salary administration; methods of wage payment; process of wage determination; Pay band compensation system.

UNIT V:

Maintaining and Retaining Human Resources: Industrial Relation-concept, objective and approaches: Reasons for poor industrial relation; Measures for improving industrial relation; Industrial Dispute- nature, causes, prevention and settlement; meaning, objectives, importance and conditions for successful collective bargaining; Workers Participation in management- concept, objectives, forms and measures; Discipline and Grievance- Statutory provisions concerning discipline; causes and machinery for redressal of grievances.

Textbook:

1. Human Resource Management, P. Jyoti & D. N. Venkatesh, Oxford Publication.
2. Human Resource Management, Gary Dessler and Biju Varkkey, Pearson Education, 2020.

Reference Books:

1. Human Resource Management Text and Cases by S S Khanka, S.Chand and company Limited, 2022.
2. Human Resource Management. K. Aswathappa, Mc Graw Hill Education, 2013.
3. Personnel and Human Resource Management. P. Subba Rao, Himalaya Publishing House, 2022.

Course Outcomes (CO):

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

CO1: Learn the various functions of management, personal and professional qualities of a manager in order to manage human resource of an organization effectively.

CO2: Understand the process of acquiring human resource through effective planning, recruitment and selection process.

CO3: Apply different training and development methods for organizational effectiveness.

CO4: Analyse the importance of performance appraisal and equitable pay for the growth of both individual and organization.

CO5: Inculcate the sense of inter personal relation required in professional front in handling employer-employee relation effectively for achievement of organizational objectives.

CO6: know the technique of managing and being managed by the organization.

Course Title: **Indian Psychology**	
Course Code: **PS 20102**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

CLO1: Develop the philosophical and cultural foundations of Indian Psychology, emphasizing its distinct worldview and indigenous roots.

CLO2: Describe and apply key psychological concepts from Indian traditions, including epistemology (ways of knowing), ontology (nature of reality), and models of the self.

CLO3: Examine the Purusharthas and Ashrama system to analyze human life goals, developmental stages, and their relevance to personal values and purpose.

CLO4:Compare Indian and Western psychological paradigms, critically evaluating their assumptions, methods, and cultural implications.

CLO5: Integrate insights from Indian psychological frameworks to develop culturally sensitive perspectives on human behavior, well-being, and self-development.

Course Contents:

UNIT I:

Foundations of Indian Psychology: Meaning and scope of Indian Psychology Historical evolution of Indian thought systems Overview of Shad-Darshanas (Six Schools of Indian Philosophy) Indian Psychology vs. Western Psychology: Key differences.

UNIT II:

Human Goals and Life Stages: The Four Purusharthas: Dharma, Artha, Kāma, Moksha The Ashrama System: Brahmacharya, Gṛihastha, Vānaprastha, Sannyāsa.

UNIT III:

Key Psychological Concepts and Ways of Knowing: Atman, Manas, Buddhi, Chitta, Ahamkara Indian epistemology: Pratyaksha (perception), Anumana (inference), Shabda (scriptural testimony) Ontology of Indian Psychology: Self, mind, and consciousness.

UNIT IV:

Psychological Insights from Indian Traditions: Patanjali's Yoga Sutras and the Eightfold Path; Buddhist Psychology: Thought, mind, consciousness; Bhagavad Gita: Emotional regulation (Samatvam), Dharma, Niskama Karma Paths of Yoga: Karma, Jnana, Bhakti, Dhyana.

Suggested Readings:

1. Bhawuk, D. P. S. (2011b). Epistemology and ontology of Indian psychology. In International and cultural psychology(pp. 163–184). https://doi.org/10.1007/978-1-4419-8110-3-9
2. Cornelissen, M., Misra, G., & Varma, S. (2010). Foundations of Indian psychology: Theories and concepts (vol.1). Pearson Education India.

3. Dalal, A. K. (2002). Psychology in the Indian tradition. Psychology and Developing Societies, 14(1), 27–43.
4. Dalal, A. K., & Misra, G. (2010b). The core and context of Indian psychology. Psychology and Developing Societies, 22(1), 121–155. https://doi.org/10.1177/097133360902200105
5. Misra, G. (2001). Indigenous psychology: A critique of the Western perspective. Indian Journal of Psychology, 76(1), 1–12.
6. Paranjpe, A. C. (1998). Theoretical psychology and the study of Indian thought. Journal of Indian Psychology, 16(2), 1–12.
7. Paranjpe, A. C. (2021). Patañjali: The most distinguished psychologist from India. Psychological Studies, 66(4), 369–379. https://doi.org/10.1007/s12646-021-00622-x
8. Rao, R. K., & Paranjpe, A. C. (2023). Psychology in the Indian tradition. DK Printworld..
9. Suar, D. (2013). Valuing the values. In D. P. Chattopadhyaya & G. Misra (Eds.), Psychology and psychoanalysis (vol. 13, part 3, pp. 957-988). New Delhi: Centre for Studies in Civilization for the Project of History of Indian Science, Philosophy and Culture.

Course Outcomes (CO):

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

CO1: Define core principles and philosophical underpinnings of Indian Psychology.

CO2: Understand the historical evolution and major schools of thought.

CO3: Demonstrate the indigenous psychological constructs such as Atman, Buddhi, Chitta, and their relevance to self and consciousness.

CO4: Evaluate the Indian frameworks of motivation and life stages.

CO5: Analyze personal and societal development.

CO6: Create Indian and Western psychological approaches, compare the approaches recognizing their implications for well-being, education, and emotional regulation.

Course Title: **Science of Happiness and Well-being**	
Course Code: **PS 20101**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

CLO1: Develop an understanding of key concepts, theories, and research in happiness and positive psychology.

CLO2: Strengthen knowledge of biological, psychological, and socio-cultural factors influencing happiness and well-being.

CLO3: Expand the ability to analyze the relationship between happiness and life outcomes such as health, productivity, and relationships.

CLO4: Acquire skills to evaluate the role of genetic, environmental, and intentional factors in shaping happiness.

CLO5: Enhance the capacity to apply and integrate evidence-based practices to improve personal and social well-being.

Course Contents:

UNIT I:

Introduction to Science of Happiness and Well-being: What is happiness? Measurement of happiness, Benefits of happiness, Theories of Happiness, Determinants of Happiness, Can we increase our own happiness? Happiness interventions; Happiness Practice 1: Assessment of Life satisfaction and affects; Practice 2: Three Good Things, multifaceted nature of well being . concept of flourishing ; collective well being ; inclusive well being.

UNIT II:

Factors Influencing Happiness: Biological factors: genetics, brain structures, neurotransmitters, and hormonal influences on happiness, Psychological factors: personality traits, cognition, motivation, emotional regulation, and coping styles, Socio-cultural factors: family, relationships, social support, culture, and societal norms.

UNIT III:

Social Relations and Happiness: How humans are wired for relationships? Affiliation, affection, and attachment, Happiness and romance, family, parenting, friends, and community; Practice 2: Active Listening; Practice 3: Assessment of

Social Relations and Empathy.

UNIT IV:

Prosocial Behaviour & Positive Environments: Altruism, Gratitude, Forgiveness, Self-Compassion, Flow, Optimism. Happiness Practice 4: Self-compassionate Letter; Goal setting and optimism; Happiness Practice 5: Self- compassionate Letter; Goal setting and optimism; Happiness Practice 6: Best Possible Self, tyaga, anasakti as concepts related to well-being and sustainability.

Suggested Readings:

1. Baumgardne, S.M., Crothers, M., Misra, G., & Saini, D. (2024). Positive Psychology. Pearson Education.
2. Csikszentmihalyi, M., & LeFevre, J. (1989). Optimal experience in work and leisure. Journal of
3. Personality and Social Psychology, 56(5), 815-822.
4. Davidson, R. J., et al. (2003). Alterations in brain and immune function produced by mindfulness meditation. Psychosomatic Medicine, 65(4), 564 570.
5. Dunn, E. W., Aknin, L. B., Norton, M. I. (2008). Spending money on others promotes happiness.
6. Science, 319(5870), 1687-1688.
7. Eisenberger, N. I., Lieberman, M. D., & Williams, K. D. (2003). Does rejection hurt? An fMRI study of social exclusion. Science, 302(5643), 290-292.
8. Emmons, R. A. & McCullough, M. E. (2003). Counting blessings versus burdens: An experimental investigation of gratitude and subjective well-being in daily life. Journal of Personality and Social Psychology, 84(2), 377 389.
9. Goetz, J., Simon-Thomas, E., & Keltner, D. (2010). Compassion: An evolutionary analysis and empirical review. Psychological Bulletin, 136(3), 351 374.
10. Goleman, D. & Boyatzis, R (2008). Social intelligence and the biology of leadership. Harvard Business Review. 1-8. www.hbr.org
11. Helliwell, J., Layard, R., & Sachs, J. (2018). World happiness report 2018. Sustainable Development Solutions Network. https://s3.amazonaws.com/happiness-report/2018/WHRweb. pdf

12. Kahneman, D. (1999). Objective happiness. In D. Kahneman, E. Diener & N. Schwarz (Eds.), Well-being: Foundations of hedonic psychology (pp. 3-25). New York: Russell Sage Foundation Press.
13. Keltner, D., & Haidt, J. (2003). Approaching awe: a moral, aesthetic, and spiritual emotion. Cognition and Emotion, 17, 297-314.
14. Killingsworth, M. & Gilbert, D. (2010). A wandering mind is an unhappy mind. Science, 330(6006), 932.
15. Lyubomirsky, S. (2008). The how of happiness (HOH). Penguin Press.
16. Lyubomirsky, S., & Layous, K. (2013). How do simple positive activities increase well-being? Current Directions in Psychological Science, 22(1), 57-62.
17. Lyubomirsky, S., King, L., & Diener, E. (2005). The benefits of frequent positive affect: Does happiness lead to success. Psychological Bulletin, 131(6), 803 55.
18. Nelson, S. K., Kushlev, K., & Lyubomirsky, S. (2014). The pains and pleasures of parenting: When, why, and how is parenthood associated with more or less wellbeing? Psychological Bulletin, 140(3), 846-895.
19. Peterson, C., & Seligman, M.E. P. (2004). Character strengths and virtues. New York: Oxford University Press.
20. Snyder, C.R. & Lopez, S.J. (Ed. 2005). Handbook of positive psychology. New York: Oxford University Press.
21. Tabibnia, G. & Lieberman, M.D. (2007). Fairness and cooperation are rewarding. Annals of the New York Academy of Sciences, 1118, 90-101.
22. Tsang, J., McCullough, M. E., & Fincham, F. D. (2006). The longitudinal association between forgiveness and relationship closeness and commitment. Journal of Social and Clinical Psychology.

Course Outcomes (CO):

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

CO1: Explain foundational concepts in the science of happiness, including its definitions, measurement, methods, key theories, and the psychological and physiological benefits of happiness.

CO2: Evaluate the biological, psychological, and socio-cultural factors that influence individual and collective happiness, with a focus on concepts such as cooperation, forgiveness, and trust.

CO3: Demonstrate an understanding of happiness-enhancing habits by engaging in experiential practices and reflective assignments aimed at integrating positive psychology into everyday life.

CO4: Analyze the role of self-compassion, flow, and optimism in promoting mental health, goal setting, and adaptive responses to life's challenges.

CO5: Apply evidence-based happiness interventions (e.g., Three Good Things, Gratitude Letters, SelfCompassion Exercises) to enhance personal well-being and emotional resilience.

CO6: Practice and cultivate gratitude through structured exercises that foster appreciation, deepen social bonds, and improve subjective well-being.

Course Title: **Climate Change Narratives**	
Course Code: **HS30052**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The objective of this course is to study climate fiction to demonstrate new ways of thinking about climate change and invoke opportunities for imagining more just and resilient futures. This course will enable skills for thinking, writing, and speaking critically about both literature and climate change. Moreover, it will enable the learners to analyze the specific formal and stylistic conventions of literary and cultural texts and situate those texts within broader debates and discourses - scientific, historical, and political - about climate change.

Course Contents:
UNIT I:
Introduction to Climate Change:

Topics of Discussion:

- The New Climate War: The Fight to Take Back Our Planet, Michael E Mann
- Time Capsule Found on the Dead Planet, Margaret Atwood
- The Drowned World, JG Ballard
- Environmental Crisis and Hindu Religion, O.P. Dwivedi and B.N. Tiwari.

UNIT II:

Impacts of Climate Change:

Topics of Discussion:

- “Evidence for Climate Change,”: Explore the CEEW project (Blog)Research present or future climate change impacts in your own community.
- Diary of an Interesting Year,” Helen Simpson “The Tamarisk Hunter,” Paolo Bacigalupi.
- “The Weatherman,” Holly Howitt.
- “Living Mountain”: The Fable of our times Amitav Ghosh.

UNIT III:

Language of Climate Communication in Literature:

Topics of Discussion:

- I’m not a plastic bag, Rachel Hope Alison.
- Leila, Prayag Akbar.

Text Books:

1. Rachel Hope Alison. I’m Not a Plastic Bag. New York: Archaia, 2012. ISBN-10 : 1936393549.
2. Prayag Akbar. Leila. Simon and Schuster, 2017. ISBN 978-0-571-34133-7.
3. Ed. by Mark Martin (Editor), Bill McKibben (Introduction), Margaret Atwood (Contributor), Paolo Bacigalupi (Contributor), T.C. Boyle (Contributor). I’m With the Bears: Short Stories from a Damaged Planet. Verso, 2011. ISBN-10 : 9781844677443.
4. J.G. Ballard. The Drowned World. Reprint Fourth Estate: United Kingdom. ISBN-0007221835
5. Amitav Ghosh. Living Mountain: The Fable of Our times. India: Fourth State India. 9354898874
6. Michael E Mann. The New Climate War: The Fight to Take Back Our Planet. USA: Public Affairs. 1541758234
7. O.P. Dwivedi and B.N. Tiwari, Environmental Crisis and Hindu Religion , NewDelhi: Gitanjali Publishing House, 1987.

Reference Books:

1. Maslin, Mark. Climate Change: A Very Short Introduction, Third Edition. Oxford: Oxford UP, 2014. ISBN: 9780198719045.
2. Rich, Nathaniel. Odds Against Tomorrow. New York: Farrar, Straus and Giroux, 2013. ISBN: 9781250.

Course Outcomes (CO):

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

CO1: Draw on relevant political, historical, and scientific information to place literary and cultural texts within wider debates and discourses about climate change.

