GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)

(Deemed to be University)

VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with A++ Grade

GITAM School of Technology

CURRICULUM AND SYLLABUS

4 Year Undergraduate Programme
UEECE01: B.Tech. Electronics and Communication Engineering

w.e.f. 2021-22 admitted batch

(Updated on 1st December 2023)

Academic Regulations

Applicable for the Undergraduate Programmes in the Schools of Business, Humanities & Social Sciences, Science and Technology

https://www.gitam.edu/academic-regulations

Vision

To become a global leader in higher education.

Mission

To impart futuristic and comprehensive education of global standards with a high sense of discipline and social relevance in a serene and invigorating environment.

Quality Policy

To achieve global standards and excellence in teaching, research, and consultancy by creating an environment in which the faculty and students share a passion for creating, sharing and applying knowledge to continuously improve the quality of education.

VISION AND MISSION OF THE SCHOOL

VISION

To become a global leader in holistic engineering education and research

MISSION

1. To impart a strong academic foundation and practical education through a flexible curriculum, state-of-the-art infrastructure, and best learning resources
2. To actively pursue academic and collaborative research with industries and research institutions, both in India and abroad
3. To build a congenial and innovative eco system by enabling the latest technologies, thus helping the students, to solve the challenges of societal importance
4. To provide our students with the appropriate leadership, management, communication skills and professional ethics for career success and to continuously impact the global lives

UEECE01: B.Tech. Electronics and Communication Engineering

(w.e.f. academic year 2021-22 admitted batch)

VISION

To excel in higher education by imparting quality teaching and research and to meet the challenges in Electrical, Electronics and Communication Engineering

MISSION

1. To impart technical skills, value-based education to students, to enable them to face the demands of the industry
2. To create innovative and instructional learning methods to hone the skills for solving problems of society
3. To carry out research through constant interaction with R & D organizations and industry
4. To motivate the students to develop expertise in multidisciplinary technologies for a sustainable growth

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1 To impart knowledge of mathematics and science concepts as tools to device and deliver efficient solutions to problems of Electronics & Communication Engineering

PEO 2 To inculcate analytical ability in the students to keep pace with changing technologies and to imbibe skill and research culture to meet the industrial and societal needs

PEO 3 To provide a platform for the graduate to be successful in technical and professional careers or develop as an entrepreneur

PEO 4 To instill teamwork, leadership, and communication skills in the student with professional, ethical, and human values to be responsible citizen of the society

Mapping of the Mission of the School with the PEOs

	PEO1	**PEO2**	**PEO3**	**PEO4**
M1	H	M	L	L
M2	L	H	M	L
M3	M	L	M	L
M4	L	L	H	H

H – High, M – Medium, L – Low

PROGRAMME OUTCOMES(POS) AND PROGRAMME SPECIFIC OUTCOMES(PSOS):

At the end of the Programme the students would be able to:

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1	Design and develop electronic, communication and signal processing systems for engineering applications in the fields of consumer electronics, embedded, wireless communication, networking, and allied interdisciplinary areas.
PSO2	Demonstrate the use of modern tools and techniques for solving contemporary real-world problems in electronics and communication systems
PSO3	Research and devise appropriate technologies for implementation of the electronics and telecommunication systems as an entrepreneur/researcher with professional ethics & concern for societal wellbeing

Curriculum Structure

(Flexible Credit System)

UNIVERSITY CORE (UC)

Course code	Level	Course title	L	T	P	S	J	C
CSEN1001	1	IT Productivity Tools^	0	0	2	0	0	1*
CLAD1001	1	Emotional Intelligence & Reasoning Skills (Soft Skills 1)	0	0	2	0	0	1
CLAD1011	1	Leadership Skills & Quantitative Aptitude (Soft Skills 2)	0	0	2	0	0	1
CLAD1021	1	Verbal Ability & Quantitative Ability (Soft Skills 3)	0	0	2	0	0	1
CLAD1031	1	Practicing Verbal Ability & Quantitative Aptitude (Soft Skills 4)	0	0	2	0	0	1
CLAD20XX	2	Soft skills 5A/5B/5C	0	0	2	0	0	1
CLAD20XX	2	Soft skills 6A/6B/6C	0	0	2	0	0	1
DOSP10XX	1	Sports 1#	0	0	0	2	0	2*
DOSL10XX	1	Club Activity#	0	0	0	2	0	2*
DOSL10XX	1	Community Service#	0	0	0	0	2	2*
ENVS1001	1	Environmental Studies^	3	0	0	0	0	3*
FINA3001	3	Personal Financial Planning#	0	0	2	0	0	1*
LANG1001	1	Communication Skills in English - Beginners	0	0	4	0	0	2*
LANG1011	1	Communication Skills in English	0	0	4	0	0	2
LANG1021	1	Advanced Communication Skills in English	0	0	4	0	0	2
MFST1001	1	Health and Wellbeing#	0	0	2	0	0	1*
POLS1001	1	Indian Constitution and History	2	0	0	0	0	2*
PHPY1001	1	Gandhi for the 21st Century	2	0	0	0	0	2*
VEDC1001	1	Venture Development	0	0	0	2	0	2

* Pass/Fail courses
# Opt any two courses among the five
^ Online/Swayam/NPTEL Courses

Soft skills courses 5 and 6								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
CLAD2001	2	Preparation for Campus Placement-1 (Soft skills 5A)	0	0	2	0	0	1
CLAD2011	2	Preparation for Higher Education (GRE/ GMAT)-1 (Soft skills 5B)	0	0	2	0	0	1
CLAD2021	2	Preparation for CAT/ MAT – 1 (Soft skills 5C)	0	0	2	0	0	1
CLAD2031	2	Preparation for Campus Placement-2 (Soft skills 6A)	0	0	2	0	0	1
CLAD2041	2	Preparation for Higher Education (GRE/ GMAT)-2 (Soft skills 6B)	0	0	2	0	0	1
CLAD2051	2	Preparation for CAT/ MAT – 2 (Soft skills 6C)	0	0	2	0	0	1

Sports Courses								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
DOSP1001	1	Badminton	0	0	0	2	0	2
DOSP1011	1	Chess	0	0	0	2	0	2
DOSP1021	1	Carrom	0	0	0	2	0	2
DOSP1031	1	Football	0	0	0	2	0	2
DOSP1041	1	Volleyball	0	0	0	2	0	2
DOSP1051	1	Kabaddi	0	0	0	2	0	2
DOSP1061	1	Kho Kho	0	0	0	2	0	2
DOSP1071	1	Table Tennis	0	0	0	2	0	2
DOSP1081	1	Handball	0	0	0	2	0	2
DOSP1091	1	Basketball	0	0	0	2	0	2
DOSP1101	1	Tennis	0	0	0	2	0	2
DOSP1111	1	Throwball	0	0	0	2	0	2

Club Activity Courses								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
DOSL1001	1	Club Activity (Participant)	0	0	0	2	0	2
DOSL1011	1	Club Activity (Member of the Club)	0	0	0	2	0	2
DOSL1021	1	Club Activity (Leader of the Club)	0	0	0	2	0	2
DOSL1031	1	Club Activity (Competitor)	0	0	0	2	0	2

Community Service courses								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
DOSL1041	1	Community Services – Volunteer	0	0	0	0	2	2
DOSL1051	1	Community Services – Mobilizer	0	0	0	0	2	2

FACULTY CORE (FC)								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
CHEM1001	1	Chemistry	2	1	2	0	0	4
CSEN1011	1	Problem Solving and Programming with C	0	0	6	0	0	3
CSEN1021	1	Programming with Python	0	0	6	0	0	3
CSEN1031	1	Artificial Intelligence Applications	0	0	2	0	0	1
EECE1001	1	Basic Electrical and Electronics Engineering	2	1	2	0	0	4
HSMCH102	1	Universal Human Values	3	0	0	0	0	3
INTN2333	2	Internship 1	0	0	0	0	1	1
INTN3444	3	Internship 2	0	0	0	0	1	3
MATHXXXX	X	Mathematics Basket 1	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 2	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 3	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 4	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 5	2	0	0	0	0	2
MATHXXXX	X	Mathematics Basket 6	2	0	0	0	0	2
MATH2361	2	Probability and Statistics	3	0	0	0	0	3
MECH1011	1	Engineering Visualization and Product Realization	0	0	4	0	0	2
MECH1021	1	Workshop	0	0	2	0	0	2
MECH1001	1	Design Thinking	0	0	2	0	0	1
PHYS1001	1	Physics	2	1	2	0	0	4
PHYSXXXX	1	Physics Basket	3	1	0	0	0	4
PROJ2999	2	Capstone Project – Introduction	0	0	0	0	2	2
PROJ3999	3	Capstone Project – Final	0	0	0	0	6	6
PROJ2888	2	Project Exhibition 1	0	0	0	0	1	1
PROJ3888	3	Project Exhibition 2	0	0	0	0	1	1
VIVA3555	3	Comprehensive Examination	1	0	0	0	0	1
XXXXXXXX	X	Management Basket	3	0	0	0	0	3
BTEN1001	1	Introduction to Biotechnology-I	2	0	0	0	0	2
BTEN1021	1	Introduction to Biotechnology-II	2	0	0	0	0	2

Mathematics Basket								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
MATH1001	1	Single Variable Calculus	2	0	0	0	0	2
MATH1011	1	Several Variable Calculus	2	0	0	0	0	2
MATH2371	2	Difference Equations	2	0	0	0	0	2
MATH1031	1	Differential Equations	2	0	0	0	0	2
MATH2281	2	Numerical techniques	2	0	0	0	0	2
MATH1021	1	Transform Techniques	2	0	0	0	0	2
MATH2381	2	Operations Research	2	0	0	0	0	2
MATH2301	2	Complex Variables	2	0	0	0	0	2
MATH1041	1	Discrete Mathematics	2	0	0	0	0	2
MATH1051	1	Graph Theory	2	0	0	0	0	2
MATH2311	2	Number Theory	2	0	0	0	0	2
MATH2291	2	Linear Algebra	2	0	0	0	0	2
MATH2341	2	Probability Theory and Random Variables	2	0	0	0	0	2
MATH2321	2	Random Processes	2	0	0	0	0	2
MATH2351	2	Optimization Methods	2	0	0	0	0	2
MATH2331	2	Computational Methods	2	0	0	0	0	2
MATH1061	1	Introduction to Mathematics – I	2	0	0	0	0	2
MATH1071	1	Introduction to Mathematics – II	2	0	0	0	0	2
MATH2361	2	Probability and Statistics	3	0	0	0	0	3
Physics Basket								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
PHYS1001	1	Physics	2	1	2	0	0	4
PHYS1011	1	Mechanics and Properties of Matter	3	1	0	0	0	4
PHYS1021	1	Principles of Quantum Mechanics	3	1	0	0	0	4
PHYS1241	1	Physics of Optoelectronic devices	3	1	0	0	0	4
PHYS1041	1	Mechanics and Modern Physics	3	1	0	0	0	4
Management Basket								
Course code	**Level**	**Course title**	**L**	**T**	**P**	**S**	**J**	**C**
FINA1031	1	Principles and Practice of Banking	3	0	0	0	0	3
HRMG1021	1	Human Resource Management	3	0	0	0	0	3
MKTG3011	3	Sales and Distribution Management	3	0	0	0	0	3
MKTG1001	1	Marketing Management	3	0	0	0	0	3
OPTS2001	2	Production and Operations Management	3	0	0	0	0	3
HRMG2001	2	Organizational Behavior	3	0	0	0	0	3
HRMG1001	1	Principles and Practice of Management	3	0	0	0	0	3

Programme Core (PC)

Course code	Level	Course Title	L	T	P	S	J	C
EECE1011	1	Electronics Workshop	0	0	2	0	0	1
EECE1021	1	Signals and Systems	2	1	0	0	0	3
EECE1031	1	Network Theory and Analysis	2	1	0	0	0	3
EECE1041	1	Electronic Devices and Amplifier Circuits	3	0	2	0	0	4
EECE2001	2	Random Signal and Noise	2	0	0	0	0	2
EECE2011	2	Analog Communications	2	0	0	0	0	2
EECE2021	2	Digital Logic Design	3	0	2	0	0	4
EECE2031	2	Analog Circuits	3	0	2	0	0	4
EECE2041	2	Control Systems	2	1	0	0	0	3
EECE2051	2	Electromagnetic Waves	3	0	0	0	0	3
EECE3001	3	Digital Signal Processing	3	0	2	0	0	4
EECE3011	3	Digital Communications	3	0	2	0	0	4
EECE3022	3	Antenna Analysis and Design	2	0	2	0	0	3
EECE3031	3	Communication Networks	3	0	2	0	0	4
EECE3041	3	Microprocessors and Microcontrollers	3	0	2	0	0	4
EECE3051	3	VLSI Design	3	0	2	0	0	4

Programme Elective (PE)								
Course code	**Level**	**Course Title**	**L**	**T**	**P**	**S**	**J**	**C**
EECE1071	1	Battery Technologies	3	0	0	0	0	3
EECE2091	2	Embedded Sensors and Motors-1	3	0	0	0	0	3
EECE2101	2	Optical Engineering	3	0	0	0	0	3
EECE2141	2	Telecommunications for Society	3	0	0	0	0	3
EECE2151	2	Electronic Appliances	3	0	0	0	0	3
EECE2161	2	Practical Electronics	2	1	0	0	0	3
EECE2171	2	Arduino for Beginners	2	0	2	0	0	3
EECE2181	2	Raspberry Pi for Beginners	2	0	2	0	0	3
EECE3121	3	Information Theory and Error Control Coding	3	0	0	0	0	3
EECE3131	3	Wireless Communications	3	0	0	0	0	3
EECE3141	3	Fiber Optic Communications	3	0	0	0	0	3
EECE3151	3	Satellite Communications	3	0	0	0	0	3
EECE4001	4	Wireless Networks	3	0	0	0	0	3
EECE3161	3	Global Positioning Systems	3	0	0	0	0	3
EECE4011	4	Software Defined Networks	3	0	0	0	0	3
EECE3171	3	Transmission Lines and Waveguides	3	0	0	0	0	3
EECE3181	3	EMI - EMC Systems	3	0	0	0	0	3
EECE3191	3	Radar Systems	3	0	0	0	0	3
EECE3201	3	Microwave Engineering	3	0	0	0	0	3

EECE3212	3	ARM System Development	3	0	2	0	0	4
EECE3221	3	Internet of Things	2	0	2	0	0	3
EECE3231	3	IoT Architecture and Protocols	3	0	0	0	0	3
EECE3241	3	IoT Applications	3	0	0	0	0	3
EECE3242	3	Wireless Sensor Networks	3	0	0	0	0	3
EECE3251	3	Sensors and Signal Conditioning	3	0	0	0	0	3
EECE4031	4	IoT Security	3	0	0	0	0	3
EECE4032	4	Cloud based IoT	3	0	0	0	0	3
EECE3261	3	Real Time Signal Processing	2	0	2	0	0	3
EECE3271	3	Digital Image Processing	3	0	0	0	0	3
EECE3281	3	DSP Processors	3	0	0	0	0	3
EECE3291	3	Biomedical Signal Processing	3	0	0	0	0	3
EECE3301	3	Speech Processing	3	0	0	0	0	3
EECE3311	3	Digital Signal Compression	3	0	0	0	0	3
EECE3322	3	Computer Organization and Design	3	0	2	0	0	4
EECE3332	3	Hardware Modeling with HDLs	2	0	2	0	0	3
EECE3341	3	FPGA System Design	2	0	2	0	0	3
EECE3351	3	Linear Integrated Circuits	3	0	0	0	0	3
EECE3361	3	Digital System Design	3	0	0	0	0	3
EECE3372	3	Data Structures with Python	3	0	2	0	0	4
EECE3381	3	Machine Learning	3	0	0	0	0	3
EECE4022	4	RF Circuit Design	3	0	2	0	0	4
EECE4042	4	VLSI Design Automation	3	0	2	0	0	4
EECE4052	4	Analog IC Design	3	0	2	0	0	4
EECE4061	4	Modern VLSI Devices	3	0	0	0	0	3
EECE4072	4	C-Based VLSI Design	3	0	2	0	0	4
EECE4081	4	Machine Learning for speech, Audio, and video Analysis	3	0	0	0	0	3
EECE4091	4	Machine Learning for Antenna Array Applications	3	0	0	0	0	3
EECE4082	4	Big Data Analytics	3	0	0	0	0	3
EECE3661	3	Neural Networks	3	0	0	0	0	3
CSEN3011	3	Artificial Neural Networks	3	0	2	0	0	4
CSEN3081	3	Deep Learning	2	1	0	0	0	3
CSEN3261	3	Machine Learning and its Applications	3	0	2	0	0	4
# opt eligible PC/PE courses from other programmes as an open elective course and earn 24 credits								
Students who enrolled for BTech programme with specialized subjects in AIML, VLSI Design, IOT should enroll for only program elective courses related to their specialization								

PROGRAMME STRUCTURE

BTech Programme consists of courses which could be grouped under University Core (UC), Faculty Core (FC), Major/Programme Core (PC), Major/Programme Electives (PE) and Open Electives (OE) as the below breakup.

Category	Credits	% of Program (in credits)
University Core (UC)	12	8%
Faculty Core (FC)	57	35%
Programme Core (PC)	52	33%
Programme Electives (PE)	15	9%
Open Electives (OE)	24	15%
Total	**160**	

Courses offered under University Core are common to all undergraduate level programmes offered by GITAM. Courses offered under Faculty core are common to all BTech programmes offered by GITAM and are meant to acquaint the student with general engineering principles in all disciplines of engineering. Based on the chosen BTech Programme, the student shall complete courses under Programme Core (specific to be chosen branch of engineering).

Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week. In general,

- **Theory:** A student attending classroom lecture/ tutorial/ skill development activity of 50 minutes' duration per week, spread over the entire semester is awarded one credit.
- **Practical:** A student attending a minimum of 100 minutes per week of laboratory session/ practical is awarded - one credit.
- **Project Work:** A student working for 50 minutes of project work per week with 3 hours of work performed independent of the instructor during the entire semester is awarded - one credit
- **Internship:** 8 hours in a day for four weeks is required for earning internship credits

Course PO Mapping

Course Code	Course Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EECE1011	Electronics Workshop						H					H		L	M	
EECE1021	Signals and Systems	H	M	L										L		
EECE1031	Network Theory and Analysis	H	M	L										L		
EECE1041	Electronic Devices and Amplifier Circuits	H	M	L										L		
EECE2001	Random Signals and Noise	L	H	M										M		
EECE2011	Analog Communications	L	H	M										M		
EECE2021	Digital Logic Design	L	H	M										L		
EECE2031	Analog Circuits	M	H	L										L		
EECE2041	Control Systems	M	H	L										L		
EECE2051	Electromagnetic Waves	H	L					M	L					L		
EECE3001	Digital Signal Processing	H	L			L								M		L
EECE3011	Digital Communications	H	M				L							M		L
EECE3022	Antenna Analysis and Design	H	M				M	L						M		L
EECE3031	Communication Networks	L					H	M						M		
EECE3041	Microprocessors and Microcontrollers						L							M	L	M
EECE3051	VLSI Design		L			M								M		H
EECE3121	Information Theory and Error Control Coding		M		L									H	M	L
EECE3131	Wireless Communications	L					M						M	H		
EECE3141	Fiber Optic Communications	L					M						M	H		
EECE3151	Satellite Communications				M	M					L			H	L	
EECE4001	Wireless Networks			L		H								H	M	
EECE3161	Global Positioning Systems	M	M			L								H	M	
EECE4011	Software Defined Networks	M	L	M					L			M		H	M	

EECE3171	Transmission Lines and Waveguides	L	M					L						H	M	
EECE3181	EMI - EMC Systems	M		M					L					M		H
EECE3191	Radar Systems								L					H	M	
EECE3201	Microwave Engineering			M				L						H	L	
EECE4022	RF Circuit Design			H			L	M	L					H		M
EECE3212	ARM System Development								L					H	M	L
EECE3221	Internet of Things			L			H	M				L		M	H	L
EECE3231	IoT Architecture and Protocols			L			H	M				L				M
EECE3241	IoT Applications			L			M	M				L				M
EECE3242	Wireless Sensor Networks	L	M	H		L								M		L
EECE3251	Sensors and Signal Conditioning		L	M		H	M		L					M	H	L
EECE4031	IoT Security			M					M			L	L	M	H	L
EECE4032	Cloud based IoT			M					M			L	M	M	H	M
EECE3261	Real Time Signal Processing			M			L	L							M	H
EECE3271	Digital Image Processing					M	L							M	H	
EECE3281	DSP Processors	L												M	H	
EECE3291	Biomedical Signal Processing	H	H		M		L							M		H
EECE3301	Speech Processing	L					M							M	H	
EECE3311	Digital Signal Compression	L												M	H	
EECE3322	Computer Organization and Design	M	L	L										M		L
EECE3332	Hardware Modeling with HDLs	L				M						L	L	M	H	L
EECE3341	FPGA System Design		M										L	H	M	L
EECE4042	VLSI Design Automation		M										L	H	M	L
EECE4052	Analog IC Design	L	M	H										M		L
EECE3351	Linear Integrated Circuits	L	M	H	L									H		M
EECE4061	Modern VLSI Devices	L		M		H								H	M	
EECE4072	C-Based VLSI Design			M		H								H	M	L
EECE3361	Digital System Design	L												H	M	L
EECE3372	Data Structures with Python	L				H						L	M	H	M	L

EECE3661	Neural Networks	L		L		M	M					L	M	M	H	L
EECE3381	Machine Learning	L		L		M	M					L		M	H	M
EECE3382	Deep Learning Techniques	L		L		M	M					L		M	H	M
EECE4081	Machine Learning for Speech, Audio and Video Analysis	L		L	M			L				M		M	H	L
EECE4091	Machine Learning for Antenna Array Applications	L		L	M			L				L		M	H	L
EECE4082	Big Data Analytics					H						M	L		H	M

Syllabus

University Core

CSEN1001	IT Productivity Tools	L	T	P	S	J	C
		0	0	2	0	0	1*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	Familiarity with Computer system and its operation.						

Course Description:

This course introduces all software tools that improve the productivity of a student in enhancing his learning experience with all the activities taken up as part of his coursework.

Course Educational Objectives:

- To enable the learner, the skill in preparing technical documents of professional quality using docs, sheets and forms.
- To involve the student in designing and creating of websites and acquaint the student with the skill of processing audio, images, documents etc.
- To create awareness in analyzing data using pivot tables, query manager etc.
- To create awareness in composing emails, mail merge, e-mail merge etc.
- To provide the exposure to work with collaborative tools.

List of Experiments:

1. Create a typical document consisting of text, tables, pictures, multiple columns, with different page orientations.
2. Create a technical paper / technical report consisting of table of contents, table of figures,table of tables, bibliography, index, etc.
3. Compose and send customized mail / e-mail using mail-merge.
4. Create / modify a power point presentation with text, multimedia using templates withanimation.
5. Create spreadsheet with basic calculations with relative reference, absolute reference, andmixed reference methods.
6. Simple report preparation using filtering tool / advanced filtering commands / pivot tables in spreadsheet application.
7. Analyse the results of a examination student wise, teacher wise, course wise, institute-wise.
8. Collecting and consolidating data using collaborative tools like google docs, sheets, forms.
9. Create charts / pictures using online tools like: www.draw.io or smart draw
10. Create a website of his interest.