CO2: Identify how literary and cultural texts complement or challenge understandings of climate change.

CO3: Reflect on understandings of and feelings about climate change.

CO4: Employ logic, creativity, and interpretive skills to produce persuasive and imaginative arguments about literature, culture, and climate change.

CO5: To create a report on climate concerns.

CO6: To evaluate the impact of climate change on the local communities.

Course Title: **International Economics**	
Course Code: **ES40436**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The course aims to equip students with a sound understanding of the theoretical concepts and practical aspects of international trade, including the essentials of import and export procedures. It also seeks to develop knowledge of the Balance of Payments, trade policies, and the role of institutions such as the International Monetary Fund, World Bank Group, and World Trade Organization, while enabling students to understand foreign exchange mechanisms and apply these concepts to real-world international trading processes.

Course Contents:

UNIT I:

Theories of International Trade: Classical Theories of International Trade-

Mercantilism, Absolute Advantage, Comparative advantage Theory, Gains from international trade; Terms of trade; Theory of Reciprocal Demand or Equilibrium terms of trade; Modern Theories of International Trade-Heckscher-Ohlin theory; Case studies.

UNIT II:

Balance of Payments and International Organizations Balance of Payments: Introduction of BoP; Structure and components; Disequilibrium in BOP and adjustment mechanisms. World Bank Group; International Monetary Fund(IMF); World Trade Organasation(WTO).

UNIT III:

Trade Policies and Regional Integration: Free trade and protection; Types and effects of trade policies; Regional trade agreements; Trade creation vs Trade diversion; Trade Blocs; India's EXIM policies and budget analysis; Case studies.

UNIT IV:

Exchange rate theories and Determination: Fixed and flexible exchange rate; Factors affecting exchange rate; Exchange rate determination; Theories of foreign exchange (Mint parity, Purchasing Power Parity (PPP) and Balance of payment theory); Strong Vs weak currency; Case studies.

Textbook:

1. R. R Paul, Money Banking and International Trade, Kalyani Publishers; 12th edition,2015, ISBN-10 : 932725774X ISBN-13 : 978-9327257748

Reference Books:

1. Södersten, B. & Reed, G., International Economics, Palgrave Macmillan, Latest Edition
2. Krugman, P.R., Obstfeld, M. & Melitz, M., International Trade: Theory and Policy, Pearson, Latest Edition
3. Salvatore, D., International Economics, Wiley, Latest Edition
4. Mannur, H.G., International Economics, S. Chand Publishing, Latest Edition
5. Carbaugh, R.J., International Economics, Cengage Learning, Latest Edition
6. Mithani, D.M., International Economics, Himalaya Publishing House, Latest Edition
7. World Trade Organization, Protectionism and the Future of Global Trade, WTO Publications, Latest

8. World Trade Organization, Global Trade Outlook and Statistics, WTO Publications, Latest
9. International Monetary Fund, World Economic Outlook, IMF Publications, Latest.

Course Outcomes (CO):

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

CO1: Describe classical and modern theories of international trade.

CO2: Explain the gains from trade, terms of trade, and reciprocal demand using appropriate economic concepts.

CO3: Examine the structure and adjustment mechanisms of Balance of Payments.

CO4: Analyse the role of IMF, World Bank, and WTO in global trade.

CO5: Evaluate trade policies, regional integration, EXIM policy, and FDI in India in the context of global trade dynamics.

CO6: Interpret exchange rate systems, theories and critically assess factors affecting exchange rate determination in the global economy.

Course Title: **Sustainable Development**	
Course Code: **ES40438**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The course aims to introduce students to the concepts, principles, and global frameworks of sustainable development while providing an understanding of major theories of economic growth and development. It also familiarizes students with important indicators used to measure economic growth, human development, and sustainability, and develops their analytical ability to evaluate contemporary challenges to sustainable development and formulate appropriate policy responses.

Course Contents:

UNIT I:

Introduction to Sustainable Development: Concept, meanings, scope, and definitions of sustainable development – Principle of Sustainable Development – The pillars of sustainable development – Approaches to Sustainable

Development: Status Quo Approach, Sustainable Development Goals (SDGs) - United Nations Global Compact. Significance Sustainability as a key driver of Innovation. Introduction to National and Global Reporting Standards. Green Account Approach.

UNIT II:

Some Basic Theories of Economic Growth and Development: Trade-off between Growth and Sustainable Development. Classical Growth Theory (Smith, Ricardo, Malthus, Mills); Neoclassical Growth Theory (Solow); Stages of Growth Theory (Rostow); Big Push Theory (Rosenstein-Rodan); Balanced vs. Unbalanced Growth (Nurkse, Hirschman); Endogeneous Growth Model; Paul Krugman Model; Sen's Theory.

UNIT III:

Indicators of Economic Growth and Sustainable Development: Quality of Life Indicators (Physical Quality of Life Index – PQLI), Human Development Indicators (Human Development Index – HDI), Poverty and Deprivation Indicators (Multidimensional Poverty Index – MPI), Hunger and Nutrition Indicators (Global Hunger Index – GHI), Inequality Indicators (Gini Coefficient). ESG Indicator.

UNIT IV:

Challenges to Sustainable Development and Interventions: Extreme poverty and inequalities, agriculture, population & food security, public health and nutrition, education, natural resources (forests, biodiversity, energy, water), climate change, disaster –vulnerability and risks. Nexus of Water, Enegy, food and public health. Environmental Sustainability Indicators (Environmental Performance Index – EPI, SDG Index under Sustainable Development Goals), World Happiness Index–WHI.

Textbook:

1. K. Lekhi and Joginder Singh (2018 Rept. 2022). The Economics of Development & Planning. Kalyani Publishers, ISBN-13: 978-9327295511.

Reference Books:

1. Ahuja, H.L., Development Economics, S. Chand Publishing, Latest Edition
2. Blewitt, J., Understanding Sustainable Development, Earthscan Publications Ltd., Latest Edition

3. Taneja, M.L. and Myer, R.M., Economics of Development and Planning, Vishal Publishing Co., Latest Edition
4. Elliott, J.A., An Introduction to Sustainable Development, Routledge, Latest Edition
5. Atkinson, G., Dietz, S. and Neumayer, E., Handbook of Sustainable Development, Edward Elgar Publishing Ltd., Latest Edition
6. Dresner, S., The Principles of Sustainability, Earthscan Publications, Latest Edition
7. Mulligan, M., An Introduction to Sustainability: Environmental, Social and Personal Perspectives, Routledge, Latest Edition
8. Robertson, M., Sustainability Principles and Practice, Routledge, Latest Edition
9. Sachs, J., The End of Poverty: Economic Possibilities for Our Time, Penguin Publications, Latest Edition
10. Sachs, J., The Age of Sustainable Development, Columbia University Press, Latest Edition
11. World Commission on Environment and Development, Our Common Future, Oxford University Press, Latest Edition

Course Outcomes (CO):

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

CO1: Define and list the concepts, principles, and pillars of sustainable development, including global frameworks such as SDGs.

CO2: Explain the major theories of economic growth and development, including classical, neoclassical, and structural approaches.

CO3: Apply development indicators such as the Human Development Index, Multidimensional Poverty Index, and Gini Coefficient to assess economic and social conditions.

CO4: Analyze the interrelationships between economic growth, sustainability, and environmental indicators, including indices such as the Environmental Performance Index and SDG Index.

CO5: Evaluate major challenges to sustainable development, including poverty, inequality, climate change, resource depletion, and food security, in both national and global contexts.

CO6: Formulate policy perspectives and sustainable strategies by integrating economic, social, and environmental dimensions to address contemporary development challenges.

Course Title: **Quiz and Knowledge Excellence**	
Course Code: **SA38031**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

- To develop interdisciplinary awareness and knowledge integration skills.
- To enhance analytical thinking and rapid decision-making ability.
- To cultivate teamwork, communication, and competitive spirit through quizzing activities.
- To improve awareness of current affairs, science, technology, culture, and society.

Course Contents:

UNIT I:

Introduction to Quizzing: History and evolution of quiz culture, types of quizzes, quiz formats, fundamentals of questioning techniques.

UNIT II:

Current Affairs and General Awareness: National and international affairs, sports, business, science and technology, literature, arts and culture.

UNIT III:

Logical Reasoning and Analytical Thinking: Puzzle solving, lateral thinking, aptitude and analytical reasoning techniques.

UNIT IV:

Audio-Visual and Rapid Fire Rounds: Visual identification, audio rounds, buzzer systems, team quizzes, online quiz platforms.

UNIT V:

Quiz Event Design and Management: Quiz hosting, anchoring skills, event organization, preparation of question banks.

Course Outcomes (CO):

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

CO1: Demonstrate improved general awareness and interdisciplinary knowledge.

CO2: Apply analytical and logical reasoning skills in quiz competitions.

CO3: Participate effectively in team-based competitive events.

CO4: Develop confidence in public intellectual engagement.

CO5: Design and organize quiz events independently.

CO6: Demonstrate leadership, teamwork, and decision-making skills through active participation and management of quiz activities.

Course Title: **Debate and Public Speaking**	
Course Code: **SA38021**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

- To develop effective communication and presentation skills.
- To enhance persuasive speaking and argument-building abilities.
- To improve confidence in public interaction and stage performance.
- To cultivate critical thinking and leadership qualities.

Course Contents:

UNIT I:

Fundamentals of Communication: Verbal and non-verbal communication, interpersonal communication and listening skills.

UNIT II:

Public Speaking Techniques: Speech preparation, voice modulation, body language and confidence building.

UNIT III:

Debating Skills: Parliamentary debate, extempore speaking, group discussion and rebuttal techniques.

UNIT IV:

Presentation and Persuasion: Presentation tools, storytelling, persuasive communication and audience engagement.

UNIT V:

Mock Debate and Public Presentation: Debate competitions, speech delivery and evaluation.

Course Outcomes (CO):

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

CO1: Deliver structured speeches confidently before audiences.

CO2: Apply debating and persuasive communication techniques effectively.

CO3: Demonstrate leadership and interpersonal communication skills.

CO4: Participate effectively in debates and group discussions.

CO5: Develop confidence in public presentation and stage performance.

CO6: Analyze and evaluate arguments critically to communicate ideas effectively in academic, professional, and social contexts.

Course Title: **Hindustani Classical Music**	
Course Code: **SA38011**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

- To introduce the fundamentals of Hindustani classical music.
- To develop understanding of Swara, Raga and Tala systems.
- To encourage appreciation of Indian musical traditions.
- To enhance vocal and rhythmic abilities through practical learning.

Course Contents:

UNIT I:

Introduction to Hindustani Classical Music: Historical background, gharanas, vocal and instrumental traditions.

UNIT II:

Fundamentals of Music: Swara, Saptak, Raga, Tala, Laya and rhythm patterns.

UNIT III:

Voice Training and Practice: Alankars, breathing exercises, pitch control and voice modulation.

UNIT IV:

Classical Compositions and Performance: Bhajans, Khayal, Dhrupad and semi-classical forms.

UNIT V:

Group Practice and Recital: Ensemble coordination, stage presentation and performance evaluation.

Course Outcomes (CO):

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

CO1: Understand the basic principles of Hindustani classical music.

CO2: Demonstrate elementary vocal and rhythmic skills.

CO3: Identify ragas and talas used in classical compositions.

CO4: Develop appreciation for Indian musical heritage.

CO5: Perform basic musical compositions confidently.

CO6: Apply vocal techniques, rhythm coordination, and stage presentation skills in individual and group musical performances.

Course Title: **Indian Classical Dance**	
Course Code: **SA38009**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

- To introduce students to Indian classical dance traditions and aesthetics.
- To develop fundamental dance techniques, rhythm, and expression.
- To promote appreciation of Indian cultural heritage through performing arts.
- To enhance confidence and stage presentation skills.

Course Contents:

UNIT I:

Introduction to Indian Classical Dance Forms: Bharatanatyam, Odissi, Katha, Kuchipudi, Manipuri and Mohiniyattam.

UNIT II:

Basic Dance Techniques: Postures, footwork, hand gestures (Mudras), facial expressions and body coordination.

UNIT III:

Rhythm and Expression: Tala system, Abhinaya, synchronization, expressive communication through dance.

UNIT IV:

Performance and Stagecraft: Costume, makeup, stage discipline, choreography and group coordination.

UNIT V:

Practical Demonstration and Performance: Group performance, recital preparation and presentation.

Course Outcomes (CO):

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

CO1: Identify major Indian classical dance traditions.

CO2: Demonstrate basic dance movements and rhythmic coordination.

CO3: Apply expressive communication techniques in performance.

CO4: Appreciate Indian cultural and artistic heritage.

CO5: Perform confidently in individual or group dance presentations.

CO6: Demonstrate rhythm, expression, and coordination effectively in classical dance performances.

Course Title: **Leadership and Team Effectiveness**	
Course Code: **HS 30225**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

An effective leader understands the team dynamics, stimulates the morale of the followers and always aims at creating a participative workforce by enhancing team work. This course mainly focuses on individual, group and organization factors associated with leadership. There is a strong connection between emotional intelligence and leadership because the technical skills and knowledge will definitely help the students to fulfil the entry level requirements. Similarly, understanding employee empowerment would assist the students in acquiring the desirable professional skills.

Course Contents:

UNIT I:

Leadership concepts and practices: Meaning, Definition and understanding of leadership; the role and functions of a leader; Differentiation between leadership and management; ; what makes a leader effective; characteristics of an effective leader; leadership in Indian organization.

UNIT II:

Leadership Perspectives: Trait perspective of leadership (Great man theory and trait theory); Behavioural perspective of leadership (mangerial grid and likert system - four management); Studies on leadership (Hawthorne, IOWA, Michigan and Ohio); Contingency perspective of leadership (fiedler's contency theory, path goal, hersey blanchard situational theory); contemporary perspective to leadership (transformational, transactional, charasmatic, servant and Nurturant-task leadership style).

UNIT III:

Team effectiveness and Leadership: Characteristics and types of teams; types and functions of group; Group vs team; understanding an effective team; who is a team leader; tuckman's team development stages; team development and team building; team meetings and leadership; team effectiveness leadership model; high-performance teams and leadership;team cohesiveness; common threats to groups.

UNIT IV:

Emotional Intelligence and Leadership: What are emotions; Meaning, type and source of emotions; Concept and competencies of emotional intelligence; Elements of emotional intelligence; importance of EI; EI at workplace; Emotional intelligence and leadership; Significance of EI for leaders; strategies to enhance EQ in our jobs; EQ vs. IQ; developing EQ; obstacles to the development of EQ.

UNIT V:

Leadership and empowerment: Employee empowerment- concept, need and importance; approaches to empowerment; advantages and disadvantages of empowerment; empowerment skills of a leader; empowering vs. Dis-empowering;

leader as a coach (coaching skill); delegation (advantages and levels of delegation, steps and principles of effective delegation); empowering interpersonal skills

Textbook:

1. Leadership Personal effectiveness and Team Building, Ranjana Mittal, Vikas Publishing House Pvt Ltd, 2015.

Reference Book:

1. Team Building and Leadership by Neelam S. Bhargava and Gourav Bhargava, Himalaya Publishing House, 2015.

Course Outcomes (CO):

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

CO1: Learn the characteristics and need of an effective leader.

CO2: Understand the effectiveness of different leadership styles in different contexts from an instrumental, political and ethical perspective.

CO3: Apply leadership theories to the real business scenario.

CO4: Analyse group dynamics and importance of team work.

CO5: Evaluate the ways to handle emotions and stress and manage work-life flexibility.

CO6: Create organizational environment that is psychologically safe and make the employees feel empowered.

Course Title: **Business Ethics and Corporate Governance**	
Course Code: **HS 30223**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This course focuses upon the fundamental principles and standards that should govern the business organizations. The objective of this paper is to make the students aware about the importance of ethics, corporate governance and role of CSR sustainable development goals in the business to encourage moral practices and sensitivity towards the ethical dimension of managerial problems.

Course Contents:

UNIT I:

Business Ethics: Concept, Principles & Theories: Meaning, objective and types of Ethics; Business ethics- concept, need, scope, objectives and importance; factors influencing business ethics; Principles of Business ethics; Relationship between ethics and business ethics; theories of business ethics; Ethical dilemma and ethical decision making.

UNIT II:

Ethics in Practice across the domain: Ethics in marketing- introduction, ethical dilemma in marketing, unethical marketing practices, measures to stop unethical practices in marketing; Ethics in Finance- introduction, code of ethics in finance, unethical practices in finance or frauds, measures to stop unethical practices in finance; Ethics in HRM- introduction, ethical issues in HRM (job discrimination, sexual harassment, employee privacy, whistle blowing, affirmative action); importance of workplace ethics and employee code of conduct.

UNIT III:

Corporate Governance: Corporate Governance- concept, objective and need. Role of law in corporate governance; important issues in corporate governance; Corporate governance in India-past, present and Future; Importance and principles of Corporate Governance.

UNIT IV:

Introduction to Corporate Social Responsibility: CSR- Concept, evolution and development; Why CSR; Apprehensions against CSR; Forms and dimensions of CSR; making business corporations socially responsible; CSR in India.

UNIT V:

Sustainable Development: Introduction, meaning, history, features, objectives of sustainable development; The pillars and principles of sustainable development; SDG and its relevance in business.

Textbook:

1. Business Ethics and Corporate Governance, Dr. K. Nirmala, Dr. B.A. Karunakara Reddy & N. Aruna Rani, Himalaya Publication House.
2. Business Ethics and Corporate Governance, C.S.V. Murthy, Himalaya Publishing, 2022.

Reference Books:

1. Corporate Social Responsibility (concept, cases and trends) by Prabhakaran Paleri, Cengage Learning India Pvt. Limited, 2020.
2. Business Ethics and Corporate Governance, Dr. S.S. Khanka, Sultan Chand, 2019.
3. Corporate Social Responsibility (CSR), Corporate Governance, Sustainable Development and Corporate Ethics/Business Ethics by C.U. Saraf, Himalaya Publishing House 2017.

Course Outcomes (CO):

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

CO1: Familiarize the learners with the concept and relevance of Business Ethics in the modern era.

CO2: Understand the value of business ethics which will guide them in maintaining firm moral values while taking managerial decision.

CO3: Apply the ability to make moral judgments in dilemmatic situations across the work domains.

CO4: Analyse the application of management practices by adhering to corporate law and ethics.

CO5: Evaluate the scope, opportunity and complexity of Corporate Social responsibility in the global and Indian context.

CO6: Create an opportunity to understand the sustainable development goals in maintaining a balance between the economic, environmental and social needs.

Course Title: **Organizational Change and Development**	
Course Code: **HS 30250**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The primary objective of the course is to understand the importance of organizational change and the need to respond to the changes in the industry. It also focuses on imparting the knowledge of organization development concepts, tools and techniques that are meant for improving the functioning of individuals, groups and organizations. The aim of the course is to develop the application of behavioral science concepts to the functioning of the organization development.

Course Contents:

UNIT I:

Organizational Change: Organizational Change: Concept and Significance; Managing Change; Concept of Analyzing the Environment; Perspectives on Change: Contingency; Resource Dependence; Population Ecology; Implications of Change.

UNIT II:

Types of Change: Types of Change: Continuous or Incremental Change; Discontinuous or Radial Change; Participate Change and Directive Change; Change Levers; Levels of Change: Knowledge Changes; Attitudinal Changes; Individual Behaviour Changes and Organizational Performance Changes.

UNIT III:

Implementation of Change: Implementing Change : Steps-Assembling a Change; Management in establishing a new direction for the organization; Setting up of change teams and promoting innovation; Aligning structure; Systems and resources; Removing road blocks; Absorbing changes into organization; keys to create a cultural change.

UNIT IV:

Organizational Growth and Development: Introduction to organizational growth and development; Historical Overview of OD (Laboratory Training, Survey Research, Action Research, Socio-technical systems); OD Values, Beliefs and Assumptions for individuals, Groups and Organizations; Role of OD Consultants – Styles, relation with client, entry strategies.

UNIT V:

Organizational Development Interventions: OD Interventions: Overview, characteristics of effective Interventions, Individual Level , Team Group Interventions; Human Resource Interventions •(Performance Management, Reward Systems, Career Planning); Techno-Structural Interventions • (Restructuring Organizations, Down sizing Employee Involvement , Work Redesign , Total Quality Management); Strategic Interventions •(Mergers and Acquisitions , Strategic Alliances and Joint Ventures, Organization Transformation); Indian Experiences of OD in Public and Private Enterprises.

Textbooks:

1. Organization Development and Change by Thomas Cummings and Christopher Worley - Cengage Publications, 2015.
2. Organizational Change and Development by Dipak Bhattacharya, Oxford Publishing House, 2011.
3. Managing Organizational Change- a multiple perspective approach by Ian Palmer, Richard Dunford, David A, Buchanan, Mc Graw Hill, 2016.

Reference Books:

1. Organization Development: Behavioral Science Interventions for Organizational Improvement, by Wendell L French, Cecil H Bell - Pearson publications.
2. Organizational Change and Development, Kumkum Mukherjee, Pearson Publications, 2015.

Course Outcomes (CO):

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

CO1: Respond and anticipate the needs of change in a proactive way.

CO2: Understand various levels and categories of change to develop appropriate intervention into the system.

CO3: Apply the OD concepts, tools and techniques for improving the performance of individual, groups and organization in change process.

CO4: Analyse and overcome the challenges in the change process.

CO5: Explain the assumptions, beliefs and values of organizational development.

CO6: Implement behavioral science knowledge to bring changes in organizational strategies, structures, and processes.

Course Title: **Foundation of Macroeconomics**	
Course Code: **CB1047**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This course aims to develop an understanding of key macroeconomic concepts such as national income, general equilibrium, inflation, unemployment, consumption, and investment. It enables students to analyse economic relationships using models like IS–LM and the Phillips Curve, measure economic indicators, and evaluate the effects of fiscal and monetary policies on overall economic performance.

Course Contents:

UNIT I:

National Income: Concepts of National Income, GDP, GNP, GDP Gap, GDP Deflator; comparison with CPI; methods of measuring GDP (Income, Expenditure, Output); circular flow of income in closed and open economies.

UNIT II:

General Equilibrium: Aggregate Demand and Supply (AD–AS); IS–LM model; product and money market equilibrium; effectiveness of fiscal and monetary policy; crowding-out effect.

UNIT III:

Inflation and Unemployment: Measurement of inflation and unemployment; Phillips Curve and expectations; natural rate of unemployment; relationship between GDP gap, inflation, and unemployment (Okun's Law).

UNIT IV:

Consumption and Investment Theories: Consumption theories (absolute, relative, permanent income, life-cycle); investment decisions; marginal efficiency of capital (MEC); autonomous and induced investment; multiplier.

Textbook:

1. Macroeconomics. H.L Ahuja. S Chand Publisher. ISBN:9789385401350.

Reference Books:

1. N.Gregory Mankiw. Principles of Macroeconomics with CourseMate, 7th edition, Cengage Publishers.
2. Andrew Abel and Ben Bernanke (2016), Macroeconomics, Publisher: Pearson.

Course Outcomes (CO):

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

CO1: Define key macroeconomic concepts such as GDP, inflation, unemployment, and national income.

CO2: Explain relationships between macroeconomic variables using models like IS–LM Model and the Phillips Curve.

CO3: Apply methods to measure GDP, inflation, and unemployment using real-world data.

CO4: Examine the impact of fiscal and monetary policies on economic equilibrium and growth.

CO5: Assess macroeconomic issues and formulate policy recommendations based on theoretical models and empirical evidence.

CO6: Integrate macroeconomics theories with real-world scenarios.

Course Title: **Econometric Modeling and Software Applications**	
Course Code:	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This course provides an introduction to the core principles and methodologies of econometrics. It focuses on developing the ability to formulate, estimate, and interpret economic models using real-world data. The course equips students with both theoretical understanding and practical skills, forming a foundation for advanced studies in econometric analysis.

Course Contents:

UNIT I:

Introduction to Econometrics and Review of Prerequisites: Definition, relevance, and scope of econometrics; types of data; distinctions between econometrics, data analytics, and machine learning. Probability distributions (normal, t, F, chi-square) and hypothesis testing. Introduction to econometric and regression analysis, and the process of econometric modelling. Topics will also be delivered with appropriate applications using statistical software as deemed suitable.

UNIT II:

Bivariate Regression Model: Assumptions of the Classical Linear Regression Model (CLRM); estimation using Ordinary Least Squares (OLS); properties of

OLS estimators; BLUE property and the Gauss-Markov theorem. Hypothesis testing in regression, measures of goodness of fit, interpretation of results, and effects of changes in origin and scale. Topics will also be delivered with appropriate applications using statistical software as deemed suitable.

UNIT III:

Multiple Regression Analysis: Concept and estimation of multiple regression models; hypothesis testing; interpretation of regression coefficients; measures of goodness of fit; comparison of coefficients; and testing for structural breaks. Topics will also be delivered with appropriate applications using statistical software as deemed suitable.

UNIT IV:

Violations of Classical Assumptions: Testing for linearity and normality. Issues related to multicollinearity, heteroscedasticity, and autocorrelation—along with their detection, consequences, and remedial measures. Topics will also be delivered with appropriate applications using statistical software as deemed suitable.

Textbook:

1. Introductory Econometrics: A Modern Approach by Jeffrey M. Wooldridge (Latest Edition), Cengage.

Reference Books:

1. Basic Econometrics by Damodar N. Gujarati and Dawn C. Porter (Latest Edition). Fundamentals of Business Statistics by J. K. Sharma. Vikas Publishing House, ISBN: 978-93-259-7616-0
2. Using Econometrics: A Practical Guide by A. H. Studenmund (Latest Edition).

Course Outcomes (CO):

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

CO1: Perform regression analysis using Excel and other statistical software.

CO2: Identify, diagnose, and address common econometric issues such as multicollinearity, heteroscedasticity, and autocorrelation.

CO3: Apply econometric techniques to real-world datasets using appropriate software tools.

CO4: Select and apply suitable econometric models in different contexts.

CO5: Critically evaluate empirical research, identifying strengths and weaknesses in econometric analyses.

CO6: Integrate qualitative variables into regression models effectively.

Course Title: **Circular Economy and Sustainable Engineering**	
Course Code:	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The course aims to introduce students to the concept and principles of the circular economy, while enabling them to understand the role of engineering in improving resource efficiency and reducing waste. It also focuses on developing the skills required to design sustainable, innovative, and circular engineering solutions that support long-term environmental and economic sustainability.

Course Contents:

UNIT I:

Introduction to Circular Economy: Concept and evolution of circular economy; Linear vs circular economic models; Principles: Reduce, Reuse, Recycle, Recover; Sustainability and circular economy linkages; Global trends and need for circular transition.

UNIT II:

Resource Efficiency and Sustainable Materials: Natural resource use and scarcity ;Material flow and resource efficiency; Sustainable and eco-friendly materials ;Recycling and material recovery technologies

UNIT III:

Circular Design and Engineering Tools: Eco-design and green product design; Life Cycle Assessment (LCA) – concept and stages; Cleaner production techniques; Reverse logistics and product life extension ; Digital technologies supporting circular economy

UNIT IV:

Circular Economy in Engineering Sectors: Green computing and e-waste management Computer Science; Civil: Sustainable construction and green buildings; Mechanical: Remanufacturing and maintenance strategies; Electrical: Renewable energy systems and smart grids ; Case studies

UNIT V:

Policy, Business Models and Implementation: Circular economy policies and regulations in India; Role of Ministry of Environment, Forest and Climate Change; Business models: sharing economy, product-service systems ; Sustainable Development Goals (SDGs) ; Challenges and future scope of circular economy.

Textbooks:

1. Towards the Circular Economy- Ellen MacArthur Foundation
2. Conceptualizing the Circular Economy: An Analysis of 114 Definitions Journal: Resources, Conservation and Recycling - Kirchherr, J., Reike, D., & Hekkert, M.
3. Materials and the Environment: Eco-informed Material Choice- Ashby, M. F.
4. Green Engineering: Environmentally Conscious Design of Chemical Processes- Allen, D. T., & Shonnard, D. R.
5. Industrial Ecologyand Sustainable Engineering- Graedel, T. E., & Allenby, B. R.
6. Human Development Reports- United Nations Development Programme (Latest Editions).

Course Outcomes (CO):

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

CO1: Explain the concept and principles of circular economy.

CO2: Analyze resource use and waste generation in engineering systems.

CO3: Apply tools like LCA and eco-design for sustainability assessment.

CO4: Evaluate circular practices across engineering sectors.

CO5: Design innovative solutions for sustainable and circular systems.

CO6: Integrate circular economy principles with real-world business, policy, and sustainability challenges.