Textbooks:

1. Katherin Murray, 'Microsoft Office 365 Connect and collaborate virtually anywhere, anytime', Microsoft Press, ISBN: 978-0-7356-5694-9
2. EXCEL 2021 The Comprehensive Beginners to Advanced Users Guide to Master Microsoft Excel 2021. Learn the Essential Functions, New Features, Formulas, Tips and Tricks, and Many More
3. https://drawio-app.com/tutorials/video-tutorials/
4. Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and WebGraphics Fourth Edition ISBN-13: 978-1449319274

References/Online Resources:

1. https://www.coursera.org/learn/introduction-to-computers-and-office-productivity-software
2. https://www.coursera.org/projects/analyze-data-pivot-tables-crosstabs-google-sheets
3. https://www.coursera.org/learn/excel-advanced#syllabus
4. https://www.coursera.org/learn/how-to-create-a-website
5. https://support.microsoft.com/en-us/office
6. https://www.diagrams.net/
7. https://edu.google.com/

Course Outcomes:

1. Create / alter documents / Technical Paper / Project report with text, pictures, graphs ofdifferent styles.
2. Create / modify power point presentations with text, multimedia and to add animationusing / creating templates.
3. Perform basic calculations / retrieve data / createpivot tables / chart using a spreadsheetapplication.
4. Create simple diagrams / charts using online tools like: www.draw.io .
5. Manage documents, presentations, spreadsheets and websites in collaborative mode.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															
Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation															

APPROVED IN:

BOS : September 6, 2021

ACADEMIC COUNCIL: 21st AC(September 17, 2021

SDG No. & Statement: 4 Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

The students can perform simple document preparation to complex calculations in isolated mode and collaborative mode that are useful throughout their career.

CLAD1001	**EMOTIONAL INTELLIGENCE & REASONING SKILLS (SOFT SKILLS 1)**	**L**	**T**	**P**	**S**	**J**	**C**
		0	**0**	**2**	**0**	**0**	**1**
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Emotional intelligence is a set of skills that are thought to contribute to the appraisal of emotions in oneself and others. It can also help contribute to the effective regulation of emotions as well as feelings (Salovey & Mayer, 1990). In terms of emotional intelligence, self-awareness and self- management have to do with our ability to relate to ourselves. Social awareness and relationship management have to do with our ability to relate to others. Similarly, the ability to solve questions on Analytical Reasoning and Data Sufficiency is a critical area tested in almost all competitive examinations and admission tests. Upon completion, students should be able (1) to deal with theirown emotions as well as the emotions of others and relate better with both. Using better knowledgeof EI, students will also be able to set more meaningful goals for themselves, choose suitable time management techniques that work best for them and work in teams more effectively. (2) to apply different concepts, ideas, and methods to solve questions in reasoning and data sufficiency

Course Educational Objectives:

- Use EI to relate more effectively to themselves, their colleagues and to others. Apply self-awareness and self-assessment (SWOT) to better understand and manage their own emotions. Apply social awareness to empathize with others and build stronger relationships with others.
- Set meaningful goals based on their strengths and weaknesses and apply time management techniques, such as Q4 organizing to put first things first.
- Manage conflicts and work in teams in an emotionally intelligent manner.
- Solve questions on non-verbal and analytical reasoning, data sufficiency and puzzles

List of Activities & Tasks for Assessment:

Unit	**Topics**	**Hours**
1	Self-Awareness & Self-Regulation: Introduction to Emotional Intelligence, *Self-Awareness:* Self-Motivation, Accurate Self-Assessment (SWOT Analysis),Self-Regulation: *Self Control, Trustworthiness & Adaptability*	3
2	Importance, Practising Social Awareness, Building Relationships, Healthy andUnhealthy Relationships, Relationship Management Competencies-Influence, Empathy, Communication, Types of Conflicts, Causes, Conflict Management	3

3	Social Media: Creating a blog, use of messaging applications, creating awebsite to showcase individual talent, creation of a LinkedIn Profile	2
4	Goal Setting & Time Management: Setting SMART Goals, Time Wasters, Prioritization, Urgent Vs Important, Q2 Organization	3
5	Teamwork: Team Spirit, Difference Between Effective and Ineffective Teams, Characteristics of High Performance Teams, Team Bonding, Persuasion, Team Culture, Building Trust, Emotional Bank Account	4
6	Verbal Reasoning: Introduction, Coding-decoding, Blood relations, Ranking Directions, Group Reasoning	6
7	Analytical Reasoning: Cubes and Dices, Counting of Geometrical figures	3
8	Logical Deduction: Venn diagrams, Syllogisms, Data Sufficiency, Binary logic	4
9	Spatial Reasoning: Shapes, Paper Cutting/Folding, Mirror images, Water images and Rotation of figures	2

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Students will be able to relate more effectively to themselves, their colleagues and to others
2. Students will be able to set their short term and long term goals and better manage their time
3. Students will be able to manage conflicts in an emotionally intelligent manner and work inteams effectively
4. Students will be able to solve questions based on non-verbal and analytical reasoning, datasufficiency and puzzle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-201**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Emotional Intelligence and reasoning skills are essential for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD1011</td><td rowspan="2">LEADERSHIP SKILLS & QUANTITATIVE APTITUDE (SOFT SKILLS 2)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Communication Skills is having the ability to convey information to others so that messages are understood, and outcomes delivered. Some essential qualities of Communication Skills include understanding the needs of others, clearly communicating messages, adapting the communication style, and using a range of communication methods. Presentation Skills is having the ability to confidently deliver an engaging messageto a group of people which achieves the objectives. Some essential qualities of Presentation Skills include a thorough preparation of content, structuring content logically, managing nerves, engaging your audience, delivering presentation objectives, positively influencing the audience, and responding to audience needs.Tackling questions based on numbers, arithmetic, data interpretation and puzzles requires the application of different rules and concepts of numerical computation, numerical estimation, and data estimation.

Course Educational Objectives:

- Learn and apply, through different individual and group activities, different ideas, and skills tocommunicate in a positive and impressive manner.
- Apply the goal setting process (based on SWOT) and Q2 organizing for effective time management.
- Apply different concepts in numbers, numerical computation, and numerical estimation to solvequestions that often appear in various competitive examinations and admission tests.
- Apply different concepts for tackling questions based on data interpretation, progression and series thatare frequently given in various competitive examinations and admission tests.

List of Activities & Tasks for Assessment:

Unit	Topics	Hours
1	Communication Skills: The Communication Process, Elements of Interpersonal Communication, Non-Verbal Communication: Body Language, Posture, Eye Contact, Smile, Tone of Voice, Barriers to Communication. Effective Listening Skills: Active Listening, Passive	5

	Listening, Asking Questions, Empathizing, Being Non-Judgmental, Being Open Minded, Mass Communication: Design of Posters, Advertisements, notices, writing formal and informal invitations	
2	Focus on Audience Needs, focus on the Core Message, Use Body Language andVoice, Start Strongly, Organizing Ideas & Using Visual Aids: SPAM Model, EffectiveOpening and Closing Techniques, Guy Kawasaki's Rule (10-20-30 Rule), Overcoming Stage Fear, Story Telling	3
3	Problem Solving & Decision Making: Difference Between the Two, Steps in RationalApproach to Problem Solving: Defining the Problem, Identifying the Root Causes, Generating Alternative Solutions, Evaluating and Selecting Solutions, Implementingand Following-Up, Case Studies	3
4	Group Discussion: Understanding GD, Evaluation Criteria, Nine Essential Qualities for Success, Positive and Negative Roles, Mind Mapping, structuring a Response, Methods of Generating Fresh Ideas	4
5	Number Theory: Number System, Divisibility rules, Remainders and LCM & HCF	3
6	Numerical Computation and Estimation - I: Chain Rule, Ratio Proportions, Partnerships & Averages, Percentages, Profit-Loss & Discounts, Mixtures, Problem on Numbers & ages	6
7	Data Interpretation: Interpretation and analysis of data in Tables, Caselets, Line- graphs, Pie-graphs, Boxplots, Scatterplots and Data Sufficiency	3
8	Mental Ability: Series (Number, Letter and Alphanumeric), Analogy (Number, Letter and Alphanumeric) and Classifications	3

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Students will be able to communicate 'one-on-one' and 'one-on-many' confidently using both verbal and non-verbal messages and deliver impressive talks/ presentations to a group both with and without the use of PPTs and create posters, advertisements, etc.
2. Students will be able to apply the rational model of problem solving and decision makingin their problem solving and decision-making efforts.
3. Students will be able to solve questions based on numbers and arithmetic given in

various competitive examinations

4. Students will be able to solve questions based on data interpretation, progressions, and series.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Leadership and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD1021	VERBAL ABILITY & QUANTITATIVE ABILITY (SOFT SKILLS 3)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Vocabulary is an important part of verbal ability. An understanding of word formation, prefixes, suffixes, and roots is necessary to remember and use a vast repository of words. Approaching words through word families and other ways of groupings is an effective way of gaining mastery over vocabulary. Understanding and getting acquainted with the different rules and exceptions in the use of grammar and structure, especially from the relevant examination point of view, is crucial to cracking questions given in many competitive tests. Similarly, improving reading comprehension skills and test taking abilities in this area takes time and effort, especially given the fact that most students do not possess strong reading habits. In so far as quantitative aptitude is concerned, students need to develop a strong foundation on the basic mathematical concepts of numerical estimation, geometry, mensuration, data sufficiency, etc. to be able to crack different round 1 tests of major recruiters and admission tests of top Indian and foreign universities.

Course Educational Objectives:

- List and discuss the different word formation methods, word denotation, connotation, collocation, etc. and introduce selected high frequency words, their antonyms, synonyms, etc.
- Apply different advanced reading skills to solve questions based on author's tone, main ideas and sub-ideas, inferences, Para jumbles, etc. that are frequently asked in various competitive exams and admission tests.
- Solve different types of questions based on vocabulary, such as word analogy; structure, grammar, and verbal reasoning; introduce common errors and their detection and correction.
- Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude. This includes questions on time and work, time and distance, pipes and cisterns, lines and angles, triangles, quadrilaterals, polygons and circles, 2- & 3-dimensional mensuration.

List of Activities & Tasks for Assessment:

1. **Vocabulary Builder:** Understanding Word Formation, Prefixes, Suffixes and Roots, Etymology, Word Denotation, Connotation and Collocation, Synonyms and Antonyms

2. **Reading Comprehension:** Advanced Reading Comprehension: Types of RC passages,

Types of Text Structures, Types of RC Questions: Distinguishing Between Major Ideas and Sub Ideas, Identifying the Tone and Purpose of the Author, Reading Between the Lines and Beyond the Lines, Techniques for Answering Different Types of Questions

3. **Para Jumbles:** Coherence and Cohesion, Idea Organization Styles, Concept of Mandatory Pairs and Its Application: Transitional Words, Antecedent-Pronoun Reference, Article Reference, Cause and Effect, Chronological Order, General to Specify, Specify to General, Idea-Example, Idea-Explanation, Etc.
4. **Grammar Usage:** Rules Governing the Usage of Nouns, Pronouns, Adjectives, Adverbs, Conjunctions, Prepositions and Articles
5. **Numerical Computation and Estimation - II:** Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Boats and Streams, Races and Games of Skill, Simple Interest& Compound Interest
6. **Geometry:** Lines and Angles, Triangles, Quadrilaterals & Polygons, and Circles
7. **Mensuration:** 2-Dimensional Mensuration (Triangles, Quadrilaterals and Circles), 3-Dimensional Mensuration (Cubes, Cuboids, Cylinder, Cone, Sphere)

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. List and discuss word formation methods, selected high frequency words, their antonyms, synonyms, etc.
2. Analyze reading passages and quickly find out the correct responses to questions asked, including para jumbles, by using reading skills like skimming, scanning, reading between the lines, etc.
3. Solve different types of questions based on vocabulary, structure, grammar and verbal reasoning
4. Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD1031</td><td rowspan="2">PRACTICING VERBAL ABILITY & QUANTITATIVE APTITUDE (SOFT SKILLS 4)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

A sound knowledge of the rules of English grammar, structure and style and its application in detecting errors in writing are important areas of Verbal Ability frequently tested as a part of the written test in many competitive examinations and admission tests of major recruiters and universities respectively. This module focuses on all important areas of grammar and structure commonly asked in major tests, such as GMAT, CAT, XLRI, CRT, etc. Similarly, in the area of Quantitative Aptitude, different kinds of questions are asked from Combinatorics (Permutations & Combinations, Probability], Cryptarithmetic & Modular Arithmetic (Cryptarithmetic, Application of base system (7, 24), Clocks (Base 24), Calendars (Base 7), and Mental Ability (Number series, Letter series & Alpha numeric series, Analogies (Numbers, letters), Classifications, Algebra (Exponents, Logarithms, Problems related to Equations, Special Equations, and Statistics) . This module focuses on all these areas by building on what the students already learnt in their earlier studies.

Course Educational Objectives:

- Apply the rules of grammar to solve questions in Error Detection, Sentence Correction and Sentence Improvement.
- Apply the rules of structure to solve questions in Error Detection, Sentence Correction and Sentence Improvement, Fill-in-blanks and Cloze Passages.
- Explain methods of solving problems in Combinatorics (Permutations & Combinations, Probability], Cryptarithmetic & Modular Arithmetic (Cryptarithmetic, Application of basesystem (7, 24), Clocks (Base 24), Calendars (Base 7)]
- Explain how to solve questions in Mental Ability (Number series, Letter series & Alpha numeric series, Analogies, Numbers, letters, Classifications] and Algebra (Exponents, Logarithms, Problems related to Equations, Special Equations, Statistics)

List of Activities & Tasks for Assessment:

1. Error Detection: Pronouns, Conjunctions, Prepositions and Articles
2. Error Detection: Tenses and their Uses
3. Sentence Correction: Subject-Verb Agreement, Antecedent-Pronoun Agreement, Conditional Clauses
4. Sentence Correction: Modifiers (Misplaced and Dangling) & Determiners, Parallelism & WordOrder, and Degrees of Comparison
5. Combinatorics: Permutations & Combinations, Probability

6. Crypt arithmetic & Modular Arithmetic: Crypt arithmetic, Application of Base System (7, 24),Clocks (Base 24), Calendars (Base 7)
7. Algebra: Exponents, Logarithms, Word-problems related to equations, Special Equations,Progressions, Statistics

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Identify and correct errors in English grammar and sentence construction
2. Identify and correct errors in Structure, Style and Composition
3. Solve problems in Combinatorics, Cryptarithmetic, and Modular Arithmetic
4. Solve problems in Mental Ability and Algebra

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

English language and quantitative aptitude skills are essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD2001	PREPARATION FOR CAMPUS PLACMENT -1 (SOFT SKILLS 5A)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course addresses all relevant areas related to campus placements and readies them to ace their upcoming/ ongoing recruitment drives. Specifically, it focuses on students' career preparedness, interview skills, test preparedness, etc.

Course Educational Objectives:

Prepare the students for their upcoming/ ongoing campus recruitment drives.

List of Activities & Tasks for Assessment:

1. Career Preparedness: Resume & Cover Letter Writing, Interview Skills: Elevator Pitch, Making the First Impression, Being Other-Oriented, Being Positive and Curious, communicating with Confidence and Poise, Frequently Asked Questions & How to Answer Them, Pitfalls to Avoid, Etc. Etiquette: Hygiene, Courtesy, Culture differences, Workplace, use of cell phone, Profanity, Slang, Protocol.
2. Verbal Ability: Practicing Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning.
3. Quantitative Aptitude: Number Systems, Algebra, Geometry, Data Handling, Data Sufficiency, Word Problems
4. Reasoning: Logical and Verbal Reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Write a power resume and covering letter
2. Answer interview questions with confidence and poise
3. Exhibit appropriate social mannerisms in interviews
4. Solve placement test questions on verbal ability, quantitative aptitude and reasoning

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for campus placement tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

CLAD2011	PREPARATION FOR HIGHER EDUCATION (GRE/ GMAT)-1 (SOFT SKILLS 5B)	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course offers a special track for students who aspire to go abroad in pursuit of their higher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests and includes fully solved mock tests as well.

Course Educational Objectives:

- Prepare the students to solve questions from all four broad areas of GRE/ GMAT
- Orient the students for GRE/ GMAT through mock tests

List of Activities & Tasks for Assessment:

1. Verbal Reasoning: Reading Comprehension, Sentence Equivalence, TextCompletion, Sentence Correction, Critical Reasoning
2. Quantitative Reasoning: Arithmetic, Algebra, Geometry, Data Analysis
3. Analytical Writing Assessment: Issue/ Argument
4. Integrated Reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for GRE/GMAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD2021</td><td rowspan="2">PREPARATION FOR CAT/ MAT – 1
(SOFT SKILLS 5C)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests and includes fully solved mock testsas well.

Course Educational Objectives:

- Prepare the students to solve questions from all four relevant areas of CAT/ XAT/MAT, etc.
- Orient the students for CAT/ XAT, etc. through mock tests

List of Activities & Tasks for Assessment:

1. Quantitative Ability: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry
2. Data Interpretation: Data Interpretation and Data Sufficiency
3. Logical Reasoning: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
4. Verbal Ability: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, Career Launcher andIMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve questions from all four relevant areas of CAT/ MAT as listed above
2. Practice test-cracking techniques through relevant mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for CAT/ MAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD2031</td><td rowspan="2">PREPARATION FOR CAMPUS PLACEMENT-2
(SOFT SKILLS 6A)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course builds on the previous course and focuses on all four major areas of campus placements, including career preparedness, mock interviews, verbal ability, quantitative aptitude, and logical reasoning.

Course Educational Objectives:

- To comprehensively prepare all eligible and aspiring students for landing their dream jobs.
- To sharpen the test-taking skills in all four major areas of all campus drives

List of Activities & Tasks for Assessment:

1. Career Preparedness II: Mock Interviews, Feedback and Placement Readiness
2. Verbal Ability II: Practising Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning
3. Quantitative Aptitude II: Number Systems, Algebra, Geometry, Data Handling,Data Sufficiency, Word Problems
4. Reasoning II: Logical and Verbal Reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Demonstrate career preparedness and confidence in tackling campus interviews
2. Solve placement test questions of a higher difficulty level in verbal ability, quantitative aptitude and logical reasoning.
3. Practice test-taking skills by solving relevant questions accurately and within time.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for campus placement tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD2041</td><td rowspan="2">PREPARATION FOR HIGHER EDUCATION (GRE/GMAT)-2 (SOFT SKILLS 6B)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The course offers a special track for students who aspire to go abroad in pursuit of theirhigher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests at a higher difficulty-level and includes fully solved mock tests as well.

Course Educational Objectives:

- Prepare the students to solve higher level questions from all four broad areas of GRE/ GMAT
- Orient the students for GRE/ GMAT through mock tests

List of Activities & Tasks for Assessment:

1. Verbal Reasoning II: Reading Comprehension, Sentence Equivalence, Text Completion, Sentence Correction, Critical Reasoning
2. Quantitative Reasoning II: Arithmetic, Algebra, Geometry, Data Analysis
3. Analytical Writing Assessment II: Issue/ Argument
4. Integrated Reasoning II

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve higher level questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for GRE/GMAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">CLAD2051</td><td rowspan="2">PREPARATION FOR CAT/ MAT – 2
(SOFT SKILLS 6C)</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests at a higher level of difficulty and includes fully solved mock tests as well.

Course Educational Objectives:

- Prepare the students to solve all types of questions from all four relevant areas of CAT/ XAT/ MAT, etc.

List of Activities & Tasks for Assessment:

1. Quantitative Ability II: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry
2. Data Interpretation II: Data Interpretation and Data Sufficiency
3. Logical Reasoning II: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
4. Verbal Ability II: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and MeenakshiUpadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMSetc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

Course Outcomes:

1. Solve higher difficulty level questions from all four relevant areas of CAT/ MAT aslisted above
2. Practice test-cracking techniques through relevant mock tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :17-09-2021 **ACADEMIC COUNCIL:17-09-2021**

SDG No. & Statement:4

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Quantitative aptitude, reasoning, verbal and language skills practiced during the preparation for CAT/ MAT tests provide essential skills for achieving inclusive and equitable education and lifelong learning opportunities for oneself and others.

<table>
<tr><td rowspan="2">DOSL1001</td><td rowspan="2">CLUB ACTIVITY – PARTICIPANT</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course recognizes student participation in multiple activities organized by various student organizations that pursue specific co-curricular and extra-curricular interests. These activities allow students to engage in and identify and pursue their personal interests and hobbies.

Course Educational Objectives:

- Create opportunities for students to participate in a variety of non-academic experiences
- Interact with and learn from peers in a setting without an external performance pressure
- Allow exploration of interesting activities and reflection about these experiences
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Participation in various club-based activities
2. Weekly reflection paper
3. Portfolio (on social media using an Instagram account)
4. Two learning papers (one per semester)

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. YouTube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

1. Identify personal interest areas
2. Learn from diverse perspectives and experiences
3. Gain exposure to various activities and opportunities for extra-curicular activities
4. Learn to manage time effectively
5. gain confidence

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

This course recognizes student participation in non-academic events and activities which focus on inclusive partnerships and collaborations with all stakeholders by using all sustainable means to promote lifelong learning.

<table>
<tr><td rowspan="2">DOSL1011</td><td rowspan="2">CLUB ACTIVITY – MEMBER OF THE CLUB</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course encourages and acknowledges student members' work in organizing events and activities organized by various student organizations that pursue specific co-curricular and extra- curricular interests. These activities allow students to actively learn from the process of conceptualizing and organizing such activities as part of a team.

Course Educational Objectives:

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Be a member of a club and organize activities in that particular interest area
2. Learn from diverse perspectives and experiences
3. Learn to design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

- Be a member of a club and organize activities in that particular interest area
- Learn from diverse perspectives and experiences
- Learn to design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSL1021	CLUB ACTIVITY – LEADER OF THE CLUB	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course encourages and recognizes student members' work in leading the student organizationsthrough various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

Course Educational Objectives:

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students(Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

- Be the leader of the club and implement the charter, vision and mission of the club
- Learn from diverse perspectives and experiences
- Learn to lead the team, design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSL1031	CLUB ACTIVITY – COMPETITOR	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course encourages and recognizes student members' work in leading the student organizationsthrough various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

Course Educational Objectives:

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities:

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities:

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curicular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Textbooks:

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References:

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes:

Upon successful completion of the course, student will be able to

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

<table>
<tr><td rowspan="2">DOSL1041</td><td rowspan="2">COMMUNITY SERVICES - VOLUNTEER</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course recognizes student participation in Community service activities organized by various student organizations and other Government and non-government organizations that exist for providing service to communities. These activities allow students to develop empathy, citizenship behavior and community values.

Course Educational Objectives:

- To help students develop empathy and citizenship behavior
- Enable students to develop an altruistic attitude and community development sensibility
- Allow exploration of community service activities and reflect about these experiences
- Learn to work in small and large teams for achieving community objectives

List of Community Service Activities:

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

List of Activities:

1. Participation in various community service activities
2. Weekly reflection paper
3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Text Books:

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd

References:

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and SherylWuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)

Course Outcomes:

1. Experience of volunteering in a variety of Community service activities
2. Gaining empathy for lesser privileged sections of society by experience
3. Understanding the process of generating community awareness
4. Understanding Disaster management and relief through training and experience
5. Developing environmental and sustainability awareness

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSL1051	COMMUNITY SERVICES - MOBILIZER	L	T	P	S	J	C
		0	0	0	0	2	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course recognizes student leadership in mobilizing community service activities as members of various student organizations or other Government and non-government organizations that existfor providing service to communities. These activities allow students to develop leadership, management skills, empathy, citizenship behavior and community values.

Course Educational Objectives:

- To help students understand leadership in a community environment
- Enable students to develop an altruistic attitude and community development sensibility
- Allow deep understanding of community service through practical experience
- Learn to lead small and large teams for achieving community objectives

List of Community Service Activities:

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

List of Activities:

1. Organizing and leading teams in various community service activities
2. Fortnightly reflection paper

3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Textbooks:

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd

References:

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and SherylWuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)
3. List of student run and other Government and non- government community service organizations

Course Outcomes:

1. Experience of mobilizing and executing Community service activities
2. Providing opportunities for community service volunteering for other fellowstudents
3. Understanding the process of mobilizing cash, kind and volunteer support
4. Building leadership and management skills
5. Building empathy and citizenship behavior

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

SDG17 : Strengthen the means of implementation and revitalize the global partnership for sustainable development

SDG Justification:

This course recognizes student participation in community service endeavours focussing on sustainable development, service to communities. This allows students to develop empathy, citizenship behaviour and inclusive community values.