Course Title: **Accounting for Everyone**	
Course Code:	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The objective of this course is to help students to have a clear, systematic understanding of financial recording, measurement, and reporting. Equal emphasis is placed on developing accounting judgment and practical skills, so that students can apply double-entry principles, account for depreciation, prepare financial statements, and understand corporate reporting practices in real-world business contexts.

Course Contents:

UNIT I:

Introduction to Accounting: Accounting: The Information Architecture, Accounting Process, Users of Accounting Information, Accounting Terms, Branches of Accounting, Merits and Limitations of Accounting. Basis of Accounting: Cash Basis and Accrual Basis, Accounting Principles: Concepts and Conventions; Accounting Equation Accounting Standards: Significance, Ind AS (Indian Accounting Standards), IFRS(International Financial Reporting Standards), & GAAP (Generally Accepted Accounting Principles).

UNIT II:

Recording of Business Transactions: Classification of Accounts: Traditional Approach and Modern Approach, Rules of Debit and Credit; Journalizing Transactions; Preparation of Ledger. Subsidiary Books and Cash Book. Trial Balance: Meaning, Objectives, and Preparation.

UNIT III:

Depreciation Accounting: Meaning and causes of depreciation; need for providing depreciation. Methods of charging depreciation: Straight Line Method (SLM) and Written Down Value (WDV) Method. Complete disposal of assets.

UNIT IV:

Financial Statements and Company Accounts: Classification of receipts and expenditure: capital and revenue. Preparation of financial statements of sole proprietorships: Trading Account, Profit and Loss Account, and Balance Sheet with adjustments. Company Accounts: Types of companies as per the Companies Act, 2013; Types of shares and share capital. Company Reports: Contents of company annual report; components of company financial statements.

Textbook:

1. Bhusan, Goyal, Accounting for Everyone, Taxman Publication.

Reference Books:

1. Tulsian & Tulsian, Accounting for Everyone, S. Chand.
2. Bansal, K. M., Financial Accounting, Taxman Publication.
3. Jain, S. P. and K. L. Narang, Financial Accounting, Kalyani Publishers, New Delhi.
4. Mittal, R. K. and Bansal, M. R., Financial Accounting, V.K. Global Publication.
5. Tulsian, P. C., Financial Accounting, Pearson Publication.
6. Maheshwari, S. N. and Maheshwari, S. K., Financial Accounting, Vikas Publishing House.

Course Outcomes (CO):

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

CO1: Remember the fundamental concepts, principles, standards, and terminology of accounting, including the accounting process, accounting equation, and branches of accounting.

CO2: Explain the basis of accounting, accounting principles, and the significance of accounting standards such as Ind AS, IFRS, and GAAP in financial reporting.

CO3: Apply the rules of debit and credit to record business transactions through journal entries, ledger posting, subsidiary books, cash book, and preparation of trial balance.

CO4: Analyze the methods of depreciation and evaluate their impact on asset valuation and financial statements, including accounting treatment for disposal of assets.

CO5: Evaluate the classification of capital and revenue items and interpret the structure and components of company financial statements and annual reports under the Companies Act, 2013.

CO6: Prepare financial statements of sole proprietorships and company-related accounting statements by incorporating necessary adjustments and appropriate accounting treatments.

Course Title: **Cost Analysis & Managerial Decision Making**	
Course Code: **CB21312**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The course aims to develop a clear understanding of cost and management accounting concepts, principles, and their practical applications in decision-making. It enables learners to prepare cost sheets and analyze cost behavior. Students gain knowledge of accounting and control of materials, labour, and overheads. The course also focuses on marginal costing techniques, break-even analysis, and profit planning. Further, it provides insights into budgeting and budgetary control systems, enhancing the ability to plan, monitor, and control organizational performance effectively.

Course Contents:

UNIT I:

Introduction to Cost & Management Accounting: Concept, scope, objectives, principles, importance, and limitations of cost and management accounting; Cost concepts, elements of cost, and classification of cost; Preparation of Cost Sheet.

UNIT II:

Accounting for Materials, Labour and Overhead: Materials - Concept and techniques of material accounting; Methods of pricing material issues: FIFO, LIFO, Average; Basic techniques of material control; Accounting for labour cost and control procedures; Labour turnover, idle time, overtime; Classification of Overhead; apportionment and reapportionment of Overhead.

UNIT III:

Marginal Costing: Marginal Costing vs Absorption Costing, Distinctive features and income determination, Break-even (BEP) Analysis: Contribution, Margin of Safety, Angle of Incidence.

UNIT IV:

Budgetary Control: Concept of Budget, Budgeting, and Budgetary Control; Objectives, Merits, and Limitations of Budgetary System; Essentials and Requisites for Successful Budgetary Control.

Textbook:

1. P. C. Tulsian, Cost and Management Accounting - S. Chand Publishing(As per NEP).

Reference Books:

1. Cost & Management Accounting, Ravi M. Kishore, Taxmann Publications.
2. Jain & Narang, Cost & Management Accounting, Kalyani Publications, New delhi.
3. Management Accounting- S swain/ S.P. Gupta/ A Sharma, V.K. Global Pub. Pvt. Ltd.
4. Management & Cost Accounting –Drury, Colin – Cengage Learning
5. Introduction to Management Accounting- Horngreen, Charles T., Gary L. Sundem.
6. Management Accounting - Narasimhan M.S., Cengage Learning
7. Management Accounting- Tata McGraw Hill, Publishing.

Course Outcomes (CO):

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

CO1: Define and describe the fundamental concepts, scope, objectives, principles, and limitations of cost and management accounting.

CO2: Explain cost concepts, elements, and classification of costs, and interpret the structure of a cost sheet.

CO3: Apply techniques of material, labour, and overhead accounting, including methods like FIFO, LIFO, and Average for material pricing.

CO4: Analyze labour cost control measures, overhead classification, and apportionment/reapportionment of overheads.

CO5: Evaluate marginal costing techniques, compare with absorption costing, and assess profitability using break-even analysis and related tools.

CO6: Design and develop budgets and implement budgetary control systems for effective planning and performance management.

Course Title: **French For Engineers**	
Course Code: **FR30202**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This course focuses on technical French for engineers and professionals, using basic vocabulary and simple contexts related to technology and innovation. Students will learn how to introduce technical ideas, use common professional expressions, and understand simple texts. The course will also help them practice speaking, reading, and writing in everyday professional situations. Build basic communicative competence in French (listening, speaking, reading, writing). Introduce French vocabulary related to engineering and science. Enable students to engage in professional/technical discussions.

Course Contents:

UNIT I:

Premiers pas en France : Learners are introduced to French sounds, greetings, self-introduction, family, nationality, and daily activities. Core grammar includes articles, gender/number agreement, subject pronouns, and verbs in the present tense.

UNIT II:

Universitè et grandes ècoles: Focus on student life, directions, housing, schedules, and emails. Learners practice polite requests, giving advice, and describing academic contexts using common verbs and time expressions.

UNIT III:

La science au quotidian: Covers everyday applications of science—shopping, meals, timetables, and making appointments. Students practice expressing needs, wishes, and future intentions while expanding technical vocabulary.

UNIT IV:

Formation scientifique: Introduces workplace and lab contexts: following protocols, describing projects, and presenting research. Grammar includes relative pronouns, passè composè, and giving instructions with infinitives.

UNIT V:

Nouvelles technologies: Emphasis on presenting data, describing people or projects, and discussing ecology and recycling. Students practice asking questions, giving advice, and using simple future tense with obligation expressions.

UNIT VI:

Les examens et le stage: Prepares learners for professional contexts: writing CVs, cover letters, SMS, and internship reports. Grammar covers imperative, passè composè with être, object pronouns, and recent past expressions.

Reference Books:

1. Hirschsprung, Nathalie, Tricot, Tony. Cosmopolite A1, Méthode de français, Hachette, Français langue étrangère, ISBN : 978-2014015973, 2017 (textbook, workbook & CD).
2. Le Gargasson, Ingrid; Naik, Shariva; Chaize, Claire. Tech French – French for Science and Technology, Méthode de français, Goyal Publishers & DistributorsPvt. Ltd., Science &Technologyseries, ISBN-13 978-8183074360, April 2011.

Course Outcomes (CO):

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

CO1: Demonstrate correct usage of French grammar, pronunciation spoken and written communication.

CO2: Acquire essential IT, computer science, manufacturing, automotive, construction, mechanical, chemical, electrical and electronics engineering related vocabulary in French, enabling them to understand and discuss basic technical topics in their field.

CO3: Apply French language skills to workplace scenarios such as giving instructions and describing processes.

CO4: Analyse short technical texts (manuals, brochures) for key information.

CO5: Compose simple technical descriptions, notes, and professional emails.

CO6: Present basic technical concepts orally using appropriate French terminology.

Course Title: **Cultural Trends in Contemporary France**	
Course Code: **FR40203**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Understand the evolution and significance of key cultural trends in France, including gastronomy, fashion, media and popular culture. Analyse the relationship between cultural industries, social structures and French societal values. Critically evaluate the role of France in shaping global cultural phenomena. Develop cultural literacy to engage with contemporary French practices in a broader socio cultural and political context.

Course Description:

This course offers an in-depth exploration of contemporary French culture, examining key domains such as gastronomy, fashion, media, and societal practices. It adopts an interdisciplinary approach to analyze how cultural industries, social dynamics, and everyday practices shape and reflect France's identity in a globalized world. The course provides critical insights into contemporary French life and its influence on international cultural landscapes

Course Contents:

UNIT I:

Gastronomy and Culinary Heritage: This module explores the evolution of French gastronomy, emphasizing its role as a cultural identity marker and a UNESCO-recognized intangible heritage. Topics include the historical roots of French cuisine, the rise of regional specialties, the art of French wine and cheese, and the contemporary fusion of traditional and modern culinary trends.

UNIT II:

Fashion and French Aesthetic: Delving into the historical and modern significance of fashion, this module examines how France has positioned itself as a global leader in haute couture and prêt-à-porter. Topics include the origins of Parisian fashion, iconic designers like Coco Chanel and Yves Saint Laurent, the rise of fashion weeks, and the impact of sustainability on the French fashion industry.

UNIT III:

Media, Art and Cultural Expression: This module highlights the role of media and art in shaping and reflecting contemporary French society. Topics include the influence of French cinema and television, digital media trends, the evolution of French art movements in the 20th and 21st centuries, and how culture is represented and preserved through these mediums.

UNIT IV:

Society, Identity, and Cultural Diversity: This module examines contemporary French society through the lens of identity, diversity, and social change. It explores themes such as immigration, multiculturalism, secularism (laïcitè), gender dynamics, and youth culture. The module also addresses debates around national identity, integration, and inclusion, highlighting how these issues shape and are reflected in cultural expressions and public discourse in modern France.

UNIT V:

Popular Culture and Lifestyle in Contemporary France: This module focuses on everyday cultural practices and popular trends that define modern French lifestyles. Topics include music, sports, festivals, digital culture, social media influencers, and changing leisure habits. It also examines how globalization and technology influence youth culture, consumption patterns, and the negotiation between tradition and modernity in daily life.

Suggested Readings:

The material will be provided and updated from time to time by the concerned faculty.

Reference Book:

1. Kidd, William, Reynolds, Siân, Contemporary French Cultural Studies, Arnold Publishers, New York, 2000, ISBN: 0-340-74050-7

Course Outcomes (CO):

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

CO1: Identify major contemporary trends in French gastronomy, fashion, culture, media and popular culture.

CO2: Describe how historical, social, political and economic factors have shaped these cultural trends in modern France.

CO3: Illustrate the influence of French cultural trends through real-world examples, such as global culinary practices or international fashion events.

CO4: Examine the interplay between French cultural industries and societal values, identifying their global impact and significance.

CO5: Critically assess the representation and commodification of French culture in global media and industries.

CO6: Design an innovative project (e.g., a short documentary, article, or presentation) that explores and contextualizes a specific aspect of contemporary French culture.

Course Title: **Immersive French: Audio-Visual Listening Skills**	
Course Code: **FR40204**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Develop learners' ability to comprehend French audio-visual materials in everyday contexts. Familiarize learners with diverse Francophone accents and pronunciation patterns. Equip learners with strategies to extract key information from spoken language. Provide cultural insights into Francophone regions to contextualize listening skills.

Course Description:

This course immerses learners in authentic French audio-visual content to develop foundational listening comprehension and practical understanding of spoken French. Through videos, podcasts, and interactive tasks, learners engage with simple everyday conversations, become familiar with basic pronunciation patterns and selected Francophone accents, and respond in guided contexts. Aligned with CEFR A1-level objectives, the course emphasizes active listening skills for real-life situations such as travel, dining, and social interaction.

Course Contents:

The course has been designed adopting the Task based and Communicative Approach, in order to enable learners to attain the language competency levels specified by CEFR.

UNIT I:

Foundations of Listening and pronunciation: French Pronunciation and Sounds: Watching videos on French alphabets and phonetics (YouTube: Français Authentique), listening to simple songs or rhymes to recognize sounds. Everyday Conversations: Audio exercises on greetings, introducing oneself, and asking basic questions (Podcasts: Coffee Break French), role-play based on simple dialogues from video content. Understanding Directions and Locations: Listening to city tour videos or map-based navigation instructions (Videos: Apprendre le français avec TV5Monde), practice following directions in small groups..

UNIT II:

Practical Listening in Context: Shopping and Dining: Watching short clips of conversations in markets or restaurants, simulating shopping or ordering food based on audio prompts. Describing People and Activities: Listening to video interviews where people describe themselves (Français Facile videos), group activities: Match audio descriptions with visual images. Travel and Transportation: Audio-visual exercises on booking tickets, asking for schedules, and navigating public transport (LingQ travel dialogues), simulated travel role-plays using audio cues.

UNIT III:

Advanced Listening Scenarios: Social Events and Invitations: Watching videos on planning events and making arrangements (YouTube: InnerFrench), group task: Plan an event and present it using audio cues. Cultural Insights Through Listening: Exploring Francophone culture via short documentaries (TV5Monde documentaries), reflecting on cultural differences based on audio-visual clips.

UNIT IV:

Travel, Navigation, and Social Interaction: This module introduces slightly more complex listening scenarios related to travel and social contexts. Learners engage with audio-visual materials on booking tickets, understanding schedules, and navigating transportation systems. It also includes listening to conversations about social plans, invitations, and basic event coordination, followed by role-play and group-based tasks.