DOSP1001	BADMINTON	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Badminton - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Badminton: Grips - Racket, shuttle
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Badminton Gameplay: Service, Forehand, Backhand
7. Preparatory Drills and Fun Games
8. Game Variations: Singles/ Doubles/ Mixed

References:

1. Handbook of the Badminton World Federation (BWF)

Course Outcomes:

1. Learn to play Badminton
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

<table>
<tr><td rowspan="2">DOSP1011</td><td rowspan="2">CHESS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Chess - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Chess: Pieces & functions, basic play
4. Chess board moves & terminology
5. Chess Gameplay: Openings, castling, strategies & tactics
6. Preparatory Drills and Fun Games
7. Game Variations & Officiating

References:

1. International Chess Federation (FIDE) Handbook

Course Outcomes:

1. Learn to play Chess
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1021	CARROM	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Carrom - History and development
2. Rules of the Game, Board components & dimensions
3. Fundamental Skills - Carrom: - Striking
4. Gameplay – General
5. Preparatory Drills and Fun Games
6. Game Variations: Singles/ Doubles/ Mixed
7. Preparatory Drills and Fun Games

References:

1. Indian Carrom Federation Handbook - Laws

Course Outcomes:

1. Learn to play Carrom
2. Understanding of the fundamental concepts such as rules of play, game variations

3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1031	FOOTBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Football - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Kicking, heading, ball control, Keeping
4. Movement, throwins, tackling, defense, scoring, defense
5. Gameplay- Formations, passing, FKs, CKs, PK, tactics
6. Preparatory Drills and Fun Games
7. Game Variations: Small sided games, 7v7, 11v11

References:

1. FIFA Laws of the Game

Course Outcomes:

1. Learn to play Football
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1041	VOLLEYBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Volley - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Striking, Ball control, Lifting
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Jumps, strikes, layoffs, attack, defense

References:

1. FIVB - Official Volleyball Rules

Course Outcomes:

1. Learn to play Volleyball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1051	KABADDI	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Kabaddi - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Raiding, catching
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Chain system movement

References:

1. Amateur Kabaddi Federation of India (AKFI) - Official Rules

2. Rules of Kabaddi - International Kabaddi Federation

Course Outcomes:

1. Learn to play Kabaddi
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
CO4																
CO5																

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

<table>
<tr><td rowspan="2">DOSP1061</td><td rowspan="2">KHO KHO</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Kho Kho - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills: Sitting, giving Kho, Pole dive
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Running, sitting
6. Gameplay: Running strategies, ring method, chain method
7. Preparatory Drills and Fun Games

References:

1. Khelo India Official Rulebook of Kho Kho

Course Outcomes:

1. Learn to play Kho Kho
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
CO4																
CO5																

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1071	TABLE TENNIS	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Table Tennis - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - TT: Grips - Racket, ball
4. Stances and footwork
5. TT Gameplay- Forehand, Backhand, Side Spin, High Toss. Strokes-Push, Chop, Drive, Half Volley, Smash, Drop-shot, Balloon, Flick, Loop Drive.
6. Preparatory Drills and Fun Games
7. Game Variations: Singles/ Doubles/ Mixed

References:

1. Handbook of the International Table Tennis Federation (ITTF)

Course Outcomes:

1. Learn to play Table Tennis
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
CO4																
CO5																

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1081	HANDBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Handball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Handball: Throwing, Ball control, Movement
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Jumps, dribbles, catching, throws
6. Gameplay: Shots, throws, movements, attack, defense
7. Preparatory Drills and Fun Games

References:

1. International Handball Federation - Rules of the Game & Regulations

Course Outcomes:

1. Learn to play Handball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
CO4																
CO5																

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1091	BASKETBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Basketball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Passing, Receiving, Dribbling
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Jumps, dribbles, catching, throws
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, attack, defense

References:

1. FIBA Basketball Official Rules

Course Outcomes:

1. Learn to play Basketball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
CO4																
CO5																

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1101	TENNIS	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Tennis - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Tennis: Grips - Racket, ball
4. Stances and footwork
5. Gameplay- Forehand, Backhand, Service, volley, smash
6. Preparatory Drills and Fun Games
7. Game Variations: Singles/ Doubles/ Mixed

References:

1. Handbook of the International Tennis Federation (ITF)

Course Outcomes:

1. Learn to play Tennis
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
CO4																
CO5																

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

DOSP1111	THROWBALL	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Educational Objectives:

- Understand training principles used in the sport
- Demonstrate knowledge of the game in a recreational /competitive play setting
- Organize an event around the sport
- Demonstrate concepts of warm up, game conditioning, training plans

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Throwball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Throwing, Receiving
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, control

References:

1. World Throwball Federation - Rules of the Game

Course Outcomes:

1. Learn to play Throwball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-07-2021 **ACADEMIC COUNCIL:19-07-2021**

SDG No. & Statement:4

Good Health and Well-being: Ensure healthy lives and promote well-being for all at all ages.

SDG Justification:

The nature of the course facilitates students to engage in various forms of fitness activities and sports-related movements that work on their overall health and wellness. The course focuses on inculcating active living as a lifestyle by making sports fun, engaging and meaningful.

<table>
<tr><td rowspan="2">ENVS1001</td><td rowspan="2">ENVIRONMENTAL STUDIES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3*</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The course enables the students to adapt eco-centric thinking and actions rather than human-centric thinking on natural resources, their utilization and conservation. The course also focuses on the importance of ecosystems, biodiversity and their degradation led to pollution. This course helps in finding solutions through application of control measures to combat pollution and legal measures to achieve sustainable development.

Course Educational Objectives:

- To impart knowledge on natural resources and its associated problems.
- To familiarize learners about ecosystem, biodiversity, and their conservation.
- To introduce learners about environment pollution.
- To acquaint learners on different social issues such as conservation of water, green buildingconcept.
- To make learners understand about the present population scenario, its impacts and role ofinformational technology on environment and human health.
- To make learners understand about the importance of field visit.

UNIT 1 **Multidisciplinary nature of environmental studies & Natural Resources** **10 hours**

Multidisciplinary nature of environmental studies Definition, scope and importance. Need for public awareness. Natural resources and associated problems. Uses and over exploitation of Forest resources, Water resources, Mineral resources, Food resources, Energy resources. Role of an individual in conservation of natural resources.

Activity:

1. Planting tree saplings
2. Identification of water leakage in house and institute-Rectify or report
3. Observing any one day of a week as Car/bike/vehicle free day.

UNIT 2 Ecosystem and biodiversity 10 hours

Ecosystem: Structure components of ecosystem: Biotic and Abiotic components. Functional components of an ecosystem: Food chains, Food webs, Ecological pyramids, Energy flow in the ecosystem (10% law), Ecological succession.

Biodiversity: Definition, Biogeographical classification of India, Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching, man wildlife conflicts. Conservation of biodiversity: In – situ and Ex-situ

Activity:

1. Visit to Zoological Park-Noting different ecosystem
2. Biodiversity register- Flora and fauna in the campus

UNIT 3 Environmental Pollution 10 hours

Definition Causes, effects, and control measures of: -Air pollution. Water pollution. Soil pollution. Marine pollution. Noise pollution. Nuclear hazards. Solid waste Management: Causes, effects, and control measures. Role of an individual in prevention of pollution. Pollution case studies.

Activity:

1. Visit to treatment plant and documentation.
2. Documentation of segregation of solid waste-Dry and Wet

UNIT 4 Social Issues and the Environment 10 hours

From Unsustainable to Sustainable development Urban problems related to energy. Water conservation, rainwater harvesting, watershed management. Environmental ethics: Issues and possible solutions. Green building concept.

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.

Activity:

1. Observing zero hour at individual level-documentation.
2. Eco friendly idols.
3. Rainwater harvesting-creating storage pits in nearby area.

UNIT 5 **Human Population and the Environment and Environment Protection Act and Field work** **10 hours**

Population growth, variation among nations. Environment and human health. HIV/AIDS, Human rights. Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Environment Legislation. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Environmental Protection Act, Issues involved in enforcement of environmental legislation.

Activity:

1. Visit to a local polluted site-industry/agriculture
2. Identifying diseases due to inappropriate environmental conditions

Text Book(s):

1. Erach Bharucha. Textbook of environmental studies for undergraduates courses- Universities Press,India Private Limited. 2019.
2. Kaushik A and Kaushik C.P. Perspectives in Environmental Studies. New Age InternationalPublishers Edition-VI. 2018.
3. Dave D Katewa S.S. Textbook of Environmental Studies, 2nd Edition. Cengage Learning India. 2012.

Additional Reading:

1. Benny Joseph. Textbook of Environmental Studies 3rd edition, McGraw Hill Publishing company limited. 2017.

Reference Book(s):

1. McKinney M.L., Schoch R.M., Yonavjak L. Mincy G. Environmental Science: Systems andSolutions. Jones and Bartlett Publishers. 6th Edition. 2017.
2. Botkin D.B. Environmental Science: Earth as a Living Planet. John Wiley and Sons. 5th edition. 2005.

Journal(s):

1. https://www.tandfonline.com/loi/genv20
2. https://library.lclark.edu/envs/corejournals

Website(s):

https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf From Climate Science to Action | Coursera

Course Outcomes:

After the completion of the course student will be able to

1. List different natural resources and their uses
2. Summarize the structure and function of terrestrial and aquatic ecosystems.
3. Identify causes, effects, and control measures of pollution (air, water & soil).

4. Function of green building concept.
5. Adapt value education

CO-PO Mapping:

	Programme Objectives (POs)												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															
CO6															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN: BOS

BOS: 04-07-22 **ACADEMIC COUNCIL:14-07-22**

SDG No. & Statement:

1. SDG-6-Clean water and Sanitation
2. SDG-7-Affordable and clean energy
3. SDG-13 - Climate change
4. SDG-14 - Life below water
5. SDG-15 - Life on Land

SDG Justification:

1. The learner will understand the importance of clean water and sanitation through this course and apply in their daily activities – SDG-6

2. The learner will make use of renewable resources to reduce pollution achieves SDG-7

3. The learner will understand present situation in climate change and takes appropriate steps to combat climate change – SDG-13

4. The learner will understand the existence of life below water – SDG-14

5. The learner will understand to promote sustainable terrestrial ecosystem – SDG15

FINA3001	PERSONAL FINANCIAL PLANNING	L	T	P	S	J	C
		0	0	2	0	0	1*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	Risk Management in Personal financing Fundamentals of Investing Saving Money for the future Personal and Family Financial Planning Introduction to Personal Finance						

Course Description:

Personal Financial Planning is one of the most significant factors in our lives. It is essential that funds are available as and when required at various stages of life. Unavailability of funds at critical stages of our life leads to financial distress and leads to many medical and non- medical problems. There are certain planned and unplanned events in our life. On the one hand, education of our children, their marriage, our retirement etc. are some of the planned events ofour life, but at the same time, some medical urgency, accident or death of an earning member might be some unplanned events. Many of these events are beyond our control, but the availability of funds can be planned to avoid any financial distress. In other words, we cannot stop the rain but can plan for an umbrella.
This course looks at the many challenges an individual faces in a complex financial environment and the rising uncertainties of one's life. It focuses on achieving long-term financial comfort of individual and family through goal setting, developing financial and life strategies, acquiring personal financial planning knowledge and managing risk throughout one's life.

Course Educational Objectives:

- To build students' ability to plan for long-term financial comfort of individual and family through goal setting, developing financial and life strategies.
- To provide students with knowledge on terms, techniques to evaluate investment avenues.
- To build the skill set of the student to enable them to file their tax returns.

UNIT 1 Basics of Financial Planning

Financial Planning Meaning, Need, Objectives, Financial Planning Process, Time Value of Money and its application using excel (NP)

UNIT 2 Risk and Insurance Management

Need for insurance, Requirement of insurance interest, Role of insurance in personal finance, Steps in insurance planning, Life and Non-life insurance products, Life insurance needs analysis (NP)

UNIT 3 Investment Products and Measuring Investment Returns

Investment Products: Small Saving Instruments, Fixed Income Instruments, Alternate Investments, Direct Equity
Measuring Investment Returns: Understanding Return and its concept, Compounding concept, Real vs Nominal Rate of Return, Tax Adjusted Return, Risk-Adjusted Return (NP)

UNIT 4 Retirement Planning

Introduction to the retirement planning process, estimating retirement corpus, Determining the retirement corpus, Retirement Products (NP)

UNIT 5 Tax Planning

Income Tax: Income tax principles: Heads of Incomes, Exemptions and Deductions, Types of Assesses, Rates of Taxation, Obligations for Filing and Reporting, Tax aspects of Investment Products, Wealth Tax

Textbooks:

1. National Institute of Securities Management (NISM) Module 1 & XA
2. Madhu Sinha, Financial Planning, 2 Edition, McGraw Hill India
3. Simplified Financial Management by Vinay Bhagwat, The Times Group

References:

1. Personal Financial Planning (Wealth Management) by S Murali and K R Subbakrishna, Himalaya Publishing House.
2. Mishra K.C., Doss S, (2009). Basics of Personal Financial Planning 1e. National Insurance Academy, New Delhi: Cengage Learning.
3. Risk Analysis, Insurance and Retirement Planning by Indian Institute of Banking and Finance.

Course Outcomes:

1. Describe the financial planning process and application of time value of money
2. Application of life and non-life insurance products in financial planning
3. Understand the investment avenues and analysis of investment returns
4. Understand the retirement planning and its application
5. Describe and analysis the Tax Planning

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**
SDG No. & Statement:
Goal 4: Quality education
Goal 12: Responsible consumption and Production
SDG Justification:
Goal 4: This course enables the students to attain their financial literacy that builds in the discipline of saving and improves their lifelong learnings.
Goal 12: This course ensures sustainable consumption and helps in providing them their life long financial requirements .

LANG1001	COMMUNICATION SKILLS IN ENGLISH - BEGINNERS	L	T	P	S	J	C
		0	0	4	0	0	2*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Communication Skills in English (Beginner) is the first of the three-level courses for a developmental enhancement of learners' communication skills in English. This course focuses on giving learners exposure to factual level of comprehension (listening and reading) and application of the learning (Speaking/Writing) with an awareness for social and personality-based variationsin communication. In addition to the LSRW skills, the focus of the course is on schematic thinking skills. This course is activity-based and practice-oriented in terms of procedural knowledge of vocabulary and grammatical structure. This syllabus is carefully developed to enable learners to engage in communication in English avoiding errors and be prepared for next level of learning English.

Course Educational Objectives:

- Train learners to listen actively, follow what is spoken in standard English, and answer questions to demonstrate their understanding of the main points of the speech, repeat part of what someone has said to confirm mutual understanding, though occasionally, there may be a need to ask for repetition or clarification. (Bloom's Taxonomy Level/s: 2 & 3)
- Equip learners with the skills to read and comprehend straightforward texts and simple argumentative writing to identify the topic, the desired/relevant information, the main points of the argument, and the major conclusion/s. (Bloom's Taxonomy Level/s: 2 & 4)
- Help learners apply their knowledge and language skills to make mini oral presentations and produce short coherent written texts using appropriate cohesive devices, suitable vocabulary, and grammatical structures. (Bloom's Taxonomy Level/s:3)
- Enable learners to communicate with reasonable accuracy in familiar contexts with adequate fluency and generally good control by equipping them with a repertoire of frequently used vocabulary, structures, and speech patterns. (Bloom's Taxonomy Level/s: 2 & 3)

List of Activities & Tasks for Assessment:

1. Listening to others and getting to know their experiences, interests and opinions
2. Introducing oneself: Salutation, basic information, relating to the context
3. Starting a conversation: Salutation, expressing purpose, expressing gratitude
4. Sharing one's experiences, interests and opinions

5. Reading short newspaper articles for gist
6. Picking new words from an article and working on them to know the meaning and usage
7. Using the new (unknown) words in own sentences
8. Sharing news with others - initiate, sustain and conclude
9. Understanding the relevance of intonation to meaning from recorded conversations, and applying the learning in pair work (role play)
10. Writing a summary of a story/personal narrative after listening to it twice and making individual notes
11. Reading graphs, charts and maps for specific information, making note of the important information and talking briefly about it within a small peer group
12. Writing a paragraph about oneself: a brief profile including major successes, failures, and goals. Giving compliments/gratitude to others
13. Writing a paragraph (descriptive, complimentary) about others (Family, friends, role model, etc.)
14. Correcting each other's' drafts: errors in language - word choice, structure, and conventions/etiquette
15. Writing a short structured descriptive/narrative essay in 3 paragraphs, reading others' essays, and sharing feedback

References:

1. V. Sasikumar, P. Kiranmayi Dutt, Geetha Rajeevan. (2007). Listening and Speaking - Foundation Books Cunninhum, S. & Moor, P. (nd). New Cutting Hedge (Intermediate). Longman
2. Cambrdige Academic English: An Integrated Skills Course for EAP (Intermediate) By Craig Thaine, CUP (2012)
3. Rutherford, Andrea J. (2007). Basic Communication Skills for Technology: Second Edition. Delhi: Pearson Education.
4. McCarthy, M., O'Dell, F., Mark, G. (2005). English Vocabulary in Use. Spain: Cambridge University Press.
5. New Headway Academic Skills: Reading, Writing, and Study Skills Student's Book, Level-1 by Sarah Philpot. OUP
6. Philpot, S. & Curnick, L. (2017). Headway: Academic Skills: Reaing, Writing, and Study Skills. Introductory Level. OUP.
7. Thaine, C. (2012). Cambridge Academic English: An Integrated Skills for EAP. Intermediate. CUP.

Online References:

- www.teachingenglish.org.uk
- learnenglishteens.britishcouncil.org

- https://eslflow.com/
- https://www.englishclub.com/
- https://www.oxfordlearnersdictionaries.com/
- https://dictionary.cambridge.org/
- learnenglishteens.britishcouncil.org

Course Outcomes:

1. Listen actively, understand and extract the essential information from short talks/conversations/discussions that are delivered in clear, standard speech. (Bloom's Taxonomy Level/s: 2 & 3)
2. Read, understand, and extract specific information from straightforward factual and simple argumentative texts on general topics and subjects of interest. (Bloom's Taxonomy Level/s: 2 & 3)
3. Speak clearly with some confidence on matters related to his/her interests and academic work and make short structured oral presentations on topics of personal interest. (Bloom's Taxonomy Level/s: 3)
4. Write short straightforward connected texts on a range of familiar/general topics using appropriate linking devices to achieve a clear sequence of ideas. (Bloom's Taxonomy Level/s: 3)
5. Acquire sufficient language competency to express oneself in speech and writing with some confidence, using appropriate vocabulary and simple grammatical structures though lexical limitations and/or difficulty with formulation might be evident at times. (Bloom's Taxonomy Level/s: 2 & 4)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :30-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG No. 4: Statement: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

The course aims to remove inequalities among admitted students with regard to basic communication skills in English and provide them communication as well as learning skills that are useful throughout their lives.

LANG1011	COMMUNICATION SKILLS IN ENGLISH	L	T	P	S	J	C
		0	0	4	0	0	2
Pre-requisite	LANG1001						
Co-requisite	LANG1021						
Preferable exposure	None						

Course Description:

Communication Skills in English (Intermediate) is the second of the three-level graded courses for a developmental enhancement of communication skills in English. Based on the learning outcomes set in the beginner level syllabus, this course focuses on giving learners more exposure to the use of language for communicative purposes and equip them with next level skills (ref. Bloom's taxonomy) and practice in terms of complexity and cognitive engagement. This course also includes inferential level of comprehension (listening and reading) that involves analysis and application of the language skills and decision-making skills while speaking/writing with an awareness for social and personality-based variations in communication. This course emphasizes guided writing through adequate tasks with pre and post context building. The focus is on stimulation and application of critical thinking in addition to schematic thinking for communication in real-life situations.

Course Educational Objectives:

- Train learners to actively listen to short audio texts with familiar content; guided activity like question-making and responding to others' questions based on the audio text would help learners engage in transactional dialogue; extended activities like extrapolating/critiquing the responses would help learners enhance their schematic thinking. (Bloom's Taxonomy Level/s: 2 & 4)
- Equip learners with strategies to read actively and critically and understand the writers’ viewpoints and attitude by providing reading comprehension tasks using authentic texts such as op-ed articles from newspapers, and reports on contemporary problems. (Bloom's Taxonomy Level/s: 4 & 5)
- Help learners understand various aspects and techniques of effective presentations (group/individual) through demonstration and modelling, and enabling them to develop their presentation skills by providing training in using the tips and strategies given. Learners would be encouraged to observe and express opinion on teacher-modelling. Reflection on issues like anxiety, stage-fear, confidence, and levels of familiarity with topic and audience would be addressed. Practice would be given on tone, pitch, clarity and other speech aspects. Detailed peer feedback and instructor's feedback would cover all the significant aspects. (Bloom's Taxonomy Level/s: 2 & 4)
- Enable learners to become aware of the structure and conventions of academic writing through reading, demonstration, scaffolding activities, and discussion. Corrective individual feedback would be given to the learners on their writing. (Bloom's Taxonomy Level/s: 2 & 3)

List of Tasks and Activities:

S.No.	Tasks	Activities
1	Listening to subject related short discussions/explanations/ speech for comprehension	Pre-reading group discussion, Silent reading (Note-making), Modelling (questioning), Post-reading reflection / Presentation
2	Asking for information: asking questions related to the content, context maintaining modalities	Group role-play in a con text (i.e. Identifying the situation and different roles and enacting theirroles)
3	Information transfer: Verbal to visual (familiar context), demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation and feedback	Pair work for discussion & feedback, Presentations, question-answer
4	Information transfer: Visual to verbal (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation and feedback	Pre-reading game/modelling, discussion in small groups, individual writing, and feedback
5	Introducing officials to peers and vice versa -Formal context	AV support, noticing, individual performance (3-4), pair work (in context), teacher modelling, group work for Introducing self and others in a formal context
6	Introducing friends to family and vice versa -Informal context	Teacher modelling/AV support, noticing structure & note-taking, Introducing friends andfamily in an informal context
7	Vocabulary in context: Find clues in a text and use them to guess the meaning of words/ phrases. Apply the newly learnt vocabulary in communication (speaking and writing).	Comprehending verbal communication: Identifying the contextual clues in oral and written texts; guessing the meaning of words/phrases in context while reading texts and listening to discussions/talks
8	A five-day journal (diary) writing based on learners reading from newspaper on a single relevant/ current social issue. Individual oral presentation and feedback from peers andinstructor.	Note-making (group work), Discussion, Feedback

9	Follow the essentials of lectures, talks, discussions, reports and other forms of academicpresentations and mak2 individual and group presentations aided with images, audio, video, tabular data, etc.	Making power point presentation aided with images, audio, video, etc. with a small group by listening to academic lectures/talks/ discussions,etc.
10	Self-reflection: Re-reading one's own drafts, identifying errors, correcting the errors, and givingrationalize the changes	Pre-task discussion/modelling, Editing the texts by careful reading and identifying the errors, peer-exchange (Pair work),feedback/consolidation
11	Collaborative work (speaking and writing) in small groups of 3 or 4 learners: discussing a general/ discipline-specific topic: creating outline, assigning specific roles to members of the group; and group presentation followed by peer and instructor feedback	Pre-task modelling (peer/teacher), general discussion on structure, group work (collaboration), feedback
12	Independent reading of different text types using appropriate reference sources by adapting suitable reading styles and speed. Focus on active reading for vocabulary: low-frequency collocations and idiomatic expressions.	Brain-storming, mapping of key terms (content specific), reading and note-making (individual), oral questioning, discussion
13	Role-play (specific social and academic situations): planning (making notes), understanding nuances of speaking in context, coordinating with situational clues and fellowspeakers/participants	Peer discussion for outline, A-V support, observing (teacher modelling), role play (guided), role-play (free), feedback
14	Writing instructions: Guidelines - Flowcharts - Procedures to be followed	Pre-task reading, pair work, teacher/peer-discussion, feedback
15	Speaking spontaneously on topics of interest and writing short structured essays on the same topics adopting appropriate academic conventions andgrammatical accuracy.	Reading for task preparation, note-making, speaking, reflection and corrective peer and teacher feedback

Reference Books:

1. P. Kiranmayi Dutt, Geetha Rajeevan. (2007). Basic Communication Skills. FoundationBooks. CUP
2. Harmer, J. (1998). How to teach English. Longman
3. Sanjay Kumar & Pushp Lata. (2018). Communication Skills: A Workbook. OUP.
4. Cambridge IGCSE: English as a Second Language Teacher's Book Fourth Edition.By Peter Lucantoni. CUP (2014).
5. Cambrdige Academic English: An Integrated Skills Course for EAP (Upper Intermediate) By Martin Hewings, CUP (2012)
6. Richards, J.C. and Bohlke, D. (2012). Four Corners-3. Cambridge: CUP.
7. Headway Academic Skills: Reading, Writing, and Study Skills Student's Book, Level-2 bySarah Philpot. OUP
8. Latham-Koenig, C. & Oxenden, C. (2014). American English File. Oxfor: OUP.
9. McCarthy, M. & O' Dell. F. (2016). Academic Vocabulary in Use. Cambridge: CUP

Online Resources:

1. https://www.grammarly.com/blog/
2. https://www.nationalgeographic.org/education/
3. https://www.bbc.co.uk/teach/skillswise/english/zjg4scw
4. https://www.englishclub.com/
5. https://www.oxfordlearnersdictionaries.com/
6. https://dictionary.cambridge.org/
7. learnenglishteens.britishcouncil.org
8. https://freerice.com/categories/english-vocabulary
9. http://www.5minuteenglish.com/
10. https://breakingnewsenglish.com/
11. https://www.digitalbook.io/
12. https://librivox.org/

Course Outcomes:

1. Understand the speaker's point of view in fairly extended talks on general or discipline-specifictopics, and follow simple lines of argument in discussions on familiar contemporary issues. (Bloom's Taxonomy Level/s: 3)
2. "Read and demonstrate understanding of articles and reports on limited range of contemporary issues in which the writers adopt particular stances. Also provide samples of written communication containing fairly complex information and reasons for choices/opinions/stances. (Bloom's Taxonomy Level/s: 2 & 3)"
3. Make short presentations on a limited range of general topics using slides, and engage in smallgroup discussions sharing experiences/views on familiar contemporary issues and give reasonsfor choices/opinions/plans. (Bloom's Taxonomy Level/s: 3 & 4)
4. Write clear, detailed text (a short essay) on a limited range of general topics, and

subjectsof interest, and communicate clearly through email/letter to seek/pass on information or give reasons for choices/opinions/plans/actions. (Bloom's Taxonomy Level/s: 3)

5. Reflect on others' performance, give peer feedback on fellow learners' presentations, responsesto writing tasks and reading comprehension questions. (Bloom's Taxonomy Level/s: 5)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :30-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG No. 4: Statement: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

The course aims to remove inequalities among admitted students with regard to basic communication skills in English and provide them communication as well as learning skills that are useful throughout their lives.