UNIT V:

Cultural Listening and Interpretive Skills: This module exposes learners to simple cultural content from Francophone contexts through short videos and audio clips. Learners practice identifying main ideas, cultural references, and familiar vocabulary in slightly extended listening passages. Activities include guided reflection, summarizing simple content, and responding creatively through short presentations or role-plays.

Suggested Readings:

This course uses the following web-based and open-source materials:

1. Podcasts: Coffee Break French (https://coffeebreaklanguages.com) Français Facile (https://www.podcastfrancaisfacile.com)
2. Videos and Platforms: Apprendre le français avec TV5Monde (https://apprendre.tv5monde.com) Français Authentique on YouTube https://www.youtube.com/user/francaisauthentique) InnerFrench (https://innerfrench.com)
3. Interactive Tools: LingQ for audio and vocabulary practice (https://www.lingq.com).Online resources for audio quizzes and comprehension tasks.

Course Outcomes (CO):

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

CO1: Recognize essential vocabulary and phrases from audio-visual sources.

CO2: Identify the main ideas and details in simple spoken French.

CO3: Respond to audio prompts in conversational scenarios.

CO4: Distinguish between different speech patterns and contexts such as questions, statements and instructions.

CO5: Demonstrate comprehension through guided tasks and refine their listening skills through feedback.

CO6: Develop responses, summaries, or role-plays based on audio-visual content.

Course Title: **Spanish For Engineers**	
Course Code: **SP30202**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To develop professional communication skills in Spanish for workplace settings. To enhance speaking and writing abilities for formal and semi-formal interactions. To build intercultural competence for global professional engagement. To engage in intercultural professional exchanges across Spanish-speaking countries.

Course Description:

This course is designed to strengthen students' communication skills in professional and technical environments. It introduces beginner level grammar structures, technical vocabulary, and workplace communication strategies required for engineering contexts. Students will develop proficiency in presenting technical ideas, participating in meetings, understanding technical documentation, and engaging in intercultural professional exchanges across Spanish-speaking countries.

Course Contents:

UNIT I:

Basics of Spanish for Engineering Communication: Introduction to Spanish alphabet, pronunciation, and basic phonetics. Basic greetings, introductions, and workplace expressions. Use of present tense (ser, estar, tener). Introducing oneself, profession, and field of study. Basic technical vocabulary: objects, tools, and workplace environments.

Activity: simple self-introduction as an engineering student / professional.

UNIT II:

Everyday Communication in Technical Contexts: Use of regular verbs in present tense (-ar, -er, -ir). Asking and answering simple questions in workplace situations. Numbers, measurements, time, and schedules. Vocabulary for common tools, equipment, and basic processes. Giving simple instructions and directions.

Role-play: interacting in a basic workplace or lab environment.

UNIT III:

Describing Tasks and Processes: Describing daily activities and simple technical tasks. Introduction to reflexive verbs (routine actions). Expressing frequency and sequencing (primero, luego, despuès). Vocabulary related to basic operations and procedures. Talking about functions of machines and tools (simple descriptions).

Activity: describing a simple process or task in Spanish.

UNIT IV:

Introduction to Professional Communication: Writing basic emails and short messages (introductions, requests). Vocabulary for meetings, schedules, and coordination. Describing simple problems and asking for help. Introduction to formal vs informal communication (tù vs usted). Listening to short conversations in workplace contexts.

Activity: writing a basic professional email and dialogue practice.

UNIT V:

Technology, Innovation, and Basic Future Expression: Vocabulary related to technology: computers, internet, and basic engineering fields. Talking about likes, interests, and career goals (me gusta, quiero). Introduction to near future: ir a + infinitivo. Describing simple plans and projects. Basic cultural awareness: engineering environments in Spanish-speaking countries.

Reflection Activity: talking about future goals as an engineer.

Suggested Readings:

1. Castro, Francisca. Nuevo Prisma A1: Curso de Español para Extranjeros. Edinumen, 2014, ISBN: 9788498483795
2. Morales, Rosario. Aula Internacional 1 (Nueva ediciòn). Difusión, 2018, ISBN:9788417249183
3. Lòpez Santiago, Josè Manuel. Español para Ingenieros: Manual de Español con Fines Especìficos. Edinumen, 2017. ISBN: 9788498487588.

Course Outcomes (CO):

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

CO1: Identify and use professional vocabulary related to meetings, emails, and workplace communication.

CO2: Demonstrate the ability to introduce oneself and interact in professional settings using appropriate expressions.

CO3: Apply basic Spanish structures in formal writing such as emails, invitations, and scheduling messages.

CO4: Interpret short professional documents, notices, and workplace dialogues.

CO5: Use Spanish confidently in presentations, networking events, and collaborative discussions.

CO6: Develop awareness of workplace culture and professional etiquette in Spanish-speaking countries.

Course Title: **Spanish and Latin American Society and Culture**	
Course Code: **SP40203**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To introduce students to the historical and cultural diversity of Spain and Latin America. To develop critical understanding of social structures, identities, and power relations in the Hispanic world. To enhance intercultural competence and global awareness through cultural analysis. To engage meaningfully with diverse Spanish-speaking contexts in academic, professional, and global settings.

Course Description:

This course offers an interdisciplinary exploration of the societies, cultures, and historical transformations of Spain and Latin America. It introduces students to key cultural practices, social structures, political histories, and contemporary issues shaping the Hispanic world. Through literature, film, media, and cultural texts, students will analyze themes such as identity, colonialism, migration, gender, race, and globalization. The course fosters critical thinking and intercultural awareness, enabling students to engage meaningfully with diverse Spanish-speaking contexts in academic, professional, and global settings.

Course Contents:

UNIT I:

Historical Foundations and Cultural Diversity: Overview of Spain and Latin America: geography, regions, and cultural diversity. Pre-Columbian civilizations (Aztec, Maya, Inca). Spanish colonization and its impact on language, religion, and society. Formation of modern nation-states.

Activity: Mapping cultural diversity and historical timelines.

UNIT II:

Colonialism, Identity, and Power: Colonial legacies and social hierarchies (race, class, caste systems). Concept of mestizaje and hybrid identities.

Indigenous and Afro-Latin American cultures. Decolonial perspectives and resistance movements.

Case study discussion: Identity and marginalization in contemporary society.

UNIT III:

Society, Gender, and Cultural Expression: Gender roles and feminist movements in Spain and Latin America. Representation of women in literature and media. Family structures, traditions, and social norms. Popular culture: music, festivals, and everyday life.

Activity: Analysis of a film or literary text from a gender perspective.

UNIT IV:

Migration, Globalization, and Contemporary Issues: Migration patterns (Latin America–U.S., intra-regional, and global diaspora). Border identities and transnational cultures. Globalization and cultural change. Social issues: inequality, urbanization, environment, and labor.

Discussion: Globalization vs. cultural preservation.

UNIT V:

Politics, Media, and Cultural Narratives: Political systems and recent developments in Spain and Latin America. Role of media, digital culture, and representation. Cultural narratives in literature, cinema, and art. Memory, dictatorship, and historical trauma.

Final Activity: Student presentations on a selected country or theme.

Suggested Readings:

1. Chasteen, John Charles. Born in Blood and Fire: A Concise History of Latin America. W.W. Norton, 2016.
2. Skidmore, Thomas E., and Peter H. Smith. Modern Latin America. Oxford University Press, 2014.
3. Carr, Raymond. Spain: A History. Oxford University Press, 2001.
4. Stavans, Ilan (ed.). The Oxford Book of Latin American Essays. Oxford University Press, 1997.
5. Moraña, Mabel, Enrique Dussel, and Carlos A. Jàuregui (eds.). Coloniality at Large: Latin America and the Postcolonial Debate. Duke University Press, 2008.

Course Outcomes (CO):

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

CO1: Identify key historical events and cultural developments in Spain and Latin America.

CO2: Analyze cultural texts (literature, film, media) in relation to social and political contexts.

CO3: Explain concepts such as colonialism, identity, race, gender, and migration in Hispanic societies.

CO4: Compare cultural practices and social structures across regions of the Spanish-speaking world.

CO5: Demonstrate intercultural sensitivity and critical awareness in global contexts.

CO6: Present analytical insights through written assignments and oral discussions.

Course Title: **Immersive Spanish: Audio-Visual Listening Skills**	
Course Code: **SP40204**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Recognize and understand common vocabulary and phrases in spoken Spanish. Improve comprehension of different Spanish accents and speaking styles. Develop active listening strategies to enhance retention and interpretation. Engage in discussions and analyses of audio-visual content. Identify cultural nuances and contextual variations in spoken Spanish. Strengthen pronunciation and listening fluency through exposure to native speech.

Course Description:

This course is designed to enhance students' listening comprehension skills in Spanish through immersive audio-visual materials. Students will engage with authentic Spanish-language content such as films, podcasts, interviews, and dialogues to develop their ability to understand spoken Spanish in different accents and contexts. The course will emphasize active listening strategies, comprehension exercises, and discussions to reinforce learning. Cultural aspects of Spanish-speaking regions will also be explored through media analysis.

Course Contents:

UNIT I:

Foundations of Audio-Visual Comprehension: Introduction to Spanish Audio-Visual Comprehension. Understanding Basic Conversations and Common Phrases. Identifying Key Words and Context Clues in Spoken Spanish.

Listening strategies: Predicting, inferencing, and selective listening.

Activity: Guided listening exercises with short dialogues.

UNIT II:

Everyday Communication and Media Exposure: Comprehending Short Interviews and Dialogues. Exploring Spanish Through Music and Lyrics, Understanding tone, emotion, and intent in speech.

Activity: lyric analysis and conversational role-play.

UNIT III:

Audio-Visual Narratives and Entertainment Media: Analyzing TV Shows and Short Films. Understanding Formal vs Informal Speech in Media. Identifying slang, idiomatic expressions, and cultural references.

Activity: Film clip analysis and group discussion

UNIT IV:

News, Accents, and Regional Variations: Engaging with Spanish-Language News and Short Documentaries. Comparing Accents and Dialects Across Spanish-Speaking Regions. Exposure to varieties: Spain, Mexico, Caribbean, and South America.

Activity: Accent recognition and comprehension exercises

UNIT V:

Integrated Listening and Final Project: Advanced Listening Practice Through Extended Conversations. Synthesizing listening strategies across different media formats. Developing summaries, critiques, and interpretations.

Final Listening Project: analysis and presentation of an audio-visual text. Final Listening Project and Peer Discussion.

Suggested Readings:

1. Spanish Listening Practice Through Conversations, Author: Claudia Orea, ISBN: 978-1549777486, 2017.
2. Learn Spanish with Audio Stories, Author: Frederic Bibard, ISBN-13: 978-1648263281, 2021.
3. Practice Makes Perfect: Spanish Listening Comprehension, Author: Jean Yates, ISBN-13: 978-1260454358, 2019.

Other Materials and Resources:

1. **Online Resources:** Spanish-language podcasts, video lectures, and comprehension exercises.
   (a) **Podcasts:**
      i. **Coffee Break Spanish** (https://coffeebreaklanguages.com): A popular podcast for learning Spanish at various levels.
      ii. **SpanishPod101** (https://www.spanishpod101.com): Offers audio lessons for beginners to advanced learners.
      iii. **Notes in Spanish** (https://www.notesinspanish.com): Provides podcasts at various levels with a focus on conversational Spanish.
   (a) **Videos and Platforms:**
      i. **FluentU**(https://www.fluentu.com): This platform uses real-world videos (like music videos, movie trailers, and more) to teach Spanish.
      ii. **SpanishDict YouTube Channel** (https://www.youtube.com/user/spanishdict): Offers video lessons and tutorials on grammar, pronunciation, and vocabulary.
      iii. **Butterfly Spanish** (https://www.youtube.com/c/ButterflySpanish): A YouTube channel that covers all aspects of Spanish with clear explanations.
   (a) **Interactive Tools:**
      i. **LingQ**(https://www.lingq.com): Offers a variety of Spanish content for audio practice and vocabulary development.
      ii. **Duolingo** (https://www.duolingo.com): A well-known interactive app with Spanish courses that use audio, quizzes, and interactive exercises.
      iii. **Babbel** (https://www.babbel.com): A language-learning app that incorporates audio, quizzes, and dialogues in its lessons.

iv. **Supplementary Media:** Films, music, and documentaries in Spanish.
v. **Listening Tools:** Transcripts, subtitles, and speech analysis software

Course Outcomes (CO):

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

CO1: Identify key vocabulary and expressions in audio-visual materials.

CO2: Interpret spoken Spanish in everyday and thematic contexts.

CO3: Utilize listening strategies to comprehend complex dialogues.

CO4: Differentiate regional accents and linguistic variations in Spanish.

CO5: Assess and discuss the effectiveness of listening techniques.

CO6: Participate in oral discussions and create summaries of audio-visual content.

Course Title: **Japanese for Engineers**	
Course Code: **JP30202**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To build a foundational knowledge of the Japanese language while fostering interest in Japan and its culture. The course aims to equip learners with basic reading skills and the ability to engage in short, everyday conversations. It will cover approximately 35% of the syllabus required for the JLPT N5 examination.

Course Description:

The course focuses on foundational introduction to Japanese language, society, and culture. Three Japanese scripts, including Hiragana, Katakana and Kanji, will be introduced, followed by general sentence structure, numerals, counting suffixes, time, and day. Text will cover various daily life topics which learners can easily relate to and use simple phrases in their conversation.

Course Contents:

UNIT I:
Mastering Hiragana, Katakana and Kanji:

- Introduction to the three Japanese syllabaries: Hiragana, Katakana and

Kanji.
- Learning to read and write these scripts.
- Recognition and pronunciation of basic characters.
- Practice writing simple words and sentences in both Hiragana, Katakana and Kanji.
- Basic Japanese vocabulary development using these scripts.

UNIT II:
Introduction to Basic Japanese Grammar:

- Introduction to Japanese sentence structure (subject-object-verb order).
- Understanding basic grammar elements such as particles（は, が, を, に, へ, と, etc.)
- Introduction to verbs, adjectives, and their conjugations in the present and past tense.
- Common expressions and phrases for daily communication.
- Practice exercises with simple sentence formation.

UNIT III:
Constructing Basic Japanese Sentences:

- Understanding and practicing sentence construction with subject, object, and verb.
- Introduction to affirmative, negative, and question sentence structures.
- Use of common verbs, adjectives, and sentence particles in context.
- Structuring sentences to talk about everyday situations and tasks.
- Sentence transformation exercises for understanding different forms.