<table>
<tr><td rowspan="2">LANG1021</td><td rowspan="2">ADVANCED COMMUNICATION SKILLS IN ENGLISH</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">LANG1011</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Communication Skills in English (Advanced) is the third of the three-level graded courses for a developmental enhancement of communication skills in English. Based on the learning outcomes set in the upper-intermediate syllabus, this course focuses on giving learners exposure to higher level of skills/input processing (ref. Bloom's taxonomy) and practice in terms of complexity and cognitive engagement. This course includes advanced level of comprehension i.e. anaytical, evaluative and extra-polative processing (listening and reading) and involves problem-solving, logical reasoning and decision-making skills in terms of application of the learning (speaking/writing) with an awareness for social and personality based variations in communication. This course provides opportunities with activity-based practice of advanced oral and written communicative skills besides building awareness on the finer nuances of language use for various purposes. This course emhasizes free writing through meaningfully engaging tasks witha pre and post context building. There is ample scope for application of critical thinking through simulated activities for effective communication in real life situations.

Course Educational Objectives:

- Enable learners to listen actively become aware of tone and attitude in speech, and demonstrate their comprehension of fairly complex lines of argument presented by a variety of speakers in talks/presentations/discussions. (Bloom's Taxonomy Level/s: 2 & 4)
- Enable learners to become aware of tone and attitude in written texts, and demonstrate theircomprehension of fairly complex lines of argument and points of view presented in a variety of texts by equipping them with upper intermediate to advanced level reading skillsand strategies. (Bloom's Taxonomy Level/s:2 & 3)
- Make effective presentations, engage in formal group discussions, and write structured essays/ short reports to highlight the significance of actions/decisions/experiences, and sustain views by providing relevant evidence and argument. (Bloom's Taxonomy Level/s:3 & 4)
- Equip learners with the skills and strategies to communicate effectively in speech and writing using the language with a degree of fluency, accuracy and spontaneity, and fairly good grammatical control adopting a level of formality appropriate to the context. Encourage learners to apply their knowledge of language and their

communication skills in real life situations. (Bloom's Taxonomy Level/s:3 & 5)

List of Activities & Tasks for Assessment:

S.No.	Tasks	Activities	CO
1	Evaluative and extrapolative reading of a longtext/short texts on a current topic related to technology and society, identifying and questioning the author's intention, post- reading discussion in small groups, maintaining group dynamics, arriving at a consensus	Pre-reading group discussion, silent reading (Note-making), modelling (questioning), post-reading reflection and brief presentation of thoughts/ideas/opinions on the themeof the text	3
2	Debate in pairs based on listening to two recorded contemporary speeches by well- known leaders in different fields. Peer feedback and instructor feedback.	Pre-recorded audio/video for listening, student checklist for noticing key words/concepts, pre-task orientation (by teacher), pair work, feedback	1
3	Information transfer: Verbal to visual (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation, question-answer (among students), modification and feedback before the final version is done	Pair work for discussion and feedback, presentations, question-answer	2
4	Information transfer: Visual to verbal (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation, question-answer(among students), modification, editing, proofreading, and feedback before the final version is done	Pre-reading game/ modelling, discussion in small groups, independent writing and feedback	4
5	Expressing opinion on a short argumentative text (e.g. a journal article or a newspaper editorial) and justifying one's opinion/stance; focus on the use of appropriate conventions of formal and polite speech, and managing bias	Listening to group discussions/ debates, reading news-paper articles on the current issues and expressing opinions in favour or against the topic (in GDs, debates or writing argumentativeessays).	3
6	Role-play (complex social and academic/professional situations):	Reading newspaper/ magazine articles/ blog posts on current social	1

	Focus on significant aspects of delivery including clarity, tone, and use of contextually appropriate vocabulary and conventions, observation, reflective discussion, and self-reflective writing	issues, listening to talks/ discussions/ debates etc. and participating in role-plays using expressions appropriate to the context.	
7	Collaborative writing in groups of 3 - 4 on topics that would require data collection and reading followed by recorded peer-reflection and peer-feedback, group presentation and feedback	Pre-task modelling (peer), general discussion on structure, group work (collaboration), presnetation, peer feedback, Open-class discussion	5
8	Formal Group Discussion on topics of currentinterest and relevance; focus on effective participation, reflection on control over argument/ counter argument, and adherence to the conventions of formal GD	Noticing strategies from AV modelling, teacher scafolding though open-house discussion, Note-making (Group work), Group Discussion (free), post perfromance discussion, Feedback	2
9	Mind-mapping for advanced reading, making correlations across texts, extending author's point of view	Reading texts on abstract topics and comprehending the author's perspective by inferring the unknown words' meaning in the context and making notes using mind-map strategy and presenting it orally.	3
10	Handling question and answer sessions after presentations: justifying arguments, taking counter-arguments, agreeing and disgreeing with rationale	Listening to some lectures, talks, and presentations in the academic seminars and adapting some strategies to handle the Q&A sessions using polite and formal expressions to agree or disagree with the statements.	1
11	Modelling an interview: with a panel of fourjudges (peers)	Pre-task activity for orientation/ strategies (controlled/guided), Model interview (AV support), Group work (role play), interview in pair (one-to-one), Interview in group (many -to-one), oral corrective feedback (peer/ teacher)	2
12	Writing a short reflective report of an event - incident/ meeting/ celebration	Writing a report on meetings/ celebrations/ events etc. by actively involving in such events and giving a short oral presentation on the same.	4
13	Speaking on abstract and complex topics beyond his/her own area of	Reading texts on abstract topics and comprehending the author's	3

	interest/field of study, using the language flexibly and effectively.	perspectives. Similarly, listening to talks and discussions on an abstract topic of other discipline and making short oral presentation by sharing views and opinions.	
14	Self-relfection on own speech in context(recorded): tone, pitch, relevance, content; extending the reflections/ideas toothers	Listening to selected general discussions (audios and videos) and observing the language production. Recording own speech on some general topic and providing a critical review (self-reflection) on it by focusing on the tone, expressions and relevance of the content, etc.	1
15	Collaborative and individual task: planning, preparing (preparing an outline, structure, setting objectives and presenting the plan of action) and executing a mini-project, and submitting a brief report on the same peer and instructor feedback after the planning stage and on completion of the mini project	Pre-task modelling (peer/teacher), general discussion on structure, group work (collaboration), oral corrective, task distribution, presentation, feedback	5

Reference Books:

1. Latham-Koenig, C. & Oxenden, C. (2014). American English File-5. Oxford: OUPRichards,
2. J.C. and Bohlke, D. (2012). Four Corners-4. Cambridge: CUP.
3. Cambrdige Academic English: An Integrated Skills Course for EAP (Advanced) By MartinHewings and Craig Thaine, CUP (2012)
4. Berlin, A. (2016). 50 Conversation Classes: 50 Sets of Conversation Cards with an Accompanying Activity Sheet Containing Vocabulary, Idioms and Grammar. Poland: CreateSpace Independent Publishing Platform
5. Zemach, D. E., Islam, C. (2011). Writing Paragraphs: From Sentence to Paragraph. Germany: Macmillan Education.
6. Stewart, J. P., Fulop, D. (2019). Mastering the Art of Oral Presentations: Winning Orals, Speeches, and Stand-Up Presentations. United Kingdom: Wiley.
7. Kroehnert, Gary. (2010). Basic Presentation Skills. Sidney: McGraw Hill.
8. Cunninghum, S. & Moor, P. (nd). Cutting Edge (Advanced) With Phrase Builder. Longman Publishers. CUP
9. McCarthy, M & O'Dell, F. (2017). English Idioms in Use (Advanced). Cambridge: CUP.

Online Resources:

1. https://www.grammarly.com/blog/
2. https://www.nationalgeographic.org/education/
3. https://www.bbc.co.uk/teach/skillswise/english/zjg4scw
4. https://www.englishclub.com/
5. https://www.oxfordlearnersdictionaries.com/
6. https://dictionary.cambridge.org/
7. learnenglishteens.britishcouncil.org
8. https://freerice.com/categories/english-vocabulary
9. http://www.5minuteenglish.com/
10. https://breakingnewsenglish.com/
11. https://www.digitalbook.io/
12. https://librivox.org/

Course Outcomes:

1. Listen to extended lectures, presentations, and discussions on a wide range of contemporary issues and demonstrate understanding of relatively complex lines of argument. (Bloom's Taxonomy Level/s: 2)
2. Make presentations using suitable AV aids and engage in formal group discussions on a wide range of topics of contemporary interest, demonstrating awareness of standard/widelyaccepted conventions. (Bloom's Taxonomy Level/s: 3)
3. Read and demonstrate understanding of the writer's stance/viewpoint in articles and reports on a wide range of contemporary issues and discipline-specific subjects. (Bloom's Taxonomy Level/s: 2 & 4)
4. Write analytical essays on a wide range of general topics/subjects of interest, and engage in written communication (emails/concise reports) to exchange relatively complex information, giving reasons in support of or against a particular stance/point of view. (Bloom's Taxonomy Level/s: 3 & 4)
5. Complete a mini project that necessitates the use of fairly advanced communication skills to accomplish a variety of tasks and submit a report in the given format. (Bloom's Taxonomy Level/s: 4 & 5)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
CO4																
CO5																

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :30-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG No. 4: Statement: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

The course aims to remove inequalities among admitted students with regard to basic communication skills in English and provide them communication as well as learning skills that are useful throughout their lives.

MFST1001	HEALTH & WELLBEING	L	T	P	S	J	C
		0	0	2	0	0	1*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course provides the students a better understanding of the role of a proper diet in maintenance of human health. This course emphasizes the composition of the food, and will help to understand how toexercise, the role of sports and physical fitness in development of a good health. The course also focuses on the importance of emotional well-being and mindfulness. This course helps in teaching the role of yoga in maintenance of physical balance.

Course Educational Objectives:

- To provide an understanding of the relationship between food and nutrition
- To emphasize the role of exercise, sports and physical fitness in obtaining a good health
- To explain about the mindfulness and emotional well being
- To teach the role of yoga and meditation in maintaining the body balance

UNIT 1

Understand the relationship between Food and Nutrition and how food composition affects nutritional characteristics. Knowledge about regulatory principles in determining diets and recommended daily allowances. Understand how to create personalised diet/nutrition plans.

UNIT 2

Understand how exercise, activity and sports helps in developing good health. Experiential exposure to the role of proper, specific nutritional interventions along with structured activities on developing proper physical health. Practical exercises and assignments in sports and exercise regimes.

UNIT 3

Introduction to emotional wellbeing and mindfulness. Teaching of mindfulness practices to reduce stress, increase relaxation and improve mental wellbeing.

UNIT 4

Introduction to Yoga theory and how Yoga helps in maintaining balance in the body. Practice of Yoga and meditation to improve overall emotional and physical balance. Practical yoga exercises and meditation techniques

Course Outcomes:

By the end of the course, student will

1. Learn the role of nutrition and diet in maintaining a good health
2. understand how the exercise, sports and physical activities will improve health
3. learn mindfulness practices for reducing stress
4. know the importance of yoga and meditation

APPROVED IN:

BOS :01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG Justification:

PHPY1001	GANDHI FOR THE 21ST CENTURY	L	T	P	S	J	C
		2	0	0	0	0	2*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course provides the students with basic knowledge on Gandhi's early life, transformations in South Africa and his entry into India's national movement. While going through the social-political, economic, and educational philosophies of Gandhi, the course analyses how his ideologies are relevant even in the 21st century.

Course Educational Objectives:

The objectives of the course are;

- To provide the students with the basic knowledge on Gandhi's life and his philosophies
- To understand the early influences and transformations in Gandhi
- To analyse the role of Gandhi in India's national movement
- To apply Gandhian Ethics while analysing the contemporary social/political issues
- To appreciate the conflict resolution techniques put forward by Gandhi and its significance in thecurrent scenario.

UNIT 1 MK Gandhi: Childhood and Education

M K Gandhi, Formative Years (1869-1893): Early childhood - study in England - Indian influences, early Western influences.

UNIT 2 From Mohan to Mahatma-South African Experiences

Gandhi in South Africa (1893-1914): South African Experiences - civil right movements in South Africa - invention of Satyagraha - Phoenix settlement- Tolstoy Farm - experiments in Sarvodaya, education, and sustainable livelihood.

UNIT 3 Gandhi and Indian National Movement

Gandhi and Indian National Movement (1915-1947): Introduction of Satyagraha in Indian soil -non- cooperation movement - call for women's participation - social boycott - Quit-India movement - fighting against un-touchability - Partition of India- independence.

UNIT 4 Gandhi and Sustainable Development

Gandhian Constructive Programs-Eleven Vows-Sarvodaya-Seven Social Sins-Gandhian Economics and Sustainable Development

UNIT 5 Gandhi and Contemporary Issues

Conflict Resolution Techniques of Gandhi-Ecological Challenges and Gandhian solutions-Gandhian Ethics-An Analysis

References:

1. Gandhi, M K. (1941). *Constructive Programme*. Ahmadabad: Navjivan Publishing House
2. Gandhi, M. K. (1948). *The Story of My Experiments with Truth*. Ahmadabad: Navjivan PublishingHouse
3. Gandhi, M K. (1968). *Satyagraha in South Africa*. Ahmadabad: Navjivan Publishing House.
4. Khoshoo, T N (1995). *Mahatma Gandhi: An Apostle of Applied Human Ecology*. New Delhi:TERI
5. Kripalani, J.B. (1970). *Gandhi: His Life and Thought*. New Delhi: Publications Division.
6. Narayan, Rajdeva (2011). *Ecological Perceptions in Gandhism and Marxism*. Muzaffarpur:NISLS
7. Pandey, J. (1998). *Gandhi and 21st Century*. New Delhi: Concept.
8. Weber, Thomas (2007).Gandhi as Disciple and Mentor. New Delhi: CUP

Course Outcomes:

After the successful completion of the course the students will be able to;

1. Understand the life of Gandhi
2. Appreciate the role of Gandhian non-violence and Satyagraha in India's freedom struggle.
3. Critically examine the philosophy of Gandhi on Education, Sarvodaya, and Satyagraha
4. Analyse the contemporary significance of Gandhian constructive programmes and eleven vows
5. Examine the possible solutions for some of the contemporary challenges like environmentalissues, moral degradation and ethical dilemmas.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG-4: Ensure Inclusive And Equitable Quality Education And Promote Lifelong Learning Opportunities For All.
Sdg-8: Promote Sustained, Inclusive And Sustainable Economic Growth, Full And Productive Employment And Decent Work For All

SDG Justification:

Statement: This course promotes the education for all the people without considering their religion, caste, gender and regional differences.

Statement: This course deals with the basic concepts of national income and employment to understand the national level scenario of how an economy is growing and providing employment.

POLS1001	Indian Constitution and History	L	T	P	S	J	C
		2	0	0	0	0	2*
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course analyzes the basic structure and operative dimensions of the Indian Constitution. It explores various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The course also deals with various challenges faced by the constitution and its coping mechanisms. Broadly, the students would understand and explain the working of different institutions and political debates ensuing from the operation of the Indian constitution in action.

Course Educational Objectives:

- To introduce constitutional history of India.
- To explain the process of making Indian constitution
- To analyze Fundamental of Rights, Duties and other principles in constitution
- To create familiarity with political developments which shaped the constitution.

UNIT 1 India as a Nation 6 hours

Khilani, S. (2004). *Introduction, The Idea of India*, Chapter 1. New Delhi: Penguin Books, pp. 1-15.

Rowat, D. (1950). 'India: The Making of a Nation', International Journal, 5(2), 95-108. doi:10.2307/40194264

Brass, P. (2018). 'Continuities and Discontinuities between pre- and post-Independence India', Chapter 1.

The Politics of Idea since independence, New Delhi: Cambridge University Press. pp. 1-30.

UNIT 2 Understanding the Constitution 6 hours

Mehta, U.S. (2011). 'Constitutionalism' in *The Oxford Companion to Politics in India*, (ed) by Nirja Gopal Jayal, and Pratap Bhanu Mehta, New Delhi: Oxford University Press. pp. 15-27.

Austin, G. (2016), 'The Constituent Assembly: Microcosm in Action' *in The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp. 1-25.

Beteille, Andre (2008): "Constitutional Morality," *Economic and Political Weekly*, Vol 43, Issue No 40

Prahladan, Vivek (2012): "Emergence of the Indian Constitution," *Economic and Political Weekly*, Vol 47, Issue No 07.

UNIT 3 The Preamble, Fundamental Rights and Directive Principles of State Policy 6 hours

Bhakshi, P.M. (2011). 'Preamble' in *The Constitution of India*, New Delhi: Universal Law. Pp. 1-5. Laxmikanth, M. (2017). 'Chapter IV: Preamble of the Constitution' in *Indian Polity*, Chennai: McGraw Hills.

Kumar, Virendra (2007): "Basic Structure of The Indian Constitution: Doctrine of Constitutionally Controlled Governance [From Kesavananda Bharati to I.R. Coelho]" *Journal of the Indian Law Institute*, Vol 49, No 3, pp 365-398.

Austin, G (2016), ' ' in *The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp.63-105.

Reddy, S (1980). Fundamental Ness of Fundamental Rights and Directive Principles in the Indian Constitution. *Journal of the Indian Law Institute*, 22(3), pp. 399-407.

Bhatia, Gautam (2017): "The Supreme Court's Right to Privacy Judgement," *Economic and Political Weekly*, Vol 52, Issue No 44

UNIT 4 Citizenship 6 hours

Jayal, N.G. (2019). 'Reconfiguring citizenship in contemporary India' in *South Asia Journal of SouthAsian Studies*, pp.33-58.

Roy, Anupama. (2010). 'Chapter I: Enframing the citizen in contemporary times' in *Mapping Citizenship in India*, New Delhi: Oxford University Press.

Das, Veena (2010): "State, Citizenship and the Urban Poor," *Citizenship Studies,* Vol 15, pp 319-333.Valerian Rodrigue

UNIT 5 Separation and Distribution of Powers 6 hours

Pal, Ruma. (2016). 'Separation of Powers' in *The Oxford Handbook of the Indian Constitution*, (ed) by Sujit Choudhry, Madhav Khosla, and Pratap Bhanu Mehta, Delhi: Oxford University Press.

Bakshi, P. (1956). 'Comparative Law: Separation of Powers in India'. *American Bar Association Journal, 42*(6), 553-595.

Rao, P. (2005). ‘Separation of Powers in a Democracy: The Indian Experience’. *Peace Research, 37*(1),113-122.

Kumar, Ashwani (2019): “Constitutional Rights, Judicial Review and Parliamentary Democracy,”

Economic and Political Weekly, Vol 51, Issue 15

Tillin, Louise. (2015). ‘Introduction’ in *Indian Federalism*. New Delhi: Oxford University Press. pp.1-30.

Chakrabarty, Bidyut and Rajendra Kumar Pandey. (2008). *Federalism’ in Indian Government andPolitics*, New Delhi: Sage Publications. pp. 35-53.

Arora, B. and Kailash, K. K. (2018). ‘Beyond Quasi Federalism: Change and Continuity in IndianFederalism’, in *Studies in Indian Politics*, pp. 1-7.

Agrawal, Pankhuri (2020): “COVID-19 and dwindling Indian Federalism,” *Economic and PoliticalWeekly,* Vol 55, Issue No 26

Recommended Readings:

De, Rohit. (2018). *A People’s Constitution – The Everyday Life of Law in the Indian Republic*, USA:Princeton University Press.

Granville Austin, *The Indian Constitution: Cornerstone of a Nation*, Oxford University Press, Oxford, 1966.

Lahoti, R.C. (2004). *Preamble: The Spirit and Backbone of the Constitution of India*. Delhi: EasternBook Company.

Rajeev Bhargava (ed), *Ethics and Politics of the Indian Constitution*, Oxford University Press, NewDelhi, 2008.

Subhash C. Kashyap, *Our Constitution*, National Book Trust, New Delhi, 2011.Tillin, Louise. (2015). *Indian Federalism*. New Delhi: Oxford University Press.

Zoya Hassan, E. Sridharan and R. Sudarshan (eds), *India’s Living Constitution: Ideas, Practices,Controversies*, Permanent Black, New Delhi, 2002.

Course Outcomes:

On the successful completion of the course students would be able to:

1. Demonstrate an understanding of the Constitution of India and how constitutional governance iscarried out in India
2. Interpret knowledge of the Fundamental Rights and Duties of the Citizens as well as theObligation of the state towards its citizens
3. Correlate familiarity with key political developments that have shaped the

Constitution andamended it from time to time.

4. Equip themselves to take up other courses in law after having done a foundation course on IndianConstitution

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :01-02-2022 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDG-16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

SDG Justification:

The course primarily talks about evolution of the constitutional institutions. Since the SDG-16 talks about the quality of the institutions, it is applicable here.

VEDC1001	VENTURE DEVELOPMENT	L	T	P	S	J	C
		0	0	0	2	0	2
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

India as part of its "Make in India" initiative has been focusing on creating incubation centers within educational institutions, with an aim to generate successful start-ups. These start-ups will become employment creators than employment seekers, which is the need of the hour for our country. This common course (university core) for all the disciplines is a foundation on venture development. It is an experiential course that starts with students discovering their deeper self in terms of how they might contribute to society by creating exciting new products and services that can become the basis of real businesses. The students learn about the emerging areas of knowledge that are the foundations of any successful company. They will learn how to develop insight into the problems and desires of different types of target customers, and from this, to identify the design drivers for a specific innovation. Students will learn specific design methods for new products and services. The students will learn that as important as the product or service itself, is a strategy for monetizing the innovation – for generating revenue, structuring the operating costs, and creating the operating profit needed to support the business, hire new employees, and expand forward. This course is aimed to be the beginning of what might be the most important journey of personal and career discovery so far in a student's life, one with lasting impact. This is not just a course, but potentially, an important milestone in life that a student remembers warmly in the years to come.

Course Educational Objectives:

Students have the opportunity to:

- Discover who they are – Values, Skills, and Contribution to Society
- Understand how creativity works and permeates the innovation process
- Learn the basic processes and frameworks for successful innovation.
- Gain experience in going through the innovation process.
- Conduct field research to test or validate innovation concepts with target customers.

UNIT 1 PERSONAL DISCOVERY 4 hours

Personal Values, Excite & Excel, Build a Team, Define Purpose, Mission Statement

UNIT 2 IDEATION 10 hours

Ideation & Impact, User Insights - Frameworks, Customer Interviews, Interpreting Results

UNIT 3 SOLUTION DISCOVERY 8 hours

Concept Design, Competitive Analysis, Product Line Strategy, Prototyping Solutions, Reality Check

UNIT 4 BUSINESS MODEL DISCOVERY 4 hours

Understand the Industry, Types of Business Model, Define Revenue Models, Define Operating Models, Define Customer Journey, Validate Business Model

UNIT 5 DISCOVERY INTEGRATION

Define Company Impact, Create Value, Tell Your Story

L – 15; Total Hours – 30

Textbooks:

1. Meyer and Lee, “Personal Discovery through Entrepreneurship”, The Institute for Enterprise Growth, LLC. Boston, MA., USA.

References:

1. Adi Ignatius (Editor-in-Chief), “Harvard Business Review”, Harvard Business Publishing, Brighton, Massachusetts,2021

Course Outcomes:

1. Identify one’s values, strengths and weaknesses and their will to contribute to the society
2. Formulate an idea and validate it with customers
3. Demonstrate prototyping and analyse the competition for the product
4. Create business models for revenue generation and sustainability of their business
5. Come up with a pitch that can used as the basis for actually starting a company based on an impactful innovation and societal impact

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :<< date >> **ACADEMIC COUNCIL: <<date>>**

SDG No. & Statement:

4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

SDG Justification:

4. The course involves identifying one’s personal values and working on real-life problems, thus forming the base to work on their passions even past the collegiate life.

17. The course is developed in collaboration with North-eastern University, USA and the training for the champions is being by North-eastern University.

Faculty Core

CHEM1001	CHEMISTRY	L	T	P	S	J	C
		2	1	2	0	0	4
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:

This course enables the students to gain knowledge on various aspects of Water and its treatment, electrochemical energy systems, Construction of batteries, renewable energy sources, Semiconductors, Steel, Cement and Polymers, Corrosion and its control, nanomaterials, Analytical instruments, and applications. The knowledge gained in this course can be applied to the latest developments in technology.

Course Educational Objectives:

1. To impart knowledge on various aspects of water and its treatment.
2. To study about electrochemical energy systems, renewable energy sources, solar cells, and their applications.
3. To gain knowledge on materials such as steel, cement, and polymers
4. To create awareness on corrosion and its control.
5. To introduce different types of nanomaterials.
6. To expose the students to latest instrumental techniques such as scanning electronic microscope (SEM) & transmission electron microscope (TEM).

UNIT 1 Water and its treatment 9 Hours

Water and its treatment: Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness. Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization-industrial water treatment- Boiler feed water and its treatment -internal conditioning– Calgon and Phosphate conditioning. External treatment of water – Ion exchange process. Desalination of water – Reverse osmosis.

UNIT 2 Electrochemical Energy Systems 9 Hours

Battery Technology: Basic concepts, battery characteristics, classification of batteries, Important applications of batteries, Classical batteries-dry/Leclanche cell, Modern batteries-zinc air, Lead-acid storage battery, lithium cells- Lithium-ion cell, Li MnO2 cell. Fuel cells- Introduction - classification of fuel cells – hydrogen and oxygen fuel cell, propane, and oxygen fuel cell- Merits of fuel cell. **Renewable energy sources – Types of renewable energy sources. Semiconductors:** Definition, types of semiconductors: doping- n type and p – type semiconductors and applications. - **Solar cells:** Introduction, harnessing solar energy, Photovoltaic cell, solar water heaters.

UNIT 3 Engineering materials and Polymer Chemistry 8 Hours

Steel – Types of Steel, chemical composition – applications of alloy steels

Cement: Portland cement, constituents, Manufacture of Portland Cement, chemistry of setting and hardening of cement (hydration, hydrolysis, equations).

Polymer Chemistry: Concept of polymerization – Types of Polymerizations, Chain growth polymerization – mechanisms of free radical and cationic polymerizations, Thermoplastic resins and Thermosetting resins: examples- Polyethylene, Styrene, Nylon 6,6 and Bakelite. and applications, Conducting polymers:– Examples – and applications.

UNIT 4 Corrosion and its control 8 Hours

Corrosion and Its Prevention: Electrochemical theory of corrosion, Corrosion due to dissimilar metal cells (galvanic cells), Corrosion due to differential aeration cells, Uniform corrosion, pitting corrosion and stress corrosion cracking, Effect of pH, temperature and dissolved oxygen on corrosion rate. Corrosion prevention and control by cathodic protection- protective coatings- paints.

UNIT 5 Nanomaterials and Analytical Instrumental Techniques 8 Hours

Nanomaterials: Introduction to nanomaterial: nanoparticles, nanocluster, carbon nanotube (CNT) and nanowires. Chemical synthesis of nanomaterials: sol-gel method. Characterization: Principle and applications of scanning electron microscope (SEM) and transmission electron microscope (TEM)

Analytical Instrumental Techniques

Review of electromagnetic spectrum, Quantization of energy. Absorption of radiation: Beer-Lambert's law. Principle and applications of pH metry, potentiometry, conductometry, IR and UV-spectroscopy with examples.

Text Books:

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi (2014).
2. B.K. Sharma, Engineering Chemistry, Krishna Prakashan, Meerut.
3. O G Palanna, Engineering Chemistry, Tata McGraw Hill Education Private Limited, (2009).

References:

1. Sashi chawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, (2003)
2. B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, University Press (2013).
3. S.S. Dara, A Textbook of Engineering Chemistry, S.Chand & Co, (2010)
4. N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications (2014).
5. K. Sesha Maheshwaramma and Mridula Chugh, Engineering Chemistry, Pearson India Edn services, (2016).

Course Outcomes:

After the completion of the course, the student will be able to

1. List the important purification methods of water.
2. Illustrate the principles and applications of batteries, solar energy.
3. Explain the importance of materials such as steel, cement, and polymers

4. Identify different protective coatings.
5. Analyze the importance of nano materials and the principles of SEM and TEM.

CHEMISTRY LABORATORY

List of Experiments:

1. Determination of Mohr's salt by potentiometric method
2. Determination of strength of an acid by pH metric method
3. Determination of conductance by conductometric method
4. Determination of viscosity of a liquid
5. Determination of surface tension of a liquid
6. Determination of sulphuric acid in lead-acid storage cell
7. Determination of chromium (VI) in potassium dichromate
8. Determination of copper in a copper ore
9. Determination of Zinc by EDTA method.
10. Estimation of active chlorine content in Bleaching powder
11. Preparation of Phenol-Formaldehyde resin
12. Preparation of Urea-Formaldehyde resin
13. Thin layer chromatography
14. Preparation of TiO2/ZnO nano particles
15. SEM analysis of nano materials

Textbooks:

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000).
2. N.K Bhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, Dhanpat Rai Publishing Company (2007).

Course Outcomes:

After the completion of the laboratory course, the student will be able to

1. explain the functioning of the instruments such as pH, Conductometric and Potentiometric methods.
2. identify different ores (Cr & Cu) and their usage in different fields (industry, software devices, electronic goods).
3. experiment with the physical parameter of organic compounds.
4. compare the viscosities of oils.
5. list the preparation of polymers and nano materials.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

CSEN1011	PROBLEM SOLVING AND PROGRAMMING WITH C	L	T	P	S	J	C
		0	0	6	0	0	3
Pre-requisite	Nil						
Co-requisite	Nil						
Preferable exposure	Familiarity with Computer system and its operation.						

Course Description:
The course is designed to enable the student to write programs for problem solving. After an introduction to program logic design using algorithms and flowcharts, converting the logic into programs is taught. The features of structured programming are explained with the C programming language as an example. This course lays the foundation both for developing program logic and for writing programs in C according to the developed logic.

Course objectives:
1. Familiarize the student with the steps involved in writing and running a compiled program.
2. Enable the student to build program logic with algorithms and flowcharts.
3. Explain with the features and constructs of C programming such as data types, expressions, loops, functions, arrays, pointers, and files.
4. Demonstrate the handling of variables and input-output operations in C.
5. Train the student to convert program logic into C language code using a top-down approach.

Module I: **Introduction to Computer Problem-Solving** 12Hours
Introduction, the Problem-Solving Aspect, Top-Down Design, Introduction to the idea of an algorithm, Introduction to Flowchart using Raptor tool.
Introduction to C Language – Structure of a C Program, Keywords, Identifiers, Data Types (int, float, char, unsigned int) and Variable declaration, Constants, Input / Output function. Operators, Expressions, Precedence and Associativity, Expression Evaluation, Type conversions.
Exercises: Construct a flowchart and write a program to
- Develop a calculator to convert time, distance, area, volume and temperature from one unit to another.
- Calculate simple and compound interest for various parameters specified by the user
- To enter marks of five subjects and calculate total, average and percentage.
- Calculate net salary of employee given basic,da,hra,pf and lic
- retrieve remainder after division of two numbers without using mod operator
- Convert an upper-case character to a lower-case character.
- Swap two numbers
- Enter two angles of a triangle and find the third angle.
- Check Least Significant Bit (LSB) of a number
- Input any number from user and check whether nth bit of the given number is set (1) or not (0)(hint: Use bitwise operators)

Module II: Control Structures 15 Hours

- **Control Structures:** Selection Statements (making decisions) – if, if-else, nested if, else if ladder and switch statements. Repetition statements (loops)-while, for, do-while statements, Nested Loops.
- Unconditional statements-break, continue, goto.
- Pointers – Pointer variable, pointer declaration, Initialization of pointer, accessing variables through pointers, pointers to pointers, pointers to void.

Exercises: Construct a Flowchart and Write a Program to

- Check whether the triangle is equilateral, isosceles, or scalene triangle.
- Check whether entered year is a leap year or not
- Find minimum among three numbers.
- Check whether a number is divisible by 5 and 11 or not.
- Check whether a number is positive, negative or zero using switch case.
- Design a calculator that performs arithmetic operations on two numbers using switch case
- Find Roots of a Quadratic Equation
- Find factorial of a number
- Check whether number is a palindrome or not
- Check whether number is perfect or not
- Convert a decimal number to binary number
- To find the sum of the series [1-X^2/2!+X^4/4! ....].
- Print following patterns
  ```
  *
  *
  * *
  * * *
  * * * *
  A
  B B
  C CC
  D D D D
  E E E EE
  1
  2 3
  4 5 6
  7 8 9 10
  ```
- Calculate the greatest common divisor of two numbers
- Generate first n numbers in the Fibonacci series
- Generate n prime numbers
- Swap two numbers using pointers.
- Performs all the five arithmetic operations using Pointers.

Module III: Functions 15 Hours

Functions-Designing Structured Programs, user defined function- function definition, function prototype, function call, Types of functions. Parameter Passing by value, parameter passing by address, Recursive functions. Dynamic Memory allocation Functions, pointers to functions. Storage classes-auto, register, static, extern.

Exercises: Write a program using functions to

- Print even and odd numbers in a given range
- Find power of a number
- Return maximum of given two numbers
- To print all strong numbers between given interval using functions.
- Check whether a number is prime, Armstrong or perfect number using functions.
- Demonstrate call by value and call by reference mechanisms.
- Find power of any number using recursion.
- Generate Fibonacci series using recursion
- Find product of two numbers using recursion
- Find the sum of digits of a number. Number must be passed to a function using pointers.
- Find GCD (HCF) of two numbers using recursion.
- Find LCM of two numbers using recursion.

Module IV: Arrays and Strings 15 Hours

Arrays – Declaration and Definition of Array, accessing elements in array, Storing values in array, linear search, binary search, bubble sort, Two – dimensional arrays, multidimensional arrays. Arrays and Pointers, Pointer Arithmetic and arrays, array of pointers, Passing array to function.
Strings – Declaration and Definition of String, String Initialization, unformatted I/O functions, arrays of strings, string manipulation functions, string and pointers.

Exercises: Write a program to

- Find minimum and maximum element in an array
- Implement linear search.
- Sort an array in descending order.
- Given a two-dimensional array of integers and a row index, return the largest element in that row.
- Find transpose of a matrix.
- Perform multiplication of two matrices
- Count total number of vowels and consonants in a string.
- Reverse the given string without using String handling functions.
- Sort strings in dictionary order
- To perform addition of two matrices.
- Read an array of elements of size 'n' and find the largest and smallest number using functions
- find total number of alphabets, digits or special character in a string using function

Module V: Structures and Files 15Hours

Structures–Declaration, initialization, accessing structures, operations on structures, structures containing arrays, structures containing pointers, nested structures, self-referential structures, arrays of structures, structures and functions, structures and pointers, unions.
Files – Concept of a file, Opening and Closing files, file input / output functions (standard library input / output functions for text files)

Exercises: Write a program to

- Store information of a student using structure
- Add two complex numbers by passing structures to a function

- Store information of 10 students using structures
- Store Employee information using nested structure
- Read file contents and display on console.
- Read numbers from a file and write even and odd numbers to separate file.
- Count characters, words and lines in a text file.

Textbooks(s)

- B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3/e, Cengage Learning

Reference Book(s)

1. Jeri R Hanly, Elliot B Koffman, Problem Solving and Program Design in C, 7/e, Pearson Education, 2012.
2. B.W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2/E, Pearson education, 2015.
3. B. Gottfried, Programming with C, 3/e, Schaum’s outlines, McGraw Hill (India), 2017.
4. P. Dey and M Ghosh, Programming in C, 2/e, Oxford University Press, 2011.

Additional Exercises:

1. Given numbers x, y, and target, return whichever of x and y is closer to the target. If they have the same distance, return the smaller of the two
2. There are three friends Ram, Raheem and Robert. Ram’s age is 20, Raheem is aged three times more than his friend Ram. After 8 years, he would be two and a half times of Ram’s age. After further 8 years, how many times would he be of Rams age? Robert’s age is 25 now. Now program your computer to determine the final ages of all the three people after 16 years and also show who is elder.
3. Given an actual time and an alarm clock time, both in “military” format (such as 0730 for 7:30am), print how many more minutes before the alarm rings. But if the time is after the alarm, print "Alarm already went off".
4. Let there be a scenario where you and your friend are going to a restaurant. You have lunch there every fourth day, and he has his lunch there every sixth day. How many days before you meet again for lunch at the same restaurant?
5. Two friends Suresh and Ramesh have **m** red candies and **n** green candies respectively. They want to arrange the candies in such a way that each row contains equal number of candies and also each row should have only red candies or green candies. Help them to arrange the candies in such a way that there are maximum number of candies in each row.
6. On a chessboard, positions are marked with a letter between a and h for the column and a number between 1 and 8 for the row. Given two position strings, return true if they have the same colour.
7. Given two strings s0 and s1, return whether they are anagrams of each other.
8. Write a program to encrypt and decrypt a password which is alphanumeric
9. Given a string, return the string with the first and second half swapped. If the string has odd length, leave the middle character in place.
10. Given an array of integers, return the second-largest element.
11. Given lists of integers people, jobs, profits. Each person i in people have people[i] amount of strength, and performing job j requires jobs[j] amount of strength and nets profits[j] amount of profit. Given that each person can perform at most one job, although a job can be assigned to more than one person, return the maximum amount of profit that can be attained.

12. Mr. Roxy has arranged a party at his house on the New Year's Eve. He has invited all his friends - both men and women (men in more number). Your task is to generate the number of ways in which the invitees stand in a line so that no two women stand next to each other. Note that the number of men is more than the number of women and Roxy doesn't invite more than 20 guests. If there are more than 20 guests or an arrangement as per the given constraints is not possible, print 'invalid'.
13. Two friends have entered their date of birth and they want to know who is elder among them. Make a structure named Date to store the elements day, month and year to store the dates.

Case Study:

1. Create a structure containing book information like accession number, name of author, book title and flag to know whether book is issued or not. Create a menu in which the following functions can be done: Display book information, Add a new book, Display all the books in the library of a particular author, Display the number of books of a particular title, Display the total number of books in the library, Issue a book (If we issue a book, then its number gets decreased by 1 and if we add a book, its number gets increased by 1)

2. Ranjan is maintaining a store. Whenever a customer purchases from the store, a bill is generated. Record the customer name, amount due, the amount paid, mobile number with purchased items in file. At the end of day print the total income generated by store.

3. Contact Management System- Create structure to store Contact information like name, gender,mail,phone number and address. Users can add new contact and can also edit and delete existing contact. (Hint: Use Files to store data)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															
Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation															

APPROVED IN:

BOS : September 6, 2021 **ACADEMIC COUNCIL: 21st AC(September 17, 2021)**

SDG No. & Statement: 4 Quality Education, Decent Work and Economic Growth

4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

SDG Justification:

Learning various problem-solving techniques will lead to become a good problem solver.

CSEN1021	PROGRAMMING WITH PYTHON	L	T	P	S	J	C
		0	0	6	0	0	3
Pre-requisite	Nil						
Co-requisite	Nil						
Preferable exposure	Familiarity with Computer system and its operation.						

Course Educational objectives:

1. To elucidate problem solving through python programming language
2. To introduce function-oriented programming paradigm through python
3. To train in development of solutions using modul ar concepts
4. To teach practical Python solution patterns

Module I: Introduction to Python 18 **Hours**

Python – Numbers, Strings, Variables, operators, expressions, statements, String operations, Math function calls, Input/output statements, Conditional If, while and for loops.

Exercises:

1. Accept input from user and store it in variable and print the value.
2. Use of print statements and use of (.format)for printing different data types.
3. Take 2 numbers as user input and add, multiply, divide, subtract, remainder and print the output (Same operations on floating point input as well)
4. Conversion of one unit to another (such as hours to minutes, miles to km and etc)
5. Usage of mathematical functions in python like math.ceil, floor, fabs, fmod, trunc, pow, sqrt etc.
6. Building a mathematical calculator that can perform operations according to user input. Use decision making statement.
7. Accepting 5 different subject marks from user and displaying the grade of the student.
8. Printing all even numbers, odd numbers, count of even numbers, count of odd numbers within a given range.
9. a) Compute the factorial of a given number. b) Compute GCD of two given numbers. c) Generate Fibonacci series up to N numbers.
10. Check whether the given input is a) palindrome b) strong c) perfect
11. Compute compound interest using loop for a certain principal and interest amount

Module II: Functions **18 Hours**

User defined Functions, parameters to functions, recursive functions. Lists, Tuples, Dictionaries, Strings.

Exercises:

- Create a function which accepts two inputs from the user and compute ${}^{n}C_{r}$
- Recursive function to compute GCD of 2 numbers
- Recursive function to find product of two numbers
- Recursive function to generate Fibonacci series
- Program to print a specified list after removing the 0th, 4th and 5th elements.
  Sample List : ['Red', 'Green', 'White', 'Black', 'Pink', 'Yellow']
  Expected Output : ['Green', 'White', 'Black']
- Program to get the difference between the two lists.
- Program to find the second smallest number and second largest number in a list.
- Given a list of numbers of list, write a Python program to create a list of tuples having first element as the number and second element as the square of the number.
- Given list of tuples, remove all the tuples with length K.
  Input : test_list = [(4, 5), (4,), (8, 6, 7), (1,), (3, 4, 6, 7)], K = 2
  Output : [(4,), (8, 6, 7), (1,), (3, 4, 6, 7)]
  Explanation : (4, 5) of len = 2 is removed.
- Program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x).
  Sample Input: (n=5) :
  Expected Output : {1: 1, 2: 4, 3: 9, 4: 16, 5: 25}
- Program to remove a key from a dictionary
- Program to get the maximum and minimum value in a dictionary.
- Program to perform operations on string using unicodes ,splitting of string,accessing elements of string using locations
- Program for Counting occurrence of a certain element in a string, getting indexes that have matching elements.For ex -.In Rabbit count how many times b has occurred . Example-I have to go to a doctor and get myself checked. Count the number of occurrences of ‘to’.
- Program for replacing one substring by another For example - Rabbit - Replace ‘bb’ by ‘cc’
- Program to Acronym generator for any user input (ex-input is Random memory access then output should be RMA).Example - Random number (RN)
- Python function that accepts a string and calculates the number of uppercase letters and lowercase letters.
- Program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings

  Sample List : ['abc', 'xyz', 'aba', '1221'] Expected Result : 2

Module III: Files and Packages **18 Hours**

Files—Python Read Files, Python Write/create Files, Python Delete Files.

Pandas -- Read/write from csv, excel, json files, add/ drop columns/rows, aggregations, applying functions.

Exercises

- read an entire text file.
- read the first n lines of a file.
- append text to a file and display the text.
- Read numbers from a file and write even and odd numbers to separate files.
- Count characters, words and lines in a text file.
- To write a list to a file.
- Given a CSV file or excel file to read it into a data frame and display it.
- Given a data frame, select rows based on a condition.
- Given is a data frame showing the name, occupation, salary of people. Find the average salary per occupation.
- To convert Python objects into JSON strings. Print all the values.
- Write a Pandas program to read specific columns from a given excel file.

Module IV: Operations in database with suitable libraries **18 Hours**

SQLite3: CRUD operations (Create, Read, Update, and Delete) to manage data stored in a database.

Matplotlib -- Visualizing data with different plots, use of subplots. User defined packages, define test cases.

Exercises

Special commands to sqlite3 (dot-commands)
Rules for "dot-commands"
Changing Output Formats
Querying the database schema
Redirecting I/O
Writing results to a file
Reading SQL from a file
File I/O Functions
The edit() SQL function
Importing CSV files
Export to CSV
Export to Excel

Reference - https://www.sqlite.org/cli.html

Matplotlib can be practiced by considering a dataset and visualizing it.
It is left to the instructor to choose appropriate dataset.

Module V: Regular Expressions **18 Hours**

Regular expression: meta character, regEx functions, special sequences, Web scrapping, Extracting data.

Exercises

Write a Python program to check that a string contains only a certain set of characters (in this case a-z, A-Z and 0-9).
Write a Python program that matches a string that has an a followed by zero or more b's
Write a Python program that matches a string that has an a followed by one or more b's
Write a Python program that matches a string that has an a followed by zero or one 'b'
Write a Python program that matches a string that has an a followed by three 'b'
Write a Python program to find sequences of lowercase letters joined with an underscore

Write a Python program to test if a given page is found or not on the server.
Write a Python program to download and display the content of robot.txt for en.wikipedia.org.
Write a Python program to get the number of datasets currently listed on data.gov
Write a Python program to extract and display all the header tags from en.wikipedia.org/wiki/Main_Page
.
Textbooks(s)

1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press

Reference Book(s)

1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press
3. Python for Data Analysis, Wes McKinney, O.Reeilly

Course Outcomes:
After completion of this course the student will be able to
- Define variables and construct expressions.
- Utilize arrays, storing and manipulating data.
- Develop efficient, modular programs using functions.
- Write programs to store and retrieve data using files.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021 **ACADEMIC COUNCIL: 21st AC(September 17, 2021)**

SDG No. & Statement: 4 Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

SDG Justification:

Learning a programming language like Python students can get decent jobs in different fields.