UNIT IV:
Expanding Sentence Types and Communication Skills:

- Learning to ask questions, express negations, and make requests.
- Practice in forming clear and logical sentences with connecting words.
- Role-play exercises to practice conversation with various sentence types.

UNIT V:
Vocabulary for IT, Computer science, Manufacturing, Automotive, Construction, Mechanical, Electrical and Electronics engineering:

- Introduction to key technical terms in Japanese related to IT, Computer science, Manufacturing, Automotive, Construction, Mechanical, Electrical and Electronics engineering.

- Focus on common IT, Computer science,Manufacturing, Automotive, Construction, Mechanical, Electrical and Electronics engineering related terminology used in the workplace.

UNIT VI:

Applying Technical Japanese in Context:

- Practice using IT, Computer science,Manufacturing, Automotive, Construction, Mechanical, Electrical and Electronics engineeringrelated vocabulary in real-world scenarios.
- Writing short and simple technical sentences in Japanese for Computer science,Manufacturing, Automotive, Construction, Mechanical, Electrical and Electronics engineers and IT professions.

Suggested Readings:

1. みんなの日本語: 1-1 (Book: Minna no Nihongo: 1-1 Textbook and Vocabulary) published by 3A corporation, Tokyo, Japan, 2018. ISBN-978-9388141147
2. まるごと、入門 A1:Marugoto, nyumon A1ISBN- 978-4384057539
3. Study materials from various textbooks and online resources other than the main textbook.

Course Outcomes (CO):

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

CO1: Students will learn to read and write in the three basic Japanese scripts, Hiragana, Katakana and Kanji, and be able to recognize and use them in everyday communication.

CO2: Students will understand basic Japanese grammar rules, including how to use common particles, verbs, and adjectives in simple conversations.

CO3: Students will be able to form basic Japanese sentences, using correct word order and common sentence structures to express ideas clearly.

CO4: Students will learn to create different types of sentences, such as questions, negatives, and statements, in Japanese, to communicate effectively in various situations.

CO5: Students will acquire essential IT, computer science, manufacturing, automotive, construction, mechanical, electrical and electronics engineering -related vocabulary in Japanese, enabling them to understand and discuss basic technical topics in their field.

CO6: Students will be able to use technical terms related to IT, computer science, manufacturing, automotive, construction, mechanical, electrical and electronics engineering in Japanese to explain simple tasks in workplace.

Course Title: **Gateway To Japan**	
Course Code: **JP40203**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The objective of this course is to provide students with a broad understanding of Japan's geography, culture, lifestyle, and social practices. It aims to develop awareness of Japanese traditions, festivals, manners, and belief systems while also introducing students to traditional and contemporary cultural expressions. By the end of the course, learners will gain a balanced perspective of Japanese society and develop intercultural awareness and appreciation.

Course Description:

This course provides a comprehensive introduction to Japan, covering its geography, culture, lifestyle, social practices, and traditional as well as contemporary aspects of society. Students will explore Japan's physical features, mythology, and demographic characteristics, along with everyday life elements such as housing, clothing, transportation, and food habits. The course further examines Japanese social manners, etiquettes, education system, and religious beliefs, including Shintoism and Buddhism. In addition, learners will be introduced to important festivals such as New Year (Oshougatsu), Bon Festival (Obon), and other cultural celebrations. The course also highlights traditional Japanese arts such as tea ceremony (Sadou), origami, and Ikebana, along with insights into popular culture, thereby offering a holistic understanding of Japan.

Course Contents:

UNIT I:

Basic Information on Japan: An overview of Japan's geography, including its neighbors, rivers, mountains, and topography. Introduction to Japanese mythology, demographic characteristics, and the Japanese writing system.

UNIT II:

Japan and Lifestyle: Exploration of everyday life in Japan, focusing on housing, clothing, food habits, and modes of transportation. Understanding lifestyle patterns and daily practices in Japanese society.

UNIT III:

Festivals and Cultural Traditions of Japan: Study of major Japanese festivals such as New Year (Oshougatsu), Bon Festival (Obon), Coming of Age Day (Seijin no Hi), Doll Festival (Hina Matsuri), 7-5-3 Festival (Shichi-Go-San), and Star Festival (Tanabata). Understanding their cultural and social significance.

UNIT IV:

Mannerism and Social Aspects in Japan: Understanding food manners, visiting homes, public behavior, interpersonal relations, and gifting culture. Study of the characteristics of Japanese people. Overview of the education system and introduction to religious beliefs such as Shintoism and Buddhism.

UNIT V:

Traditional Culture of Japan: Introduction to traditional Japanese arts and practices such as tea ceremony (Sadou), origami, and Ikebana (flower arrangement). Understanding their cultural importance and philosophical background.

Suggested Readings:

1. Nippon, the land and its people by Yasuo Aoto, 1988, ISBN-978-4311700026
2. Joy Hendry, Understanding Japanese Society(Second Edition), Nissan Institute, Routledge Japanese Series, 1995, ISBN: 0-415-10259-6
3. Rebecca Kingsley, Japanese Gods and Myths (Ancient Culture), Chartwell Books, 1999, ISBN: 978-0785810803
4. Internet Sources and other authentic Study Materials

Course Outcomes (CO):

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

CO1: Students will acquire knowledge of Japan's geography, culture, and demographic characteristics.

CO2: Students will understand Japanese lifestyle, social practices, and cultural traditions.

CO3: Students will learn basic manners, etiquette, and interpersonal behavior in Japanese society.

CO4: Interpret short professional documents, notices, and workplace dialogues.

CO5: Students will develop awareness of Japanese festivals and their cultural significance.

CO6: Students will understand traditional Japanese arts such as tea ceremony, origami, and Ikebana, along with aspects of contemporary culture.

Course Title: **German For Engineers**	
Course Code: **GR30202**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Acquire basic German vocabulary and grammar for everyday communication. Develop elementary listening, speaking, reading, and writing skills. Engage in simple conversations related to personal, academic, and everyday topics. Gain an introduction to German culture, society, and its relevance to technology and global careers. Build a foundation for further German language learning at A1.2 level or beyond.

Course Description:

This course introduces engineering students to the basics of the German language and culture, focusing on fundamental communication skills aligned with the CEFR A1.1 level. Students will learn to engage in simple everyday interactions, understand basic spoken and written German, and develop initial intercultural competence for academic and global professional contexts. The course uses an interactive, task-based approach and real-life scenarios relevant to students' academic and professional pathways.

Course Contents:

UNIT I:

Willkommen und Kennenlernen:

Topics: Greetings (Hallo, Guten Tag), introducing oneself, countries & languages, numbers 1–20, basic classroom phrases. Grammar: Personal pronouns, verb sein (to be), W-questions (Wer, Wie, Wo), sentence structure (Verb-second position). Skills: Introducing oneself, exchanging basic information, spelling names. Culture: Formal vs informal greetings, Germany's federal states. Vocabulary (CS/IT Focus): Computer (der Computer), Internet (das Internet), Smartphone, E-Mail, Passwort, Login, Benutzer.

UNIT II:

Persönliche Informationen und Formulare:

Topics: Nationalities, languages, telephone numbers, addresses, age, simple forms (online and paper). Grammar: Yes/No questions, articles (der, die, das), possessive pronouns in singular (mein, dein). Skills: Filling out forms (enrollment, Wi-Fi access), giving and asking for contact details. Culture: Registration in Germany (Anmeldung). Vocabulary (CS/IT Focus): Adresse, Telefonnummer, Benutzername, Daten, Formular, E-Mail-Adresse, QR-Code.

UNIT III:

Mein Alltag und Uni-Leben:

Topics: Daily routines, campus map, basic university structures (Mensa, Hörsaal), numbers 20–100, telling time. Grammar: Regular verb conjugation, word order in statements and questions, temporal adverbs (heute, morgen). Skills: Talking about schedules, asking/giving times, describing one's day. Culture: Student life in Germany, punctuality, Vorlesungen vs Seminare. Vocabulary (CS/IT Focus): Universität, Campus, Online-Kurs, Software, WLAN, App, Download.

UNIT IV:

Termine und Zeitmanagement:

Topics: Days of the week, calendar, appointments, making and declining invitations for academic and informal events. Grammar: Negation with nicht, basic prepositions of time (am, um, von…bis). Skills: Setting appointments (online/offline), using a digital calendar, asking about availability. Culture: German punctuality and appointment culture. Vocabulary (CS/IT Focus): Kalender, Termin, Online-Meeting, Videokonferenz, Uhrzeit, Synchronisieren.

UNIT V:

Familie und Soziale Kontakte:

Topics: Family members, relationships, friends, social networks, invitations. Grammar: Possessive articles (mein, dein), plural forms, nominative case. Skills: Introducing family, describing relationships, inviting someone to a gathering. Culture: Family structure in Germany, social gatherings. Vocabulary (CS/IT Focus): Soziale Netzwerke, Profil, Nachricht, Freundschaftsanfrage, Kontaktliste.

Suggested Readings:

1. Stefanie Dengler, Netzwerk Neu A1 Textbook + Workbook + Glossar Audios Available on Allango (Set Of 3 Books), Goyal Publisher, ISBN-13:9789390474318, December 2021.

Course Outcomes (CO):

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

CO1: Recall and use basic German vocabulary and expressions for everyday situations. (Remembering/Understanding)

CO2: Construct simple sentences and questions using fundamental grammatical structures. (Applying)

CO3: Engage in short spoken interactions (greetings, introductions, simple exchanges). (Applying)

CO4: Interpret simple texts (emails, forms, notices) and extract key information. (Understanding)

CO5: Write brief texts such as emails, forms, and personal descriptions. (Applying/Creating)

CO6: Demonstrate basic cultural awareness in communication contexts. (Understanding)

Course Title: **Cultural Trends in Contemporary Germany**	
Course Code: **GR40203**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To deepen understanding of Germany's contemporary cultural and societal trends in a globalized context. To critically evaluate Germany's role in the European Union and global affairs. To explore emerging trends in Germany's cultural, social, and political spheres. To analyze challenges and opportunities in contemporary German society, including issues of sustainability, diversity, and innovation. To cultivate critical perspectives on Germany's cultural diplomacy and its global influence.

Course Description:

This course delves deep into the cultural, social, and political dynamics shaping contemporary Germany. Students will explore Germany's role in the European Union, the impact of globalization, the evolution of German identity, and the challenges faced by the country in a rapidly changing world. The course includes critical discussions on contemporary issues such as gender equality, political movements, digital transformations, and Germany's cultural diplomacy.

Course Contents:

UNIT I:
Germany in the European Union: Germany's leadership role in the EU, Economic and political contributions, Cultural integration within the EU.

UNIT II:
Globalization and German Identity: Impact of globalization on German society, Evolution of German identity in a multicultural world, Role of the German diaspora.

UNIT III:
Contemporary Political Movements: Rise of political activism and grassroots movements, Populism and its impact on German politics, Germany's approach to addressing international crises.

UNIT IV:
Gender Equality and Social Inclusion: Gender roles and feminist movements in Germany, LGBTQ + rights and inclusion Policies for social equity and diversity.

UNIT V:
Digital Transformation and Cultural Diplomacy: Germany's digital advancements and tech innovation, Influence of digital media on culture and society, Germany's global cultural diplomacy: Goethe-Institut, cultural festivals,

and international outreach.

Suggested Readings:

1. Robb, Burns. German Cultural Studies: An Introduction. Oxford University Press.
2. Fulbrook, Mary. The Divided Nation: A History of Germany 1918-1990. Cambridge University Press.

Online Resources:

1. Deutsche Welle (DW) - Politics and Culture Section: www.dw.com
2. Goethe-Institut's Digital Learning Resources: www.goethe.de
3. European Union's Cultural Integration Reports: www.europa.eu

Course Outcomes (CO):

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

CO1: Recall key aspects of Germany's role in the European Union and global culture.

CO2: Explain the socio-political factors influencing contemporary German identity and cultural diplomacy.

CO3: Apply knowledge of German cultural trends to analyze their global implications.

CO4: Investigate the challenges Germany faces in addressing social, environmental, and technological transformations.

CO5: Assess the impact of Germany's policies and cultural movements on its societal development and global standing.

CO6: Design research-based presentations and projects that reflect an understanding of contemporary German cultural dynamics.

Course Title: **Immersive German - Audio-Visual Listening Skills**	
Course Code: **GR40204**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **OE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

Develop students' ability to comprehend German audio-visual materials in everyday contexts. Familiarize learners with diverse Germanic accents and pronunciation patterns. Equip students with strategies to extract key information from spoken language. Provide cultural insights into German speaking regions to contextualize listening skills.

Course Description:

This course immerses students in native German audio-visual content to develop their listening comprehension and practical understanding of spoken German. Through videos, podcasts, and interactive listening tasks, students will learn to interpret everyday conversations, recognize different accents, and respond appropriately. Aligned with CEFR A1-level objectives, this course prepares learners for real- life communication, emphasizing active listening in various contexts like travel, dining, and social interactions.

Course Contents:

UNIT I:

Listening to Personal Conversations Skills: Understanding introductions, small talk, greetings; Inputs: Street interviews, family dialogues, phone conversations; Tasks: Identify personal info from audio; Match statements to speakers; Dialogue reconstruction.

UNIT II:

Daily Routines & Past Events Skills: Understand reports of past events and routines; Inputs: Vlogs, radio reports, interviews; Tasks: Timeline creation from audio, Spot the event and details; Fill in past tense forms.

UNIT III:

At the Store, Market, or Service Counter Skills: Understand transactional dialogues and product descriptions; Inputs: Store videos, cashier recordings, market scenes; Tasks: Note prices, preferences; Fill out a shopping list; Answer follow-up questions.

UNIT IV:

At Work & At the Doctor's Skills: Understand formal workplace language, health discussions; Inputs: Workplace interviews, clinic visits; Tasks: Match symptoms with treatment; Label actions in work settings; Categorize audio: work or health?

UNIT V:

Public Announcements & Instructions Skills: Understand travel Instructions, announcements, rules; Inputs: Train station audio, museum guides, announcements; Tasks: Answer WH-questions from announcements; Fill missing info in travel plans; Match actions to rules heard

Suggested Readings:

1. Stefanie Dengler, Tanja Mayr-Sieber, Paul Rusch, Helen Schmitz, Netzwerk Neu A Textbook+Workbook+Glossar Audios Available OnAllango (Set Of 3 Books), Goyal Publisher, ISBN-13: 9789390474370, December 2021.