CSEN1031	ARTIFICIAL INTELLIGENCE APPLICATIONS	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	CSEN1011: Problem Solving and Programming with C CSEN1021: Programming with Python						
Co- requisite	Nil						
Preferable exposure	Programming						

Course Description:

The surge in the production of data has led to the development of various technologies. The term "Artificial Intelligence (AI)" has become ubiquitous in everyday applications from virtual assistants to self-driving cars. Several applications such as Healthcare, Finance, Bioinformatics etc. are benefitting from the advances in the domain. The global market for artificial intelligence is going to face a phenomenal growth over the coming years with organizations across the world capitalizing on the disruptive technologies that AI is offering. This course introduces the recent applications of AI namely, Virtual Assistants, Computer Vision, along with trending topics such as Deep Learning and Reinforcement Learning. The idea of the course is to introduce the basic concepts of AI as well as latest trends in the domain. This course is envisaged to provide a basic understanding on latest developments of AI to all disciplines engineering undergraduates.

Course Educational Objectives:

1. Provide introduction to basic concepts of artificial intelligence.
2. Explore applications of AI
3. Explore the scope, advantages of intelligent systems
4. Experiment with different machine learning concept
5. Exposure to AI-intensive computing and information system framework

UNIT 1 **2 Hours**

Introduction to Artificial intelligence: Basics of AL Agents and Environment, The Nature of Environment.

List of Experiment(s):

Implementation of toy Problems (8-Puzzle, Wumpus World, Vacuum-clean Example, etc)

UNIT 2 **2 Hours**

Applications of AI: Game Playing, [Deep Blue in Chess, IBM Watson in Jeopardy, Google's Deep Mind in AlphaGo]

List of Experiment(s):

1. Implementation of (Sudoku, Crossword Puzzle, or Wumpus World, etc)

UNIT 3 **2 Hours**

Conceptual introduction to Machine Learning: Supervised, Unsupervised, and Semi-Supervised Learning.

List of Experiment(s):

1. Supervise - Perform Data Labelling for various images using object recognition

UNIT 4 **2 Hours**

Reinforcement Learning, Introduction to Neural Networks, Deep Learning

List of Experiment(s):

1. Explore the effect of different hyperparameters while implementing a Simple Fully Connected Neural Network. (https://playground.tensorflow.org)

UNIT 5 **2 Hours**

Image Processing & Computer Vision: Introduction to Image processing, Image Noise, Removal of Noise from Images, Color Enhancement, Edge Detection.

List of Experiment(s):

1. Lobe.ai - Build custom models using the visual tool for Object recognition and sentiment analysis that can convert facial expressions into emoticons

UNIT 6 **2 Hours**

Segmentation. Feature Detection & Recognition. Classification of images. Face recognition, Deep Learning algorithms for Object detection & Recognition.

List of Experiment(s):

1. Teachable Machine Brain.JS In Browser Object Recognition through
2. Haar Cascade Object detection for Eye and Face in Python using Open CV

UNIT 7 **2 Hours**

Conceptual introduction to Natural Language Processing: Speech Recognition & Synthesis: Speech Fundamentals, Speech Analysis, Speech Modelling.

List of Experiment(s):

1. Sentiment Analysis and Polarity detection

UNIT 8 **2 Hours**

Speech Recognition, Speech Synthesis, Text-to-Speech, Sentiment Analysis, Segmentation and recognition.

List of Experiment(s):

1. Text to Speech recognition and Synthesis through APIs

UNIT 9 **2 Hours**

Introduction to o Chatbot, Architecture of a Chatbot. NLP in the cloud, NL Interface, How to Build a Chatbot, Transformative user experience of chatbots, Designing Elements of a chatbot, Best practices for chatbot development. NLP components. NLP wrapper to chatbots. Audiobots and Musicbots.

List of Experiment(s):

1. Building a Chatbot using IBM Watson visual studio
2. Building a Chatbot using Pandora bots
3. Build a virtual assistant for Wikipedia using Wolfram Alpha and Python

UNIT 10 **2 Hours**

Smart Applications: Smart Manufacturing, Smart Agriculture, Smart Healthcare, Smart Education, Smart Grids, Smart Transportation and Autonomous Vehicles, Smart Homes, Smart Cities

List of Experiment(s):

1. Build a smart application specific to the domain of the student.

Textbooks:

1. Tom Markiewicz& Josh Zheng, Getting started with Artificial intelligence, Published by O'Reilly Media,20l7
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach.

References:

1. Aurtlien Giron. Hands on Machine Learning with Scikit-Learn and TensorFlow concepts,Tools, and Techniques to Build intelligent Systems , Published by O'Reilly Mcdia,20l 7
2. Build an AI Assistant with wolfram alpha and Wikipedia in python.https://medium .com/@salisuwy/build-an-ai-assistant-with-wolfram-alpha-and-wikipedia-in-python-d9bc8ac838fe.
3. Joseph Howse, Prateek Joshi, Michael Beyeler - Opencv Computer Vision Projects withPython-Publishing (201 6).
4. Curated datasets on kaggle https://www.kaggle.com/datasets.

Course Outcomes:

1. Able to grasp the concepts of artificial intelligence, machine learning, natural language processing, image processing
2. Recognize various domains in which Al can be applied
3. Implement the methods in processing an image:
4. Implement simple of chatbots
5. identify smart applications:

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : September 6, 2021

ACADEMIC COUNCIL: 21st AC(September 17, 2021)

SDG No. & Statement:

SDG Justification:

EECE1001	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	S	J	C
		2	1	2	0	0	4
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:

This course introduces the fundamental principles and building blocks of electrical and electronics engineering. The first three units cover the electric circuit laws, theorems, and principles of electrical machines. The last two units cover semiconductor devices and their applications.

Course Educational Objectives:

1. To impart the analysis and design aspects of DC networks in electrical and electronic circuits
2. To explain the basic concepts of AC networks used in electrical and electronic circuits.
3. To demonstrate the importance and operating principles of electrical machines (transformers, motors and generators)
4. To impart the knowledge about the characteristics, working principles and applications of semiconductor diodes, Metal Oxide Semiconductor Field Effect Transistors (MOSFETs).
5. To expose basic concepts and applications of Operational Amplifier and configurations.

UNIT 1 **7 Hours**

DC Circuits: Basic circuit elements and sources, Ohms law, Kirchhoff's laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Superposition, Thevenin's and maximum power transfer theorem.

UNIT 2 **8 Hours**

AC Circuits: Alternating voltages and currents, AC values, single phase RL, RC, RLC series circuits, power in AC circuits, Power Factor, three phase systems-Star and Delta Connection-Three phase power measurement.

UNIT 3 **9 Hours**

Electrical Machines: Construction, working principle and application of DC machines, Transformers, single phase and three phase Induction motors, special machines-Stepper motor, Servo motor and BLDC motor.

UNIT 4 **8 Hours**

Semiconductor Devices: p-n Junction diode - Basic operating principle, current-voltage characteristics, rectifier circuits (half-wave, full-wave, rectifier with filter capacitor), Zener diode as Voltage Regulator; Metal oxide semiconductor field effect transistor (MOSFET): Operation of NMOS and PMOS FETs, MOSFET as an amplifier and switch.

UNIT 5 **8 Hours**

Operational Amplifiers: The Ideal Op-amp, The Inverting Configuration, The closed loop gain, Effect of Finite open-loop gain, The Noninverting Configuration, The closed loop gain, Characteristics of Non-Inverting Configuration, Difference amplifiers, A Single Op-amp difference amplifier. Adders, subtractors, integrators, differentiators, filter circuits using Opamps,

Basic Electrical and Electronics Engineering Laboratory

List of Experiments:

1. Verification of Kirchhoff's Laws.
2. Verification of DC Superposition Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Maximum power transfer Theorem.
5. Load test on DC generator.
6. Load test on single phase transformer.
7. Measurement of voltage, current and power factor of single phase RL, RC series circuits.
8. Measurement of voltage, current and power factor of single phase RLC series circuit.
9. Measurement of power in a three phase circuit.
10. Current Voltage Characteristics of a p-n Junction Diode/LED.
11. Diode Rectifier Circuits.
12. Voltage Regulation with Zener Diodes.
13. Design of a MOSTFET amplifier and MOSFET inverter/NOR gate
14. Inverting and Non-inverting Amplifier Design with Op-amps.
15. Simulation experiments using PSPICE
    a) Diode and Transistor Circuit Analysis.
    b) MOSFET Amplifier design.
    c) Inverting and Noninverting Amplifier Design with Op-amps.

Textbooks:

1. D. P. Kothari, I. J. Nagrath, Basic Electrical and Electronics Engineering, 1/e, McGraw Hill Education (India) Private Limited, 2017.
2. B. L. Theraja, Fundamentals of Electrical Engineering and Electronics, 1/e, S. Chand Publishing, New Delhi, 2006.
3. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits 6/e, Oxford University Press, 2014.

References:

1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education,

2011.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.
3. R. K. Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi, 2012.

Course Outcomes:

After completion of this course, the student will be able to

1. predict and analyse the behaviour of an electrical circuit (L3).
2. analyse the performance quantities such as losses, efficiency and identify applications of DC machines (L4).
3. explain the use of transformers in transmission and distribution of electric power and other applications (L2).
4. demonstrate the operation and applications of various electronic devices (L2).
5. construct Inverting and Noninverting configurations of Op-amp (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:
SDG3: Good Health and Well Being: Understanding the fundamentals of electrical and electronics systems can help in designing systems, to promote good health and well being

SDG5: Gender Equality: Acquiring the interdisciplinary knowledge help overcome the gender barriers in workplace

SDG8: Descent Work and Economic: The learners of this course can get descent work and earn financial benefits and they can work in interdisciplinary areas

SDG12: Responsible Consumption and Production: Use of right and energy efficient electric and electronic components and devices results in reasonable consumption and production
SDG Justification:

<table>
<tr><td rowspan="2">HSMCH102</td><td rowspan="2">UNIVERSAL HUMAN VALUES 2:
UNDERSTANDING HARMONY</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Co- requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Nil</td></tr>
</table>

Course Description:

During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

Course Educational Objectives:

The objective of the course is fourfold:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society, and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society, and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE TOPICS: The course has 28 lectures and 14 practice sessions in 5 modules:

UNIT 1 Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. 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 2 Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of 'I' and harmony in 'I'.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life.
Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT 3 Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. 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 4 Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.

4. Holistic perception of harmony at all levels of existence.
5. 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 5 Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. 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.
5. Case studies of typical holistic technologies, management models and production systems
6. 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
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

Text Books:

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

References:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)

13. Gandhi - Romain Rolland (English)

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor’s role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one’s own self and do self- observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up “ordinary” situations rather than” extra-ordinary” situations.

Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials)would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty.

Teacher preparation with a minimum exposure to at least one 8- day FDP on Universal Human Values is deemed essential.

ASSESSMENT:
This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:
Assessment by faculty mentor: 10 marks
Self-assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks Semester End Examination:

50 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

Course Outcomes:
By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to- day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by
  a. faculty-student or mentor-mentee programs throughout their time with the institution
  b. Higher level courses on human values in every aspect of living. E.g. as a professional

INTN2333	INTERNSHIP 1	L	T	P	S	J	C
		0	0	0	0	1	1
Pre-requisite	Completion of minimum of four semesters						
Co- requisite							
Preferable exposure							

Course Educational Objectives:

1. The course is designed to expose the students to expected industry skills and industry environment and to take up onsite assignment as trainees or interns.

Contents: **1 Week**

One week of work at industry site. Supervised by an expert at the industry.

Mode of Evaluation: Internship Report, Presentation and Project Review

Course Outcomes:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. identify skill set required to participate activity in real-time projects relevant to the industry
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. formulate technical background required to participate in Internship 2

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

INTN3444	INTERNSHIP 2	L	T	P	S	J	C
		0	0	0	0	1	3
Pre-requisite	Completion of minimum of six semesters						
Co- requisite							
Preferable exposure							

Course Educational Objectives:

1. The course is designed to expose the students to industry environment and to take up onsite assignment as trainees or interns.

Contents: **1 Week**

Four weeks of work at industry site. Supervised by an expert at the industry

Mode of Evaluation: Internship Report, Presentation and Project Review

Course Outcomes:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. Communicate effectively
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. Develop the ability to engage in research and to involve in life-long learning
5. Comprehend contemporary issues
6. Engage in establishing his/her digital footprint

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">MATH1001</td><td rowspan="2">SINGLE VARIABLE CALCULUS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">NIL</td></tr>
</table>

Course Description:

This course is designed to impart knowledge on differentiation and integration of function, emphasizing their inter-relationship and applications to engineering.

Course Educational Objectives:

1. To familiarize the students in the concepts the derivatives and its underlying concepts like limits and continuity.
2. To explain the concept of derivative and calculation of extreme values of extreme values of various functions.
3. To impart knowledge on integration for the computation of areas, arc lengths.
4. To demonstrate various techniques of integrations.

UNIT 1 Limits and continuity of single and several variables 6 Hours

Limit of a Function and Limit Laws, The Precise Definition of a Limit, One-Sided Limits, Continuity (Without proofs). Functions of Several Variables, Limits and Continuity in Higher Dimensions (Without proofs)

UNIT 2 Derivatives and applications 7 Hours

The Derivative as a Function, Differentiation Rules, The Chain Rule, Extreme Values of Functions on Closed Intervals, Monotonic Functions (Without proofs)

UNIT 3 Integrals and applications 7 Hours

The Definite Integral, The Fundamental Theorem of Calculus, Indefinite Integrals and the Substitution Method, Definite Integral Substitutions and the Area between Curves, Arc Length (Without proofs)

UNIT 4 Techniques of integration 6 Hours

Using basic Integration Formulas, Integration by Parts, Trigonometric Integrals, Trigonometric Substitutions, Integration of Rational Functions by Partial Fractions (Without proofs)

Textbooks:

1. Joel Hass, Christopher Heil, Maurice D. Weir, Thomas' Calculus, Fourteenth edition, Pearson Addison Wesley (2018).

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
4. Hyghes-Hallett, Gleason, McCallum et al. Single Variable Calculus (6th Edn) John Wiley and Sons New York, 2013.

Course Outcomes:

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

- determine limit, one sided limit, continuity of single and several variable functions.
- solve problems in a range of mathematical applications using differentiation
- solve problems in a range of mathematical applications using integration
- apply the fundamental theorem of calculus.
- evaluate integrals using various techniques.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusion and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1011	SEVERAL VARIABLE CALCULUS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	MATH1001						
Co- requisite	NIL						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed to impart knowledge on calculus of functions of more variables which are useful in modelling and analyzing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Course Educational Objectives:

1. To teach basic concepts of partial derivatives.
2. To explain the evaluation of double integrals and its applications.
3. To demonstrate the evaluation and applications of triple integrals.
4. To acquaint the knowledge of line and surface integrals and applications.

UNIT 1 Partial derivatives and applications 7 Hours

Partial Derivatives of a Function of Two Variables and More Than Two Variables, Second-order Partial derivatives, The Chain Rule for Functions of Two and Three variables, Extreme Values and Saddle Points, Lagrange Multipliers, Taylor's Formula for Two Variables (Without proofs)

UNIT 2 Double integrals 6 Hours

Double and iterated Integrals over Rectangles, Double Integrals over General Regions, Area by Double Integration: Area of bounded region in a plane, Double Integrals in Polar Form. (Without proofs)

UNIT 3 Triple integrals 5 Hours

Triple Integrals in Rectangular Coordinates: Triple Integrals, Volume of a Region in Space, Finding limits of integration, Triple Integrals in Cylindrical and Spherical Coordinates. (Without proofs)

UNIT 4 Integrals and Vector fields 8 Hours

Vector Fields and Line Integrals: Line Integrals of Vector Fields, Line Integrals with Respect to dx, dy, or dz, Work Done by a Force over a Curve in Space, Green's Theorem in the Plane: Tangential form, Using Green's Theorem to Evaluate the Line Integral and Verification, Surface Integrals: Surface Integrals of Vector Fields, Stokes' Theorem (Without proofs)

Textbooks:

1. Joel Hass, Christopher Heil, Maurice D. Weir, Thomas' Calculus, Fourteenth edition, Pearson Addison Wesley (2018).

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
3. Hyghes-Hallett, Gleason, McCallum et al. Multivariable Variable Calculus (6th Edn) John Wiley and Sons New York, 2013.
4. James Stewart. Multivariate Calculus, Concepts and Contexts. (3rd Edn) Thomson/Brooks/Cole, Canada, 2005.

Course Outcomes:

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

- utilize functions of several variables in optimization.
- employ the tools of calculus for calculating the areas.
- calculate volumes using multiple integrals.
- determine the work done using vector calculus
- determine the rate of flow of a fluid using vector calculus

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusion and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2371	DIFFERENCE EQUATIONS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

Difference equations is the study of equation which involves the difference of a discrete function. In this course, the student can form a difference equation, solving linear higher order difference equations using analytical techniques, simultaneous linear difference equations and also find the solution of linear higher order difference equations and simultaneous difference equations using Z-transforms.

Course Educational Objectives:

1. Student is able to know how to find the order of a difference equation and complementary function of a difference equation.
2. Student is able to know how to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.
3. Student is able to know how to find Z-transforms a discrete function using properties and using to basic theorems.
4. Student is able to know how to find the inverse Z-transforms a function and also using convolution theorem.
5. Student is able to know how to find the solution of a difference equation using Z-transforms

UNIT 1 **Difference equations - I** **5 Hours**

Introduction, definition of order, and solution of difference equation, formation of difference equations, linear difference equations, complementary function, rule for finding complementary function.

UNIT 2 **Difference equations-II** **5 Hours**

Particular integrals, Rule for finding particular integrals, simultaneous linear difference equations.

UNIT 3 **Z-transforms** **5 Hours**

Introduction, Definition, some standard Z-transforms, linear property, damping rule, Shifting U_n to the **right and to the left, Multiplication by n, two basic theorems.**

UNIT 4 **Inverse Z-transforms** **5 Hours**

Convergence of Z-transforms, evaluation of inverse Z-transforms, properties, convolution theorem.

UNIT 5 Applications of Z-transforms 5 Hours

Solving difference equations and simultaneous linear difference equations with constant coefficients by Z-transforms.

Textbooks:

1. "Higher Engineering Mathematics" by B.S. Grewal published by Khanna Publishers

References:

1. Advanced Engineering mathematics by Irvin Kreyszig

Course Outcomes:

1. Able to find the order of a difference equation and complementary function of a difference equation.
2. Able to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.
3. Able to find Z-transforms a discrete function using properties and using to basic theorems.
4. Able to find the inverse Z-transforms a function and also using convolution theorem.
5. Able to find the solution of a difference equation using Z-transforms

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1031	DIFFERENTIAL EQUATIONS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to impact the knowledge on ordinary, partial differential equations and their applications.

Course Educational Objectives:

6. To familiarize the students with the basic concepts of ordinary differential equations.
7. To demonstrate the evaluation and applications of first order differential equations.
8. To explain the evaluations of linear homogeneous and non-homogeneous differential equations.
9. To familiarize the students with the basic concepts of partial differential equations.
10. To explain the concepts of first order partial differential equations.
11. To demonstrate the evaluation of differential equations using math software's

UNIT 1 First Order Ordinary Differential Equations 5 Hours

Order and Degree of an Ordinary Differential Equation (ODE), ODE's of first order and first degree, Variable separable method, Linear Equations, Bernoulli's Equations.

UNIT 2 Linear Ordinary Differential Equations of High Order 6 Hours

Definitions, Complete Solution, Operator D, Complimentary function, Inverse operator, Rules for finding particular integral (e^{ax}, sinbx/cosbx, x^m& $e^{ax}v(x)$)

UNIT 3 Applications of Linear Ordinary Differential Equations of Higher Order 5 Hours

Method of Variation of Parameters, Simple Harmonic Motion, Oscillations of a Spring

UNIT 4 Introduction to Partial Differential Equations 5 Hours

Introduction, Formation of Partial Differential Equation(PDE), Solutions of a PDE, Equations solvable by direct integration, Linear equations of the first order.

UNIT 5 Partial Differential Equations of Second Order 5 Hours

Homogeneous linear equations with constant coefficients, Rules for finding the complementary function and particular integral, Working procedure to solve the equations.

Textbooks:

1. Simmons, G.F., Differential Equations with Applications and Historical Notes, Second Edition, McGraw-Hill, Inc., 1991.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

References:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984
2. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.
3. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.

Course Outcomes:

1. Form and find the solution of an ordinary differential equation.
2. Apply the concept of differential equations to solve real world problems.
3. Evaluate linear homogeneous and non homogeneous differential equations
4. Form and find the solution of a partial differential equations of first order.
5. Evaluate second order partial differential equations and solution of differential equations using computational tool.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH2281</td><td rowspan="2">NUMERICAL TECHNIQUES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed to enhance problem solving skills of engineering students using a powerful problem-solving tool namely numerical Techniques. The tool is capable of handling large systems of equations, nonlinearities and complicated geometries that are common in engineering practice but often impossible to solve analytically.

Course Educational Objectives:

1. To familiarize the students with numerical solutions of nonlinear and systems of linear equations.
2. To get exposed to finite differences and interpolation.
3. To demonstrate the numerical differentiation and integration.
4. To explain the numerical solutions of ordinary differential equations

UNIT 1 Solution of algebraic and transcendental equations 6 Hours

Regula-falsi method and Newton- Raphson method. **Solution of linear system of equations**-Iterative methods: Gauss Jacobi method, Gauss Seidel method, and finding the eigenvalues of a matrix by Power method.

UNIT 2 Interpolation 5 Hours

Difference operators (shifting, delta, del) and difference tables, Newton's forward and backward interpolation formulae, Divided difference formula, and Lagrange's interpolation formula.

UNIT 3 Numerical Differentiation and Numerical Integration 5 Hours

Numerical Differentiation: Derivatives using forward, and backward difference formulae.
Numerical Integration: Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rules.

UNIT 4 Numerical solutions of ordinary differential equations - 1 5 Hours

Picard's method, Taylor's series method, Euler's method, and Modified Euler's method

UNIT 5 Numerical solutions of ordinary differential equations - 2 5 Hours

Runge-Kutta method (second and fourth order), Predictor-Corrector methods-Adams-Bashforth and Milne's methods.

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.

References:

1. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5/e, New Age International(P) Limited, 2007.
2. S.S. Sastry, Introductory methods of Numerical Analysis,4/e,PHI Learning Publications,2009.
3. H.C Saxena, Finite Differences and Numerical Analysis, Chand and Company Pvt. Ltd., New Delhi.

Course Outcomes:

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

1. analyze how root finding techniques can be used to solve practical engineering problems.
2. apply various interpolation techniques to solve practical problems .
3. apply numerical differentiation and integration whenever and wherever routine methods are not applicable .
4. solve differential equations using various numerical methods .
5. know the strengths and weaknesses of the various methods and be able to decide which ones are appropriate for a particular problem

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH1021</td><td rowspan="2">TRANSFORM TECHNIQUES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">MATH1031</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed to impact the knowledge on (Laplace, Fourier) transforms and applications of these transforms on differential equations.

Course Educational Objectives:

1. To introduce and explain the concepts of Laplace transforms and properties.
2. To demonstrate the evaluation of Laplace transforms of special functions and additional properties.
3. To impart knowledge on obtaining Fourier series
4. To introduce and explain the concepts of Fourier transforms and properties.
5. To explain the evaluation of Fourier transforms of various function and then applications to boundary value problem.
6. To demonstrate and understand the transform techniques using available software

UNIT 1 Laplace transforms 5 Hours

Introduction, transforms of elementary functions, properties of Laplace transforms, transforms of derivatives, transforms of Integrals, Multiplication by t^n, Division by t.

UNIT 2 Applications of Laplace transforms 5 Hours

Evaluation of integrals by Laplace transforms, Inverse transforms, Solution of Differential equations.