Course Outcomes (CO):

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

CO1: Recognize essential vocabulary and phrases from audio-visual sources.

CO2: Identify the main ideas and details in simple spoken German.

CO3: Respond to audio prompts in conversational scenarios.

CO4: Distinguish between different speech patterns and contexts.

CO5: Assess their progress and refine their listening skills through feedback.

CO6: Develop responses, summaries, or role-plays based on audio-visual content.

Course Title: **Industrial Wiring and Control Panel Design**	
Course Code: **EE28011**	Contact Hours: **L-T-P-Cr : 0-0-2-3**
Course Type: **VE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This vocational course will provide an overview of electrical occupations, including the training and the employment options available in electrical industry. It is also designed to provide related training in the electrical trade that will give students the proper coursework in installation and designing of control panel.

Course Contents:

Hands on Practice:

1. Design multiwire circuit for a direct motor starter (DoL) with one operating (forward) direction using QElectrotech software.

2. Design multiwire circuit for a direct motor starter (DoL) with two operating (forward & reverse) direction using QElectrotech software.
3. Design multiwire circuit for a Star – Delta motor stator with one operating (forward) direction using QElectrotech software.
4. Design multiwire circuit for a Star – Delta motor stator with two operating (forward reverse) direction using QElectrotech software.
5. Design & connect for a direct motor starter (DoL) with one operating (forward) direction in modular set up .
6. Design & connect for a direct motor starter (DoL) with two operating (forward reverse) direction in modular set up .
7. Design & connect for a Star – Delta motor stator with one operating (forward) direction in modular set up.
8. Design & connect for a Star – Delta motor stator with two operating (forward reverse) direction in modular set up.
9. Install & wire for a direct motor starter (DoL) with one operating (forward) direction in Industrial Control Panel.
10. Install & wire for a direct motor starter (DoL) with two operating (forward & reverse) direction in Industrial Control Panel.
11. Install & wire for a Star – Delta motor stator with one operating (forward) direction in Industrial Control Panel.
12. Install & wire for a Star – Delta motor stator with two operating (forward & reverse) direction in Industrial Control Panel.

Reference Books:

1. Installation, commissioning and maintenance of electrical equipment by Tarlok Singh.
2. Industrial Electrical Systems by B. P. PATIL and M. A. CHAUDHARI.

Course Outcomes (CO):

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

CO1: Realize the purpose and general principles of control components and circuits.

CO2: Install Industrial wiring circuits according to given specification and plan.

CO3: Analyze circuit operations on basic motors.(3Φ induction Motor).

CO4: Interpret and install circuits according to rules and regulations of the National Electrical Code book.

CO5: Connect motor controllers for specific applications with emphasis on safety practices and in accordance with National Electrical Code (NEC) requirements.

CO6: Select and size contactors, relays and timing relays and overload relays both physically and schematically and describe their operating principles.

Course Title: **Installation, Operation and Maintenance of Solar Power System**	
Course Code: **EE28013**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **VE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To impart job-oriented training to students and make them well convergent on Installation, operation & maintenance of solar PV system. This vocational course is based on study of solar photovoltaic (PV) cells, modules, and system components; electrical circuits; PV system design and sizing for use on homes, commercial building etc., understanding energy conversion from sunlight to electricity, and working with solar conversion equipment. This Course will give students the book knowledge and hands on experience needed to become entrepreneur / self-employed.

Course Contents:

Designing of solar panel and installation:

1. Homer
2. PVSYST
3. Helioscope

Hands on Practice:

1. Demonstrate the I-V and P-V Characteristics of PV module with varying radiation and temperature level.
2. Demonstrate the I-V and P-V characteristics of series and parallel combination of PV modules.
3. Show the effect of variation in tilt angle on PV module power.
4. Demonstrate the effect of shading on module output power.

5. Demonstrate the working of diode as bypass diode and blocking diode.
6. Draw the charging and discharging characteristics of battery.
7. Observe the output waveform of the inverter in auto mode.
8. Workout power flow calculations of standalone PV system of AC load with battery.
9. Workout power flow calculations of standalone PV system of DC load with battery.
10. Find the MPP manually by varying the resistive load across the PV panel.

Reference Books:

1. Solar Photo Voltaic Technology and Systems by Chetan Singh Solanki.
2. Non-Conventional Energy Resources by B.H.Khan.
3. Solar Energy - Principles of Thermal Collection and Storage by P. Sukhatme.
4. Solar Energy: Fundamentals, Design, Modeling and Applications by G. N. Tiwari.

Course Outcomes (CO):

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

CO1: Demonstrate and apply the knowledge of solar electric systems terms and concepts.

CO2: Size and design a photo voltaic system.

CO3: Mount, ground, position, install, wire and connect a photo voltaic system.

CO4: Test voltage generated by photo voltaic system.

CO5: To learn different types of solar PV modules and batteries used in solar PV plant.

CO6: Design of solar PV plant based on estimated loads.

Course Title: **Domestic Wiring and Home Automation**	
Course Code: **EE28015**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **VE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

This vocational course will provide an overview of electrical occupations, including the training and the employment options available in electrical consultancy. It is also designed to provide related training in the electrical wing that will give students the proper coursework in installation and designing of domestic wiring and home automation. To develop electrical wiring skills in students through systematic training that would enable the students to construct and test various electrical circuits using appropriate electrician tools, wires, protective devices and wiring accessories as per IS standards.

Course Contents:

Hands on Practice:

1. Perform the assembly, wiring and implementation of a single switch (SPST Switch) in circuit.
2. Perform the assembly, wiring and implementation of a Double switch (SPST Switch) in circuit.
3. Perform the assembly, wiring and implementation of a power socket in circuit.
4. Perform the assembly, wiring and implementation of a controlled power socket circuit in housing.
5. Perform the assembly, wiring and implementation of a two ways switches (SPDT Switch) in circuit.
6. Perform the assembly, wiring and implementation of a impulse relay in circuit.
7. Perform the assembly, wiring and implementation of a time switch in circuit
8. Perform the assembly, the wiring and the implementation of a timer lighting in circuit.
9. Perform the assembly, the wiring and the implementation of a twilight switch in circuit in house or in a shop.
10. Perform the assembly, wiring and implementation of a controlled lighting in circuit (time switch, timer, twilight switch).
11. Perform the assembly, the wiring and the implementation of a water heater in circuit.
12. Perform the assembly, wiring and implementation of a central impulse relay in circuit.
13. Study and implementation of Light sensitive switch.
14. Perform the assembly, wiring and implementation of a fan in circuit.
15. Perform the assembly, wiring and implementation of a distribution panel.
16. Home automation using KNX technology.

17. Application of Load shedding contactor and programmable time switch.

Reference Books:

1. Home Automation - A Smart Home Guide: The Beginner's Manual Including Google Home, Echo Dot and Amazon Alexa. Easy Instructions, Directions and Commands ... and Home Automation Guide Series Book 1) Kindle Edition
2. Home Automation and Wiring by James Gerhart

Course Outcomes (CO):

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

CO1: Use appropriate electrician tools, wires, protective devices and wiring accessories.

CO2: Rig up wiring diagrams using conduit system of wiring.

CO3: Apply IS standards for electrical wiring

CO4: Prepare different types of wiring joints.

CO5: Well convergent in drawing electrical wiring circuit.

CO6: Enhancement of knowledge regarding specification and application of different electrical devices.

Course Title: **Cyber Physics Application in Industrial IoT**	
Course Code: **EE28015**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **VE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The students will utilize the principles of Cyber-Physical Systems (CPS) and Internet of Things (IoT) to develop applications, implement IoT applications by selecting appropriate hardware and software platform and also Develop IoT applications using open-source platforms.

Course Contents:

Cyber Physical System:

CPS Real-world,Design and Validation of CPS,Smart city application CPS,CPS Hardware Platforms (Process, Sensors and Actuators).

Industry 4.0:

IOT Fundamentals and protocols including layers, Sensor and Interfacing.

Hands on Practice:

1. Architecture and pin diagram of Arduino UNO/MEGA and ESP8266
2. IDE installation for open source C++ or Python
3. Analog and Digital voltage sensing and processing through Firmware
4. Analog and Digital voltage based actuator through Firmware
5. Display OLED/Seven segment integration through IDE PCB Design Concept and implementation with Uc
6. Implementation of UI/UX through Rest API based Thing speak
7. DATA logging and Generating CSV through RestAPI
8. Writing a Firmware for ESP-8266 or NODEMCU(programming based knowledge)
9. IoT based transformer / condition monitoring system

Reference Books:

1. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally
2. Asoke K Talukder and Roopa R Yavagal, "Mobile Computing," Tata McGraw Hill, 2010.
3. Computer Networks - Andrew S. Tanenbaum, Pearson Education Pvt. Ltd., Delhi, 4th Edition
4. Data and Computer Communications - William Stallings, Pearson Education Pvt. Ltd., Delhi, 6th Edition.
5. F. Adelstein and S.K.S. Gupta, "Fundamentals of Mobile and Pervasive Computing," McGraw Hill, 2009.

Course Outcomes (CO):

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

CO1: Understand basics of cyber physics components

CO2: Acquire knowledge on sensors and actuators.

CO3: Explain the function of microcontroller board using its Layout diagram.

CO4: Apply analog and digital I/O for cyber-physics

CO5: Implement different protocols for IoT connectivity.

CO6: Design architecture for IoT enabled Cyber Physics.

Course Title: **Industrial Control and Remote Monitoring**	
Course Code: **EE28019**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **VE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To provide hands on experience in developing Industrial Control and remote monitoring by using PLC (Programmable logic Controller), thus by utilizing it in Process control applications.

Course Contents:

Programmable Logic Controller System:

Introduction to Industrial Automation, Introduction to PLC programmable logic controller PLCs & related software and its major Components: Relay logic Hardware Platforms (Switches, Sensors and Actuators), Study of Contactors, Timers, Counter and Comparator.

Human Machine interface:

Introduction to HMI Communication with PLC, HMI tags and Assignments, Project on Industrial load sequential feedback control Using PLC HMI.

Hands on Practice:

1. Introduction of PLC SOFTWARE as TIA Portal
2. Ladder Programming for Basic gates logics by using SPST Contacts
3. Ladder Programming on SPDT
4. Latching Concept and related Latching program
5. Study of program memory and Programming on Memory Bits
6. Study of TIMER BLOCKs and its Programming
7. Introduction to COMPARATOR BLOCK and its Programming
8. Introduction to COUNTER BLOCK and its Types with Programming
9. Project on Industrial Load OFF/ON control Using PLC and HMI
10. Introduction to analog Logic in PLC and its Programming

Reference Books:

1. Programmable logic Controller by Vijay R. Jadhav Khanna Publishers, Second Edition 2012.
2. Industrial Automation Using PLC, SCADA and DCS by R.G Jamkar Laxmi Publications Private Limited.
3. PLC and SCADA by Prof Rajesh Mehra and Er. Vikrant Vij, Ist Edition, University Science Press.
4. Programmable logic Controller: Programming methods and Applications By John R Hackworth and Frederick D. Hackworth Jr. Pearson Education, 1st Edition, 2006.

Course Outcomes (CO):

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

CO1: Understand the typical components of a Programmable Logic Controller.

CO2: Explain the concept of Electrical ladder logic and its relationship to PLC instructions.

CO3: Understand the concept of digital electronics and data acquisition.

CO4: Program PLC logical switching circuits for industrial applications.

CO5: Choose and utilize Timer, Counter, and other intermediate programming functions.

CO6: Design and program automated industrial production line.

Course Title: **MATLAB Applications**	
Course Code: **EE28021**	Contact Hours: **L-T-P-Cr : 0-0-2-1**
Course Type: **VE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The prime focus of this course is to provide the students a basic understanding of the MATLAB coding and to solve mathematical and engineering problems numerically relevant to the academic and industrial applications.

Course Contents:

Introduction to MATLAB:

Introduction to the course, description, installation and basics of MATLAB as a programming tool. Performing matrix inversion and solving eigen-value problems using Gauss-Jordan Method.

Loop Commands and Applications:

Demonstration and practice of the basic commands and features of the MATLAB (Do loop, If-else loop, While loop etc... plotting graphs).

Math Applications:

Formulate a Matlab algorithm for the solution of algebraic and transcendental equations using bi-section method. Regula-Falsi method and Newton Raphson method. Performing matrix inversion and solving eigen-value problems using Gauss-Jordan Method, Formulate a Matlab algorithm for interpolation using Newton's forward/backward interpolation formula, Numerical solution of ordinary differential equations through Euler's Method and 4th order Runge-Kutta method, Numerical solution of partial differential equations: Solution to Laplace equation.

Concept of Simulink:

Introduction to simulink in MATLAB, Open-ended programming/numerical experiment.

Textbooks:

1. S. C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, Indian Edition, McGraw Hill, 2012.
2. V. Rajaraman, Computer Oriented Numerical Methods, PHI, 2002.
3. David Houcque, Introduction to Matlab for engineering students, Northwestern University.

Course Outcomes (CO):

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

CO1: Use the MATLAB environment as a programming tool.

CO2: Execute the MATLAB commands and features to defined problem.

CO3: Apply the concepts of the MATLAB to write codes for a verity of mathematical problems such as finding the roots of an equation.

CO4: Analyse the errors in the post-processing and display the results graphically.

CO5: Write the algorithms for solving partial and ordinary differential equations.

CO6: Write the algorithms to solve the complex engineering and industry standard problems.

Course Title: **Combinatorics and Graph Theory**	
Course Code: **CS40004**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **RE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To explore several concepts of combinatorics. To understand the applications of generating functions. To describe Euler's formula, Hamiltonpaths, planargraphs and coloring problem. To practice useful algorithms on networks such as shortest path algorithm, minimal Spanning tree algorithm, and max-cut algorithm.

Course Contents:

UNIT I:

Introduction to Combinatorics -permutation of multisets -Combinations ofMultisets -distributionof distinct objects into distinct cells - distribution of non-distinct objects into distinct cells - Shamire secret sharing - Catalan number - Principle of inclusion and exclusion - Derangement.

UNIT II:

Generating functions - Partitions of integer - Ferrer graph - Solving recurrence relations using generating functions - Generating permutations and combinations - Pigeonhole principle: simple and strong Form - A Theorem of Ramsey.