UNIT 3 Fourier Series 6 Hours

Introduction, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval.

UNIT 4 Half-Range Fourier Series 3 Hours

Even and odd functions, Half range sine series, and Half range cosine series.

UNIT 5 Fourier transforms 7 Hours

Introduction, Fourier sine & cosine integrals, Fourier transforms, Properties of Fourier transforms-linear, change of scale & shifting property.

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

References:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel R. Hass, Thomas' Calculus, 13/e, Pearson Publishers, 2014.
3. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson Publishers, 2011.

Course Outcomes:

At the end of the course students will be able to

1. find Laplace transform of a function along with properties.
2. evaluate the Laplace transform of special functions.
3. apply the Laplace transform for solving differential equations (continuous systems)
4. evaluate the Fourier transform of a function along with properties and solve boundary value problems by Fourier transforms.
5. evaluate the engineering problems using transform techniques with the help of advanced math software

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2381	OPERATIONS RESEARCH	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

Operations Research (OR), also known as management science, has become an indispensable tool in scientific management. Operations Research focuses on developing and analyzing strategic and tactical levels to aid in decision-making and decision-making on the operational level. The essential tools of OR are algorithms, procedures that create and improve solutions to a point at which optimal or, at least, satisfactory solutions have been found.

Course Educational Objectives:

This course is designed to:

1. introduce the fundamentals of Operations Research to the students at the undergraduate level
2. solve different types of optimization problems of various categories and applying modern methodologies in the area of optimization
3. help students to develop a deep understanding of the classical and numerical optimization techniques and problem-solving capabilities

UNIT 1 Linear Programming 4 Hours

Formulation of LPP, convex sets and their properties, slack and surplus variables, Basic solution, Basic feasible solution, non-degenerate and degenerate basic feasible solutions, optimal solution, General, Standard, and Canonical form of LPP.

UNIT 2 Simplex Method 8 Hours

Simplex method, Degeneracy in LPP, Artificial variables techniques-Two Phase method, Big M-method.

UNIT 3 Duality 5 Hours

Duality in linear programming, primal-dual relationships, weak duality theorem, strong duality theorem, and dual simplex method.

UNIT 4 Integer Programming 4 Hours

Gomory's cutting plane method, Branch and Bound method for solving integer linear programming problems

UNIT 5 Sensitivity Analysis 5 Hours

Introduction to sensitivity analysis, variations in the price vector, variations in the requirement vector, addition of a new decision variable to the existing problem.

Textbooks:

1. Operations Research by S.D.Sarma, Kedarnath, Ramnath and company, 15th edition, 2008.
2. Operations Research An Introduction by Hamdy A. Taha, 8th edition, Pearson, 2007.

References:

1. Linear Programming by R K Gupta, Krishna Prakashan Mandir, 13th edition 2014.
2. Operations Research Theory and Applications by J K Sharma, 4th edition, Macmillan Publishers India Ltd, 2009

Course Outcomes:

On successful completion of this course, students will be able to:

1. understand the linear programming problem, its formation, and basic definitions of solutions
2. understand the simplex method, which is a very efficient algorithm to solve a linear programming problem
3. understand the dual primal relationship, properties of duality, and the dual simplex algorithm
4. find integer solutions to LPP by cutting plane methods
5. find variations in price and requirement vectors and retaining optimality

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2301	COMPLEX VARIABLES	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed to familiarize the students with complex analysis, nature of a series, evaluation of integrals using Cauchy's theorem.

Course Educational Objectives:

- To explain the concept of complex functions and analytic functions.
- To explain the concept of conformal mapping.
- To explain the concept of Cauchy's theorem and residue theorem.
- To explain the convergence of series such as Taylor's and Laurent.
- To explain the concept of Cauchy's theorem and residue theorem.

UNIT 1 Functions of a Complex variable 6 Hours

Limit and continuity, Differentiation, Analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugates- applications to flow problems.

UNIT 2 5 Hours

Geometrical representation of f(z) – Some standard transformations – Bilinear transformation - Conformal mappings. Special conformal transformations ($w = z^2$, $w= z+1/z$, $w = e^z$, $w= \cosh z$)

UNIT 3 Complex Integration 5 Hours

Integration of complex functions - Cauchy's theorem - Cauchy's integral formula.

UNIT 4 Series representation of analytic functions 5 Hours

convergent series of analytic functions, Laurent 's and Taylor series, zeros and singularities of an analytic function

UNIT 5 Calculus of residues 5 Hours

Residue -Cauchy Residue theorem – Calculation of residues (All theorems without proof).

Text Books:

1. B.S.Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers, New Delhi, 2012.

References:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics Narosa Publishing House, New Delhi, 2014.
2. N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, 8th Edition, Lakshmi Publications, New Delhi, 2012.

Course Outcomes:

1. Make use of differentiation and integration of complex functions in engineering problems.
2. Concept of conformal mappings .
3. Use Cauchy's theorem and Cauchy's integral formula to evaluate the line integrals
4. Apply Taylor's and Laurent's series to expand complex functions and know about the convergence region .
5. Evaluation of integrals using Residue theorem.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH1041</td><td rowspan="2">DISCRETE MATHEMATICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

Discrete Mathematics introduces students to the mathematics of networks, social choice, and decision making. This course provides students with a hands-on exploration of the relevancy of mathematics in the real world. This course reflects the rigor taught in many entry-level mathematics courses.

Course Educational Objectives:

1. To introduce basics of mathematical logical operators and connectives
2. To impart knowledge on normal forms and rules of inference.
3. To impart knowledge on partially ordered and total ordered sets.
4. To familiarize closed form solution of linear recurrence relations by various methods.
5. To impart knowledge on basic concepts of algebraic structures.
6. To write program structures, and understand when programming is most applicable

UNIT 1 Logic Operators and Connectives 5 Hours

Negation, conjunction, disjunction, conditional and bi-conditional, well formed formulae, tautologies, equivalence of formulae, duality, tautological implications.

UNIT 2 Mathematical logic 5 Hours

Conjunctive and disjunctive normal forms- principal disjunctive and conjunctive normal forms, Rules of inference for propositional calculus (Rule P, Rule T and CP rule).

UNIT 3 Sets and Relations 5 Hours

Basic concepts of set theory, Power set, relations, properties of binary relations in a set, Equivalence relations, composition of binary relations, Partial ordering, Partially ordered set.Hasse diagram.

UNIT 4 Recurrence relations 5 Hours

Recurrence relations, solving linear recurrence relations by characteristic roots method, system of recurrence relations.

UNIT 5 Algebraic Structures 6 Hours

Algebraic Structures-Semi group, Monoid, Groups, subgroups, cosets (definition and examples) Lagrange's theorem on finite groups

Text Books:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 1997.
2. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGrawHill,2012.

References:

1. Bhishma Rao, Mathematical Foundations of Computer Science, SciTech Publications (India) Pvt Ltd.
2. Discrete Mathematical Structures,Sixth edition-Kolman,Busby,Ross

Course Outcomes:

Upon successful completion of this course the student should be able to

1. Check the validity of a statement formula
2. analyze the concepts in set theory and relations
3. find a general solution of recurrence equation
4. build the algebraic structures and apply Lagrange's theorem on finite groups
5. Convert problem solving strategies to procedural algorithms

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH1051</td><td rowspan="2">Graph Theory</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course introduces basic concepts in Graph Theory, including properties and characterization of graph/trees and graph theoretic algorithms, which are widely used in Mathematical modelling and has got applications across Computer Science and other branches in Engineering.

Course Educational Objectives:

1. To introduce basics of group theory and its applications
2. To impart knowledge on basic concepts of paths and circuits
3. To impart knowledge on Trees, spanning trees, shortest spanning trees
4. To familiarize in the matrix representation of graphs
5. To transform scientific problems into generic computational models

UNIT 1 **Basics of graphs** **5 Hours**

Finite and Infinite Graphs, Incidence and Degree, Isolated Vertex, Pendant Vertex, and Null Graph, complete graph, Bi-partite and complete Bi-partite graphs.

UNIT 2 **Matrix representation of graphs** **5 Hours**

Adjacency Matrix, Incidence Matrix, Path Matrix (Definition and examples)

UNIT 3 **Paths and circuits** **6 Hours**

Paths, and Circuits, Connected Graphs, Disconnected Graphs, and Components, Euler Graphs, Hamiltonian graphs (Definition, examples and without proofs)

UNIT 4 **Trees** **5 Hours**

Trees and their properties, spanning trees, minimal spanning trees, Kruskal's algorithm for finding a minimal spanning tree.

UNIT 5 **Applications of Trees and Fundamental circuits** **5 Hours**

Preorder, in order and post order traversals, Prefix and Postfix notations of an arithmetic expression, parsing trees.

Textbooks:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 1997.

2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall of India, 2006.

References:

1. Bhishma Rao, Mathematical Foundations of Computer Science, SciTech Publications (India) Pvt Ltd.
2. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGrawHill,2012.

Course Outcomes:

Upon successful completion of this course the student should be able to

1. analyse the concepts in graph theory
2. apply graph theory concepts in core subjects such as data structures and network theory effectively
3. Identify different types of paths
4. Construct minimum spanning tree using some algorithms and identify tree traversals
5. Solve the graphical problems which are accessed in available software

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2311	NUMBER THEORY	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed to explain the basics and applications of number theory for the students of Computer Science. The core courses of these branches encounter with concepts like prime factorization, modular arithmetic, and quadratic reciprocities in number theory. The first unit of the course provide a strong platform for such encounters and the other units focuses on applications of number theory.

Course Educational Objectives:

1. To teach basic concepts of number theory focusing on Computational aspects.
2. To teach the concepts of factorization of integers.
3. To teach Format's theorem and quadratic residues.
4. To explain Chines remainder theorem and Euclidean algorithm.
5. To explain polynomial arithmetic.

UNIT 1 Basic Concepts in Number Theory 5 Hours

Topics in elementary number theory, Divisibility, Greatest Common Divisor, Euclidean Algorithm

UNIT 2 5 Hours

Fundamental theorem of Arithmetic, Congruences, Properties of congruences, Linear congruences

UNIT 3 5 Hours

Fermat's theorem, Fermat's little theorem, Wilson's theorem

UNIT 4 5 Hours

Chinese remainder theorem, The functions $\tau \ and \ \sigma$, Euler Phi-function, Euler's theorem, Some properties of phi function

UNIT 5 5 Hours

The order of integer modulo n, Primitive roots for prime, Composite number having primitive roots

Textbooks:

1. Elementary Number Theory | 7th Edition by David Burton, Mc Graw Hill Education

References:

1. Basic Number Theory by S.B. Malik,S. Chand publishers

Course Outcomes:

Upon successful completion of this course the student should be able to

1. Apply concepts of number theory focusing on Computational aspects.
2. Analyze concepts of factorization of integers.
3. Explain Fermat's theorem and quadratic residues.
4. Analyse Chines remainder theorem and Euclidean algorithm.
5. Analyse the concept of polynomial arithmetic.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2291	LINEAR ALGEBRA	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to gain knowledge in the concepts of Linear Algebra focusing on basics of matrices, vector spaces and singular value decomposition to understand the basic concepts of Linear Algebra in the applications of image processing and machine learning.

Course Educational Objectives:

1. To familiarize with theory of matrices and tools for solving system of linear equations
2. To impart knowledge on Eigen values and Eigen vectors.
3. To teach basic concepts of vector spaces and their properties.
4. To explain the concepts of inner product spaces.
5. To familiarize with concept of singular value decomposition and its applications

UNIT 1 **Fundamentals of Matrices** **5 Hours**

Introduction to Matrices and Rank of a matrix, Echelon form, solving system of linear equations.

UNIT 2 **Eigen values and Eigen vectors** **5 Hours**

Eigen values and Eigen vectors, positive definite matrices, Linear dependence, and Linear independence.

UNIT 3 **Vector Spaces** **6 Hours**

Vector space, linear combination of vectors, linear span, basis and dimension, linear Transformation.

UNIT 4 **Inner Product Spaces** **5 Hours**

Inner Product Spaces, examples of inner product spaces, norm and length of a vector cauchy-schwarz's inequality.

UNIT 5 **Singular value decomposition** **5 Hours**

Singular values, computing singular value decomposition and Introduction to principal component analysis.

Textbooks:

1. Higher Engineering Mathematics, B. S. Grewal.
2. Linear Algebra, Schaum's Outline,4th edition, Seymour Lipchutz,Marc Lipson

References:

1. Advanced Engineering Mathematics, 7th Edition, Peter V. O'Neil.
2. Advanced Engineering Mathematics, 2nd Edition, Michael. D. Greenberg.
3. Introduction to linear algebra, 5th Edition, Gilbert Strang.
4. Applied Mathematics (Vol. I & II), by P. N. Wartikar& J. N. Wartikar.
5. Digital Image Processing, R C Gonzalez and R E Woods.

Course Outcomes:

At the end of the course the student will be able to
- solve the system of linear equations
- calculate Eigen values and Eigen vectors
- find the basis
- learn Singular value decomposition
- learn principal Component analysis

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems.

<table>
<tr><td rowspan="2">MATH2341</td><td rowspan="2">PROBABILITY THEORY AND RANDOM VARIABLES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

To expose the students to the basics of probability theory and random processes essential for modelling and quantifying uncertainties and noise in systems

Course Educational Objectives:

- To know about various random life length models and their uses in finding the reliability of different electronic devices.
- To learn about basic properties and characteristics of various random processes with reference to signal and trunk processes.

UNIT 1 Probability 5 Hours

Axioms of probability theory. Probability spaces. Joint and conditional probabilities. Bayes' Theorem- Independent events.

UNIT 2 Random Variable 5 Hours

Random variables and random vectors. Distributions and densities. Independent random variables. Functions of one and two random variables.

UNIT 3 Multiple Random Variables 6 Hours

Vector random variables, joint distribution and density functions, properties, conditional distribution and density, statistical independence, distribution and density of a sum of random variables, central limit theorem.

UNIT 4 Expected Value of a Function of Random Variables 6 Hours

Joint moments about the origin, joint central moments, jointly Gaussian random variables - two random variables case, N random variable case.

UNIT 5 Random Process 6 Hours

Temporal characteristics - the random process concept, stationarity and statistical independence, correlation functions, Gaussian random processes, Poisson random process.

Textbooks:

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.
2. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.

References:

1. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
2. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

Course Outcomes:

Upon successful completion of this course, the student should be able to

1. Analyze the outcomes of random experiments and develop the concept of random variables and obtain probabilities through them
2. define single random variables in terms of their PDF and CDF, and calculate moments such as the mean and variance
3. explore the random experiments specified by multiple random variables and study the Distribution of them
4. apply the fundamentals of probability theory and random processes to practical engineering problems
5. identify and interpret the key parameters that underlie the random nature of the problems

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2321	RANDOM PROCESSES	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed to impart knowledge on random processes needed in applications such as signal processing, digital communications, speech processing, data modelling, etc.

Course Educational Objectives:

1. To familiarize the students in the concepts of probability and random variables.
2. To study Random Processes, its types, distribution, and density functions.
3. To study Gaussian and Poisson processes.
4. To apply random process to signal processing in communication systems.
5. To apply skills in analysing random phenomena which occur in Electrical and Electronics Engineering applications.

UNIT 1 Random Processes 6 Hours

Temporal characteristics - the random processes concept, Classification of random processes, stationarity and statistical independence. Time averages and Ergodicity.

UNIT 2 Correlation and Covariance functions 5 Hours

Auto correlation, Cross correlation, Properties. Covariance functions. Gaussian random processes, Poisson random processes

UNIT 3 Density functions 5 Hours

Probability density and joint probability density functions, Properties.

UNIT 4 Spectral densities functions - I 5 Hours

Spectral characteristics, the power density spectrum: Properties, relationship between power density spectrum and autocorrelation function.

UNIT 5 Spectral densities functions-II 5 Hours

Cross-power density spectrum, Properties, relationship between cross power spectrum and cross-correlation function.

Textbooks:

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.

References:

1. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.
2. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
3. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

Course Outcomes:

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

- solve the problems on multiple random variables, joint distribution and independence
- solve the problems Gaussian and Poisson processes
- understand the concept of random processes
- determine covariance and spectral density of stationary random processes
- characterize the random signals in communication systems with their autocorrelation and power spectral density functions

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2351	OPTIMIZATION METHODS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

Optimization is the art of finding the best result under given conditions. In this fast-expanding world, an engineer has to use many Optimization methods, as it is the most significant in decision-making, design, manufacturing, maintenance, planning, and scheduling.

Course Educational Objectives:

This course is designed to:

- introduce various optimization methods for solving real-world problems
- find optimal solutions to transportation, assignment, and sequencing problems
- know project planning and scheduling
- study the network analysis techniques through CPM and PERT

UNIT 1 Transportation Problem 6 Hours

Introduction and LP formulation of Transportation Problem, feasible solution, basic feasible solution, finding Initial basic feasible solutions by North West corner rule, Least-cost entry method, Vogel's approximation method, Transportation Algorithm (MODI Method) to find an optimal solution.

UNIT 2 Assignment Problems 5 Hours

Introduction to Assignment Problem, Mathematical formulation, Hungarian Method for finding optimal solution, unbalanced assignment problem, Travelling Salesman Problem.

UNIT 3 Sequencing Problem 4 Hours

Introduction, Basic terminology, Algorithms to obtain optimal solutions for sequencing problems with n jobs and two machines and n jobs and k machines.

UNIT 4 Network Analysis in Project planning 4 Hours

Project, Project Planning, Project Scheduling, Project Controlling, Work breakdown structure, Network Techniques, terms used in network-activity, event, path, network, dummy activity, looping, Fulkerson's rule, network diagram, and activity on node diagram.

UNIT 5 PERT and CPM 7 Hours

Critical path method (CPM), Measure of activity, Critical path analysis, the four floats, subcritical and supercritical activities, slack, Programme evaluation and review technique (PERT), time estimates, frequency distribution curve for PERT

Text Books:

1. Operations Research by S.D.Sarma, Kedarnath, Ramnath and company, 15^{th} edition, 2008.
2. Operations Research An Introduction by Hamdy A. Taha, 8^{th} edition, Pearson, 2007.

References:

1. Linear Programming by R K Gupta, Krishna Prakashan Mandir, 13^{th} edition 2014.
2. Operations Research Theory and Applications by J K Sharma, 4th edition, Macmillan Publishers India Ltd, 2009

Course Outcomes:

On successful completion of this course, students will be able to:

1. apply MODI method for finding optimal transportation cost
2. apply Hungarian Method for solving assignment problems and finding an optimal route to the salesman
3. understand the process of finding optimal sequencing for processing jobs on machines
4. understand the network terminology and construction
5. apply CPM and PERT techniques for project management

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4
Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:
Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

<table>
<tr><td rowspan="2">MATH2331</td><td rowspan="2">COMPUTATIONAL METHODS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Engineering and Science</td></tr>
</table>

Course Description:

This course is designed for Aerospace Engineering undergraduate students. It is designed for the students for the basic understanding of techniques for numerical solution of algebraic equations, differentiation, integration used to solve aerospace engineering application problems.

Course Educational Objectives:

1. Develop the mathematical skills in the areas of numerical methods.
2. Focus on the theory and applications of numerical methods in many engineering subjects which require solutions of linear systems, finding eigenvalues, eigenvectors, Interpolation, and applications, solving ODEs, PDEs.
3. Help in the foundation of computational mathematics for postgraduate courses, specialized studies, and research.
4. Train in developing the codes for implementing the numerical methods using any programming languages.
5. Formulate a mathematical model for a given engineering problem

UNIT 1 Mathematical Modeling of Engineering Problems 5 Hours

Approximations: Accuracy and precision, round-off and truncation errors, error problem with example problems. **Roots of Equations:** Formulations of linear and non-linear algebraic equations, solution with bisection, Newton-Raphson and Secant methods. Application to practical problems. **Algebraic Equations**: Formulation of linear algebraic equations from engineering problems, solution of these problems by Gauss elimination method, pitfalls of elimination and techniques for improving the solutions, Gauss Seidel iteration for solving sparse equations by avoiding storage of zero coefficients in matrix, convergence of iteration methods. LU decomposition methods for symmetric (Chelosky) matrices.

UNIT 2 Eigenvalues and Eigenvectors Problems 5 Hours

Formulation of equations to column, truss, spring-mass and friction problems. Solutions for the largest and smallest eigenvalues and corresponding eigenvectors. **Interpolation Methods:** Polynomial interpolation, Lagrange interpolation polynomials with equi- spaced data. **Regression or Curve Fitting:** Linear regression by least squares method.

UNIT 3 Initial Value Problems 6 Hours

Ordinary differential equations, Euler, Heun's and Ralston methods. Runge- Kutta method of 2nd and 4th order, application to vibration and heat transfer problems. **Boundary Value Problems:** Linear and nonlinear ordinary differential equations, boundary value problems over semi-infinite domain, solution of nonlinear equations by finite difference method.

UNIT 4 6 Hours

Laplace Equations: Finite difference discretization of computational domain, different types of boundary conditions, solution to elliptic equations. **Parabolic Transient Diffusion Equations:** Explicit and implicit formulation, Crank Nicolson Method.

UNIT 5 Numerical Integration 6 Hours

Trapezoidal, Simpson's 1/3 and 3/8 rule and Gauss quadrature method.

List of Computational Exercises:

1. Determine the real root for a given polynomial equation by (i) Bisection, (ii) Newton-Raphson until the approximate error falls below 0.5%.
2. Solve the system of simultaneous linear equations by
   i. Naïve -Gauss elimination
   ii. Gaussian elimination with partial pivoting
   iii. Gauss -Seidel method.
   iv. LU decomposition
3. Implement power method to find Eigenvalues and Eigenvectors for Spring mass system
4. Solve the parabolic partial differential equations by using explicit, implicit and semi-implicit methods
5. Solve the elliptic partial differential equations by finite difference techniques.
6. Finding the integral for a second-order polynomial using Gauss quadrature formula.
7. Solve numerical differentiation problems using Runge-Kutta 2nd and 4th order methods.
8. Find the integral by numerical methods such as Trapezoidal and Simpson's rule.

Textbooks:

1. S.P. Venkateshan, P. Swaminathan, Computational Methods in Engineering, 1/e, Ane Publisher, 2014.
2. S.C. Chapra, R.P. Canale, Numerical Methods for Engineers, 6/e, Tata McGraw-Hill, 2012.

References:

1. S.K. Gupta, Numerical Methods for Engineers, 1/e, New Age International, 2005

Course Outcomes:

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

1. Demonstrate understanding of common numerical methods and how they are used to

obtain approximate solutions to otherwise intractable mathematical problems.

2. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
3. Analyse and evaluate the accuracy of common numerical methods.
4. Implement numerical methods using any programming language (matlab, scilab, python…)
5. Write efficient, well-documented code and present numerical results in an informative way.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1061	Introduction to Mathematics - I	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	Engineering and Science						

Course Description:

This course is designed to introduce the mathematics required for basic physics, engineering mathematics, and introductory engineering courses.

Course Educational Objectives:

- To explain the concepts of Trigonometry.
- To explain the basic concepts of differentiation and differential equations
- To teach the evaluation of definite and indefinite integrals.
- To explain the basic concepts of differential equations, multivariable and vector calculus

UNIT 1 : Representations , Co-ordinate systems and Trigonometry 3 Hours

Representations for Scalars, Vectors, Matrices and Tensors. Coordinate systems: cartesian and polar coordinate systems.

Trigonometry: Trigonometric functions, Periodicity, Trigonometric Ratio of Compound angles, multiple and sub multiple angles, transformations, brief introduction of inverse trigonometric, hyperbolic and inverse hyperbolic functions.

UNIT 2 Differential Calculus 3 Hours

Limits and Continuity: Definition of right hand limit, left hand limit, standard limits

(without proofs)**,** definition of continuity and simple illustrations.