UNIT III:

Graph - simple graph - graph isomorphism - incidence and adjacency matrices - Haveli-Hakimi criterion - Subgraphs Tree – Minimum-cost spanning tree – Kruskal's algorithm- Prim's algorithm - Cayleys' formula – Kirchoff's Matrix-tree Theorem - Fundamental circuits - Algorithms for fundamental circuits - Cut-sets and Cut-vertices - fundamental cut-sets.

UNIT IV:

Euler graph - Fleury's algorithm - Hamiltonian graph - Planar and Dual Graphs - Kuratowski's graphs Coloring - Greedy coloring algorithm - chromatic polynomial.

UNIT V:

Mycielski's theorem – Matching, Halls marriage problem - Independent set -

Dominating set – Vertex cover - clique - approximation algorithms.

Textbooks:

1. RalphP.Grimaldi,“Discrete and Combinatorial Mathematics”, Fifth Edition, PHI / Pearson Education, 2004.
2. G.Chartrand, P. Zhang, “Introduction to GraphTheory”, McGraw-Hill, 2006.

Reference Books:

1. KennethH Rosen,“Discrete Mathematics and its Applications”, Seventh Edition, McGraw Hill, 2012.
2. D.S.Chandrasekharaiah, “Graph Theory and Combinatorics”, Prism, 2005.
3. Douglas B.West,“Combinatorial Mathematics”, Cambridge University Press, 2020.
4. Bikash Kanti Sarkar, Swapan Kumar Chakraborty, “Combinatorics and Graph Theory”, 2016.

Course Outcomes (CO):

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

CO1: Comprehend the fundamentals of combinatorics and apply combinatorial ideas in Mathematical arguments in analysis of algorithms and queuing theory.

CO2: Integrate mathematical and graph theoretic principles to formulate and solve discrete mathematical problems.

CO3: Analyze different forms of graphs and apply spanning-tree and matrix-based algorithms to solve graph problems.

CO4: Apply graph-theoretic algorithms and concepts to solve graph traversal, planarity, and coloring problems.

CO5: Explore related graph structures using Mycielski’s theorem and Hall’s Marriage Theorem.

CO6: Evaluate graph-based optimization problems and select suitable exact or approximation algorithms for specific problems.

Course Title: **Design and Analysis of Parallel Algorithms**	
Course Code: **CS40006**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **RE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand different parallel architectures and models of computation. To introduce the various classes of parallel algorithms. To study parallel algorithms for basic problems. To study graph Algorithms.

Course Contents:

UNIT I:

Introduction to Parallel Computers: Need for parallel processing - SM-SIMD algorithms - Shared memory SIMD - Tree and mesh interconnection computers-Classifying MIMDA lgorithms - parallel computational models such as PRAM - LMCC - Hypercube- Cube Connected Cycle- Butterfly- Perfect Shuffle Computers - Tree model - Pyramid model - Fully Connected model - PRAM - CREW - EREW models - simulation of one model from another one.

UNIT II:

Matrix Operations and Performance Measures: Matrix operations - Mesh transpose - Shuffle transpose - EREW transpose - Mes hmultiplication - Cube multiplication - Matrix by vector multiplication - Tree multiplication - Performance Measures of Parallel Algorithms - speed-up and efficiency of PA - Cost optimality- An example of illustrate Cost-optimal algorithms such as summation - Min/Max on various models.

UNIT III:

Selection and Sorting: Sequential algorithm -Parallel Sorting Networks - Algorithm for parallel selection -Sortingon a linear array - broadcasting a datum - Computing all sums - Sorting on a mesh - Sorting on EREW SIMD computer - enumeration sort - parallel quick sort - hyper quick sort - Sorting on other networks - Parallel Merging Algorithms on CREW / EREW / MCC / -Parallel Sorting Networks on CREW / EREW / MCC.

UNIT IV:

Searching and Numerical Problems: Parallel Searching Algorithm - Kth element - Kth element in X+Y on PRAM - Parallel Matrix Transportation and

Multiplication Algorithm on PRAM - MCC - Vector-Matrix Multiplication - Solution of Linear Equation - Root finding - SIMD algorithm - Roots of nonlinear equations - MIMD algorithm - Partial differential equations -Computing Eigen values - Monte Carlo methods -parallel random number generators – random number distributions.

UNIT V:

Graph Problems: Definitions - Graph coloring - Computing the connectivity matrix - Finding connected components -search and traversal - Minimal alpha - beta tree - Minimum Cost Spanning Tree -Addition tree - Multiplication tree - Combinatorial Algorithms - Permutation - Combinations - Derangements.

Textbooks:

1. M. J. Quinn, "Designing Efficient Algorithms for Parallel Computer", McGraw Hill, 1987.
2. S. G. Akl, "Design and Analysis of Parallel Algorithms", PHI, 1989.

Reference Books:

1. J. Jaja, "An Introduction to Parallel Algorithms", Addison Wesley, 1992.
2. F. T. Leighton, "Introduction to Parallel Algorithms and Architectures: Arrays, Trees", Morgan Kaufmann Publishers In, 1991.
3. F.Thomson Leighton, "Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes", Morgan Kaufmann Publishers, San Mateo California, 1992.

Course Outcomes (CO):

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

CO1: Develop parallel algorithms for standard problems and applications.

CO2: Explain and derive the complexity of algorithms for basic and collective Communication operations.

CO3: Apply different methods and performance measures to analyze algorithms with respect to cost and scalability.

CO4: Perform design and analysis of parallel algorithms in real-time applications.

CO5: Design and develop parallel algorithms for SIMD and MIMD architectures

CO6: Implement graph algorithms in parallel environments

Course Title: **GPU Computing**	
Course Code: **CS40008**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **RE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To learn the architecture of GPU and basics of parallelism. To learn about the evolution of GPU computing. To learn GPU programming using CUDA. To study the methods of performance improvement in GPU.

Course Contents:

UNIT I:

Introduction: Graphics Processing Units (GPU) as Parallel Computers - Architecture of a modern GPU - Why more speed or parallelism? –Parallel Programming Languages and Models-Overarching Goals- History of GPU computing - Evolution of Graphics Pipelines - GPU Computing.

UNIT II:

Parallel Programming: Goals of Parallel Programming-Problem Decomposition –Algorithm Selection -Computational Thinking-Introduction to OPEN CL: Background-Data Parallelism Model-Device Architecture Kernel Functions-Device Management Kernel Launch.

UNIT III:

Introduction to CUDA: Data Parallelism-CUDA Program Structure-A Matrix-Matrix Multiplication Example-Device Memories and Data Transfer - Kernel Functions and Threading - Function declarations - Kernel launch - Predefined variables -Runtime API - CUDA Threads: CUDA Thread Organization – Using blocked and threaded-Synchronization and Transparent Scalability-Thread Assignment-Thread Scheduling and Latency Tolerance - CUDA Memories: Importance of Memory Access Efficiency - CUDA Device Memory Types - A Strategy for Reducing Global Memory Traffic - Memory as a Limiting Factor to Parallelism.

UNIT IV:

Performance considerations: Thread execution - Global memory bandwidth - Dynamic partitioning of SM resources - Data prefetching - Instruction mix - Thread Granularity - Floating Point considerations: FP format - Representable numbers - Special bit patterns and precision - Arithmetic accuracy and rounding - Algorithm considerations - Debugging and Profiling: Debugging CUDA programs - Profiling CUDA programs - CUDA and MPI.

UNIT V:

Parallel Programming: Parallel Programming and Computational Thinking-Goals of Parallel Programming-Problem Decomposition - Algorithm Selection - Computational Thinking – Open CL – Introduction.

Textbooks:

1. David Kirk, Wen-mei Hwu, "Programming Massively Parallel Processors: A Hands-on Approach", Third Edition, Morgan Kaufmann, 2017.

Reference Books:

1. Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs(Applications of GPU Computing)",First Edition, Morgan Kaufmann, 2012.

Course Outcomes (CO):

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

CO1: Understand the basics of GPU architecture programs using CUDA and OpenCL.

CO2: Develop parallel applications targeting GPUs.

CO3: Develop Debugging tool.

CO4: Analyse the performance of the memory and thread execution in view of parallel programming.

CO5: Simulate parallel algorithms in GPUs for performance improvement.

CO6: Design special architecture for parallel processing of GPUs and CPU.

Course Title: **Metaverse and Blockchain**	
Course Code: **CS40010**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **RE**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

To understand the History of Metaverse and Blockchain. Explore the role of

Metaverse to connect the real world and blockchain. To understand the advanced development of blockchain in the future. To study an open ecosystem of smart properties and assets. To explore the integration of futuristic technologies such as blockchain, cryptocurrency, DAO, AR/VR.

Course Contents:

UNIT I:

Introduction To Metaverse: Introduction to Metaverse and immersive experience-History of Metaverse-Metaverse value chain with 7 layer.

UNIT II:

Technologies Involved In The Metaverse: Metaverse as a product of Extended Reality- Augmented Reality (AR)- Virtual Reality (VR)- Benefits of AR / VR - Difference between AR / VR - Mixed Reality (MR) - Artificial Intelligence(AI) Introduction in Metaverse - Financial and Economics of Metaverse - Benefits of Metaverse.

UNIT III:

Blockchain adoption in Metaverse: Blockchain Overview-History of Blockchain-Need of Decentralization in MV-Smart Contract Capabilities in Blockchain –Blockchain in Metaverse-Understanding Tokens-Understanding the NFT-NFT Token Standards-NFTs in MV-Cryptocurrency in MV.

UNIT IV:

AR, VR, MR, Blockchain in Metaverse: Everything about VR (Virtual Reality)-Everything about AR (Augmented Reality)-Everything about MR (Mixed Reality)-Blockchain Identity Management in Metaverse -NFT (non-fungible token) for Metaverse-Introduction to NFTs-History of NFTs-Benefits of NFTs.

UNIT V:

Use-Cases: Gaming in Metaverse - Meetings in Metaverse - Virtual Learning in Metaverse - Social Interactions in Metaverse - Virtual Real-estate in Metaverse - E-commerce in Metaverse - Travel in Metaverse - Personalized Avatars-Digital Identity in Metaverse.

Textbooks:

1. Matthew Ball, “The Metaverse: And How It Will Revolutionize Everything” Publisher: Liveright, Kindle Edition,2022

2. QuHarrison Terry, Scott Keeney, "The Metaverse Handbook: Innovating for the Internet's Next Tectonic Shift", Publisher: Wiley; 1st edition, 2022.

Reference Books:

1. The Wearable Technology Handbook, Haider Raad, scholar publcialtions,2017.
2. Metaverse Made Easy: A Beginner's Guide to the Metaverse, Dr. Liew Voon Kiong,Publisher, LiewVoonKiong, 2022.
3. Metaverse For Beginners and Advanced: A Complete Journey Into the Metaverse Virtual.
4. World(Web3.0), Darell Freeman, Publisher DarellFreeman, 2022.
5. Metaverse Glossary-Your Gateway to the Future, Ravindra Dastikop, Evincepub Publishing, 2022.
6. The Metaverse: Prepare Now for the Next Big Thing Paper back, Terry Winters, Winters media Publiaction 2021.

Course Outcomes (CO):

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

CO1: Understand the History of Metaverse and the role of Metaverse to connect the real World and blockchain.

CO2: Working with advanced development of blockchain in the future.

CO3: Exploring the open ecosystem of smart properties and assets.

CO4: Integrating futuristic technologies such as blockchain, cryptocurrency, DAO, AR/VR.

CO5: Incorporate AI in Metaverse to explore the accuracy and feasibility of the model.

CO6: Design and develop tools for Metaverse environments.

Course Title: **Web Design**	
Course Code: **CS19001**	Contact Hours: **L-T-P-Cr : 3-0-0-3**
Course Type: **GER**	Pre-requisites: **Nil**

Course Learning Objectives (CLO):

The Objective of the course is to learn the concepts of the fundamentals of web technologies. Design responsive and user-friendly web pages. Develop static websites using HTML5, CSS3, and Bootstrap. Add interactivity using JavaScript. Publish and maintain websites on web hosting platforms.

Course Contents:

UNIT I:

Introduction to Web Design: Introduction to Internet and World Wide Web, Website Architecture, Static vs Dynamic Websites, Web Browsers and Web Servers, Domain Name and Web Hosting, Introduction to Web Design Tools (VS Code, Notepad++), Basic Web Design Principles, Creating the First Web Page.

UNIT II:

HTML5 Fundamentals: Structure of HTML Document, HTML Elements and Attributes, Headings, Paragraphs, Lists, Hyperlinks, Images, Tables, Forms and Input Controls, Multimedia (Audio, and Video), Semantic HTML5 Tags, HTML Validation.

UNIT III:

CSS3 and Responsive Web Design: Introduction to CSS, Types of CSS, Selectors, Colors and Backgrounds, Fonts and Typography, Box Model, Display Properties, Positioning, Flexbox, CSS Grid, Responsive Design, Media Queries, Bootstrap Framework, Bootstrap Components.

UNIT IV:

Bootstrap Framework: Introduction to Bootstrap, Bootstrap Grid System, Containers, Rows, and Columns, Navigation Bars, Buttons, Cards, and Forms.

UNIT V:

Website Development Tools, Forms and Multimedia: HTML Forms and Input Controls, Form Elements and Validation, Audio and Video Embedding, Google Fonts and Icons, Website Planning and UI Principles, Web Accessibility Basics, Search Engine Optimization (SEO) Basics, Version Control Concepts, Introduction to Git and GitHub.

Textbook:

1. HTML and CSS: Design and Build Websites, by Jon Duckett, John Wiley Sons, 1st Edition 2011.

Reference Book:

1. Responsive Web Design with HTML5 and CSS, by Ben Frain, Packt Publishing, 5th Edition, 2025.

Course Outcomes (CO):

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

CO1: Explain the fundamental concepts of web technologies, website architecture, domain names, web hosting, and the role of HTML5 in web development.

CO2: Design and develop structured web pages using HTML5 elements, hyperlinks, tables, forms, multimedia, and semantic tags.

CO3: Apply CSS3 techniques, including selectors, the box model, Flexbox, Grid, and media queries, to create visually appealing and responsive web pages.

CO4: Develop responsive and interactive websites using the Bootstrap framework and JavaScript for navigation, validation, and dynamic webpage behavior.

CO5: Plan, test, debug, and optimize websites by incorporating multimedia content, accessibility features, and basic SEO practices while using version control tools.

CO6: Design, develop, test, and publish a complete responsive website by integrating HTML5, CSS3, Bootstrap, and JavaScript, demonstrating industry-relevant web design skills.