Differentiation: Introduction, definition, differentiation of a function at a point and on an interval, derivative of a function, differentiation of sum, difference, product and quotient of functions, differentiation of algebraic, exponential, logarithmic functions, composite, implicit, parametric, hyperbolic, inverse hyperbolic functions, derivatives of first and second order.

UNIT 3 Integration 8 Hours

Indefinite Integrals: Integration as the inverse process of differentiation, standard forms, properties of integrals, integration by the method of substitution covering algebraic, trigonometric, exponential functions, integration by parts, logarithmic functions, inverse trigonometric functions.

Definite Integrals: Definition of a definite integral and its properties (without proof)

UNIT 4 Introduction to differential equations , Multivariable calculus, and Vector Calculus 8 Hours

Differential Equations : Order and degree of a ordinary differential equations, Formation of ordinary differential equations

Multivariable Calculus : Limits and continuity of functions of two or more variables, Partial derivates, Total derivates(without problems)

Vector Calculus : Gradient, Divergence and Curl (with simple problems), Introduction to line, surface and volume integrals (without problems) illustrated with Stokes, Gauss, and Green's theorems (Only statements).

Textbooks:

1. Text book for Intermediate Mathematics, Board of Intermediate Education, AP, Volumes IA, IB & IIA, 2018.
2. NCERT class XI and XII (part 1) Mathematics text books.
3. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

References:

1. V. Venkateswara Rao, N. Krishna Murthy, B.V.S.Sharma, Intermediate Mathematics, S.Chand & Company Ltd., Volume I & II.
2. Chandrika Prasad, A first Course in Mathematics.
3. Text book for Intermediate Mathematics, Deepti Publications.

Course Outcomes:

After the completion of the course the student should be able to

- solve problems involving trigonometric functions
- understand the principles of differential calculus
- evaluate integration using various techniques
- understand the basic concepts of ordinary differential equations,
- understand the basic concepts of multivariable and vector calculus

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH1071	**INTRODUCTION TO MATHEMATICS - II**	**L**	**T**	**P**	**S**	**J**	**C**
		2	**0**	**0**	**0**	**0**	**2**
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**Engineering and Science**						

Course Description:

This course is designed to introduce the mathematics required for basic physics, engineering mathematics, and introductory engineering courses.

Course Educational Objectives:

1. To describe the basic concepts of matrices
2. To introduce complex numbers and their properties.
3. To teach the techniques based on partial fractions
4. To explain the concepts of straight lines and circles
5. To impart knowledge on solid geometry.
6. To demonstrate the solution of a problem using computational

UNIT 1 Matrices 6Hours

Matrices, determinants, definition, types of matrices, algebra of matrices, properties of determinants of 2 X 2, 3 X 3 matrices, inverse of a matrix, solving simultaneous linear equations in two and three variables using matrix inverse method, Cramer's rule and Gauss Jordan method. Eigenvalues and Eigenvector of matrices.

UNIT 2 Complex Numbers 6 Hours

Complex number as an ordered pair of real numbers, representation of z⍰ (a, b) in the form (a + ib) conjugate complex numbers, modulus and amplitude of a complex number, geometrical representation of a complex number, Argand diagram.

UNIT 3 Partial Fractions 6 Hours

Introduction, resolving g(x) into partial fractions when g(x) contains non repeated linear factors, repeated linear factors, repeated and non-repeated irreducible quadratic factors.

UNIT 4 Co-ordinate Geometry 6 Hours

Straight lines: General equation of a straight line,line passing through the point of intersection of two given lines, angle between two intersecting lines, condition for perpendicularity and parallelism, length of the perpendicular from a point to a straight line, distance between two parallel lines (without proofs).

Circles: Equation of a circle, centre and radius, equation of a circle through three non collinear points, parametric equations of a circle.

Unit V Solid Geometry **6 hours**

Solid Geometry: Equation of a plane, Intersection of two planes, Equation of a sphere in spherical and cartesian coordinates, Intersection of a plane and a sphere.

Textbooks:

1. Textbook for Intermediate Mathematics, Board of Intermediate Education, AP, Volumes IB, IIA & IIB, 2018.
2. NCERT class XI and XII (part 1 & 2) Mathematics text books.

References:

1. V. Venkateswara Rao, N. Krishna Murthy, B.V.S. Sharma, Intermediate Mathematics, S. Chand & Company Ltd., Volume I & II.
2. Chandrika Prasad, A first Course in Mathematics.
3. Text book for Intermediate Mathematics, Deepti Publications.

Course Outcomes:

After the completion of the course the student should be able to

1. describe the properties of matrices
2. describe the properties of complex numbers
3. find a fractional function and resolve it into partial fractions
4. illustrate straight-line and circle properties and describe different regions in different co-ordinate systems
5. illustrate the procedure to solve a problem using math software

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MATH2361	PROBABILITY AND STATISTICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	Engineering and Science						

Course Description:

Probability theory is important when it comes to evaluating statistics. This course treats the most common discrete and continuous distributions, showing how they use in decision and estimation problems, and constructs computer algorithms for generating observations from the various distributions.

Course Educational Objectives:

1. To familiarize the students with the foundations of probability and statistical methods
2. To impart concepts in probability and statistical methods in engineering applications.

UNIT 1 Data Science and Probability 10 Hours

Data Science: Statistics introduction, Population vs Sample, collection of data, primary and secondary data, types of variables: dependent and independent Categorical and Continuous variables, data visualization, Measures of central tendency, Measures of dispersion (variance).

Probability: Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem (without proof).

UNIT 2 Random Variable and Probability Distributions 8 Hours

Random variables (discrete and continuous), probability density functions, probability distribution - Binomial, Poisson and normal distribution-their properties (mathematical expectation and variance).

UNIT 3 Correlation, Regression and Estimation 8 Hours

Correlation, correlation coefficient, rank correlation, regression, lines of regression, regression coefficients, principle of least squares and curve fitting (straight Line, parabola and exponential curves). **Estimation:** Parameter, statistic, sampling distribution, point estimation, properties of estimators, interval estimation.

UNIT 4 Testing of Hypothesis and Large Sample Tests 8 Hours

Formulation of null hypothesis, alternative hypothesis, the critical region, two types of errors, level of significance, and power of the test. Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

UNIT 5 Small Sample Tests 6 Hours

Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

Textbooks:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

References:

1. S. Ross, A First Course in Probability, Pearson Education India, 2002.
2. W. Feller, An Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.

Course Outcomes:

Upon successful completion of this course, the student should be able to

1. classify the concepts of data science and its importance
2. apply discrete and continuous probability distributions
3. explain the association of characteristics through correlation and regression tools
4. identify the components of a classical hypothesis test
5. infer the statistical inferential methods based on small and large sampling tests

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 4

Ensure inclusive and equitable quality education and promote lifelong opportunities for all.

SDG Justification:

Learning of various mathematical techniques will lead to knowledge of applications in Engineering problems

MECH1011	ENGINEERING VISUALIZATION AND PRODUCT REALIZATION	L	T	P	S	J	C
		0	0	4	0	0	2
Pre-requisite	Nil						
Co- requisite	3D Printing						
Preferable exposure	Fusion 360 Additional Modules						

Course Description:

This course introduces basic engineering drawing concepts such as projections, sectional views, and utility of drafting and modelling packages. The course imparts the knowledge of modelling and assembling of components using CAD software. The course also includes preparation of 3D models using 3D printing. The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.

Course Educational Objectives:

1. To create awareness of engineering drawing as relevant to industry standards.
2. To improve visualization abilities essential for successful engineering design.
3. To impart 2D sketching and 3D modeling using the relevant software.
4. To teach assembly drawing and simulation of motion between mating components.
5. To introduce basic 3D printing software for preparing the products for printing.

List of experiments:

1. Manual Drawing: Introduction to Engineering graphics: Principles of Engineering Graphics and their significance, conventions in drawing lettering, BIS Conventions, Dimensioning, Sectional Views
2. Free hand sketching, Free hand sketching of isometric & orthographic views and interpretation of drawings.
3. Computer Aided Drafting, Introduction to CAD software: Basic draw and Modify commands in 2d
4. Introduction to 2D and 3D modelling using CAD packages
5. Assembly drawings, Assembly of individual 3D components, animation of motion
6. Coordinating multiple moving parts under joint constraints.
7. 3D printing, Introduction to 3D printing software, slicing.
8. Grading and rendering of simple geometries using software.

List of Projects:

Any one project among the following can be opted by the student and submitted:IC Engine Model (3D printed mini model)

- Belt Drive for a bike
- Four Wheel Drivable
- ATV Robot
- Toy making
- Carrom board
- Chess board and pieces model toy train,
- Avengers
- Building Bridges dams etc.,
- Wind Turbine Model etc
- Design of Radar and 3D Printing of Radar
- Models' Programmable logic Controllers –PLC
- Arduino Board Design and 3D Printing of Enclosures for Arduino Boards
- Design of mini mother boards

Text Books:

1. N D Bhatt, 'Engineering Drawing',53,Charotar Publishers, Gujarat India,2019,9789380358963
2. Lydia Sloan Cline,'Fusion 360 for Makers: Design Your Own Digital Models for 3D Printing and CNC Fabrication – Import, 5 June 2018 ',1,Make Comm**UNIT** y LLC,USA,2018,9781680456509

References:

1. Randy Shih,'Parametric Modeling with Autodesk Fusion 360 ',(Spring 2021 Edition),SDC Publications,Squibb Road Mission, KS,2021,1630574376, 9781630574376

Online Resources:

1. Introduction-to-parametric-modeling. 14, 2021, 1:27 p.m., https://www.ascented.com/courseware/product/autodesk-fusion-360--introduction-to-parametric-modeling
2. PP Song et al.,,'https://www.researchgate.net/publication/325189986_Research_and_Application_of_Autodesk_Fusion360_in_Industrial_Design', 2018,8

Course Outcomes:

1. Prepare drawings as per international standards.
2. Utilize Engineering visualization as Language of Engineers.
3. Sketch 2D models using CAD software
4. Sketch 3D models using CAD package.
5. Develop model for printing simple objects using 3D printer

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:
SDG 4 - ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.
SDG-9 engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation***.***
SDG Justification:
SDG 4-The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.
SDG 9-The modules and topics mentioned in this course are designed to ensure the engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation.

MECH1021	WORKSHOP	L	T	P	S	J	C
		0	0	2	0	0	2
Pre-requisite	None						
Co- requisite	Isometric Views, Development of surfaces						
Preferable exposure	2D Drawings, Power tools						

Course Description:

This course enables the students to familiarize with the basic fabrication practices and to explore the various devices, tools and equipment used. Hands-on exercise is provided in various trade sections. Essentially student should understand the labor involved, machinery or equipment necessary, time required to fabricate and should be able to estimate the cost of the product or job work which are fundamental tasks for engineering plans.

Course Educational Objectives:

1. Explain tools used in carpentry, fitting and sheet metal and practice procedure of doing experiments.
2. Make the students to learn types of basic electric circuit connections and PCBs.
3. Provide training to prepare FRP composites.
4. Train the students on preparing 3D plastics using injection molding.
5. Demonstrate on utilizing 3D printer for printing 3D objects

List of Jobs:

1. Wood Working - Cross halving Joint/Dove Tail Joint/End Bridle Joint (Any two)
2. Sheet Metal working - Taper tray/conical funnel/Elbow pipe (Any Two) (including soldering).
3. Fitting- V fit/Dove Tail fit/ Semicircular fit (Any Two)
4. Electrical Wiring -Parallel and series connection
5. Electrical Wiring -Two-way switch connection
6. Electrical Wiring- Wiring of lighting systems
7. Injection molding-Make any two plastic components using injection molding machine.
8. 3D printing Demonstration

Text Books:

1. P. Kannaiah, K. L. Narayana, 'Workshop Manual', 2/e, Scitech Publications, India, 2007.
2. B. L Juneja , 'Workshop Practice ', 1/e, Cengage Learning ,Delhi, 2015

References:

1. K Mallick, 'Fiber-Reinforced Composites: Materials, Manufacturing, and Design', 3/e, CBC Press, New York, 2007.

Course Outcomes:

After completion of this lab the student will be able to

1. Summarize application of different power tools
2. Develop different parts with metal sheet/wood working/fits in real time applications.
3. Demonstrate electrical circuits in various applications.
4. Prepare models using injection molding m/c .
5. Familiarize with 3D printer operations

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :29-4-2021 **ACADEMIC COUNCIL: 17-9-2021**

SDG No. & Statement:

SDG 4 - ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.

SDG Justification:

The modules and topics mentioned in this course are designed to ensure all-inclusive and thorough education with equity to all persons and always promote learning opportunities.

MECH1001	DESIGN THINKING	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Pre-requisite(s): Engineering Visualization and Product Realization

Course Description:

Design is a realization of a concept or idea into a configuration, drawing or product. Design Thinking is the cognitive and practical process by which design concepts are developed by designers. Innovation is a new idea or a new concept. Product development is the creation of a new or different product that offers new benefits to the end-user. This course introduces design thinking in product innovation.

Course Educational Objectives:

1. To familiarize the product design process
2. To introduce the basics of design thinking
3. To bring awareness on idea generation
4. To familiarize the role of design thinking in services design

Topic	Type
Each member of the group has to ask (vocally) the group members different questions about a product that they would like to design. Write down the questions and answers and submit as a word or pdf document.	Exercise
Each member of the group must ask (vocally) the group members questions about the product chosen in the previous experiment. This helps to gain indepth insights as well as new findings and information in order to grasp the problem or situation holistically or simply to find relevant questions for an interview. Write down the questions and answers and submit as a word or pdf document	Exercise
Identify relevant factors of influence that constitute the basis for a new or improved product or offer; then analyze it in a targeted manner. ➢ Make sure that you are sufficiently creative in the analysis process, because the focus is on technical “details”. ➢ Boost the efficiency of the analysis process by avoiding empty runs. ➢ Make use of a standardized procedure in order to examine the problem and solution space again with the help of data.	Exercise
➢ Do research, talk with people, and have empathy to formulate profound stories. ➢ Summarize the results from the “understand” and “observe” phases and discuss with the team. ➢ Highlight unexpected results and generate new perspectives.	Exercise

➢ In general, share insights, ideas, and results (solutions) with others. ➢ Explore untapped market opportunities. ➢ Provide differentiated and new offers based on the user needs. ➢ Adapt a strategy to new market needs by understanding the competitive edge. ➢ Establish the right vision for the design challenge or a road map for stepby-step implementation and control mechanisms.	Exercise
➢ Find out at an early stage whether the basic need is satisfied and the product attracts interest on the market. ➢ Find out through iterative testing whether the user need is met with a minimally functional product and how the product should be enhanced. ➢ Find out through user feedback how much demand there is for the product before developing further details and features. ➢ Minimize the risk of investing in a solution for which there is little demand on the market, thus saving time, money, and energy.	Exercise
➢ Perform a true A/B test or several variants of a prototype in the form of a multi-variants test or as split testing. ➢ Do a quantitative evaluation. ➢ Carry out a qualitative survey and evaluate the number and content of feedbacks. ➢ Compare individual variants of a function or a prototype (e.g. buttons, visuals, arrangement).	Exercise
➢ Collect and appraise experiences made in the project in a structured manner. ➢ Learn from experience and make use of it in the next project. ➢ Facilitate a positive attitude toward mistakes and appreciate progress. ➢ Identify and document the findings; make them applicable and usable.	Exercise
Case Studies: Example : Software Prototyping, Additive Manufacturing; Design of Arduino Boards for various applications etc	Exercise

Text Books:

1. Pahl, Beitz, Feldhusen, Grote,'Engineering Design: a systematic approach',3rd,Springer Science & Business Media,London,2007,978-1846283185
2. Christoph Meinel,Larry Leifer,Hasso Plattner,'Design Thinking Understand – Improve – Apply',1st,Springer,Berlin, Heidelberg,2011,978-3-642-13756-3

References:

1. Marc Stickdorn, Jakob Schneider,'This is Service Design Thinking: Basics, Tools, Cases',1st,WILEY,United States,2012,978-1-118-15630-8

Course Outcomes:

1. Innovate new methods in product development
2. 2 Apply Design Thinking in developing the new designs

3. Select ideas from ideation methods in new product development
4. Use Design Thinking in developing software products
5. Apply principles of Design Thinking in service design

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS: 29-4-2021 **ACADEMIC COUNCIL: 17-9-2021**

SDG No. & Statement:
SDG 9
The modules and topics mentioned in this course are designed to ensure the engineers build resilient infrastructure which promote inclusive and sustainable industrialization and foster innovation.
SDG Justification:
The course involves design aspects

PHYS1001	PHYSICS	L	T	P	S	J	C
		2	1	2	0	0	4
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**NIL**						

Course Description:

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibres and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors and some widely used semiconductor devices for various applications.

Course Educational Objectives:

1. To introduce mathematical principles to estimate forces, fields and waves.
2. To familiarize students with electromagnetics in modern communication systems.
3. To impart knowledge concerning the electrical behaviour of dielectric materials.
4. To demonstrate the properties of magnets.
5. To introduce semiconductor physics and devices.

UNIT 1 Basics of Electromagnetics 9 Hours

Electrostatic field: Coulomb's law and Gauss 'law, derivation of Coulombs law from Gauss' law, applications of Gauss' law (line charge, thin sheet of charge and solid charged sphere), Gauss' law of electrostatics in dielectric medium, divergence and curl of electric fields, electric potential, relation between potential and force, Poisson's and Laplace equations. Magnetostatic field: Biot–Savarts' law, divergence and curl of magnetic fields, Faraday's and Ampere's laws in integral and differential form, displacement current, continuity equation, Maxwell's equations.

UNIT 2 Fiber Optics 7 Hours

Introduction, advantages of optical fibers, principle and structure, acceptance angle, numerical aperture, modes of propagation, classification of fibers, fiber optic communication, importance of V-number, fiber optic sensors (Temperature, displacement and force), applications.

UNIT 3 Dielectric, Magnetic and superconducting Materials 10 Hours

Dielectric materials: Introduction, electric polarization, dielectric polarizability, susceptibility and dielectric constant, types of polarizations (qualitative treatment only). Magnetic materials: Introduction, magnetic dipole moment, magnetization, magnetic susceptibility and permeability, origin of permanent magnetic moment, classification of magnetic materials, Weiss theory of ferromagnetism (qualitative), domain theory, hysteresis, soft and hard magnetic materials.

Superconductivity: definition –Meissner effect –type I & II superconductors –BCS theory (qualitative) –high temperature superconductors –Josephson effects applications.

UNIT 4 **Semiconductor Physics** **8 Hours**

Introduction, origin of energy band, intrinsic and extrinsic semiconductors, mechanism of conduction in intrinsic semiconductors, generation and recombination, carrier concentration in intrinsic semiconductors, variation of intrinsic carrier concentration with temperature, n-type and p-type semiconductors, carrier concentration in n-type and p- type semiconductors, Drift and diffusion currents in semiconductors.

UNIT 5 **Semiconductor Devices** **8 Hours**

Zener Diode, Tunnel diode, Hall effect and its applications, magnetoresistance, p-n junction layer formation and V-I characteristics, direct and indirect band gap semiconductors, construction and working of photodiode, LED, solar cell.

PHYSICS LABORATORY

List of Experiments

1. To determine the magnetic field along the axis of a circular coil carrying current.
2. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle
3. To determine magnetic susceptibility by Quincke's tube method
4. To determine the Hall coefficient using Hall effect experiment
5. To determine the resistivity of semiconductor by Four probe method
6. To determine the energy gap of a semiconductor.
7. To study the characteristics of PN Junction diode.
8. To study magnetic hysteresis loop (B-H curve).
9. To determine the dielectric constant of a substance by resonance method.
10. To determine hysteresis loss by CRO.
11. To study the characteristics of Photodiode
12. To study the characteristics of Solar Cell
13. To study the characteristics of Zener diode
14. To study the resonance of LCR circuit

Text Books:

1. David J.Griffiths, "Introduction to Electrodynamics", 4/e, Pearson Education, 2014.
2. Charles Kittel, "Introduction to Solid State Physics", Wiley Publications, 2011.
3. M. N. Avadhanulu, P.G. Kshirsagar, "A Text book of Engineering Physics", 11/e, S. Chand Publications, 2019.

References:

1. Principles of Physics, 10ed, ISV, Jearl Walker, David Halliday, Robert Resnick, Wiley India.
2. Gerd Keiser, "Optical Fiber Communications", 4/e, Tata Mc Graw Hill, 2008.
3. S.O.Pillai, "Solid StatePhysics", 8/e, New Age International, 2018.

4. S.M. Sze, “Semiconductor Devices-Physics and Technology” , Wiley, 2008.

Journal(s):

1. https://aapt.scitation.org/doi/abs/10.1119/1.3317450
2. https://aapt.scitation.org/doi/full/10.1119/1.5144798
3. https://aapt.scitation.org/doi/abs/10.1119/1.1511591

Course Outcomes:

1. Apply mathematical principles to estimate magnetic and electric forces, fields and waves
2. Use the principles of EM waves and Maxwell equations to understand communication systems
3. Apply basic properties of dielectric, magnetic and superconducting materials in electromagnetics
4. Understand physics of semiconducting materials
5. Use working principles of semiconducting devices in electronic circuits

Text Book:

1. S. Balasubramanian, M.N. Srinivasan “A Text book of Practical Physics”- S Chand Publishers,2017

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PHYS1011	MECHANICS AND PROPERTIES OF MATTER	L	T	P	S	J	C
		3	1	0	0	0	4
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	NIL						

Course Description:

This course is designed for students of Aerospace, Civil and Mechanical Engineering. It introduces fundamentals of elasticity and thermal properties – the essentials for understanding the behaviour of materials. Mechanics of solids is taught to acquaint them with the behaviour of rigid objects. An introduction to sensors will be useful for all the branches as an application of modern technology.

Course Educational Objectives:

1. To acquaint the basic concepts of sound waves and principles in acoustic design.
2. To introduce the concepts of elasticity, strain hardening and failure in materials and impart the relation between stress and strain.
3. To impart the phenomenon of heat transfer so as to understand a wide variety of practical engineering problems.
4. To demonstrate the use of Newton's laws of motion for understanding the mechanics of a particle.
5. To explain the working principle and construction of different types of sensors.

UNIT 1 Mechanics 10 Hours

Basic laws of vectors and scalars; Rotational frames; Conservative and non-conservative forces; F = - grad V; Central forces; Elliptical, parabolic and hyperbolic orbits; Noninertial frames of reference; Centripetal acceleration; Harmonic oscillator; Damped harmonic motion; Forced oscillations and resonance. Degrees of freedom.

UNIT 2 Elasticity 8 Hours

Concepts of elasticity and plasticity, stress and strain, Hooke's law, different moduli of elasticity, Poisson's ratio, strain energy, stress-strain diagram, elastic behavior of a material, factors affecting elasticity, relation between different moduli of elasticity, determination of elastic moduli.

UNIT 3 Thermal Properties 10 Hours

Transfer of heat energy; Thermal expansion of solids and liquids; Expansion joints - bimetallic strips; Thermal conduction, convection and radiation and their fundamental laws; Heat conductions in solids; Thermal conductivity - Forbe's and Lee's disc method: theory and experiment; Applications (qualitative only): heat exchangers, refrigerators, ovens and solar water heaters.

UNIT 4 Acoustics 8 Hours

Characteristics of sound waves; Weber-Fechner Law; Absorption coefficient, determination of absorption coefficient; Reverberation time; Sabine's formula, derivation of Sabine's formula using growth and decay method; Intensity of sound; Acoustics of buildings, Acoustic requirements of a good auditorium.

UNIT 5 Sensors 9 Hours

Sensors (qualitative description only); Different types of sensors and applications; Strain and pressure sensors- Piezoelectric, magnetostrictive sensors; Fibre optic methods of pressure sensing; Temperature sensor - bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors.

Text Books:

1. D.Kleppner and Robert Kolenkow"An Introduction to Mechanics- II" Cambridge University Press,2015.
2. M.N. Avadhanulu & T.V.S. Arun Murthy, S Chand A Textbook of Engineering Physics, Volume-I 2018.
3. Ian R Sinclair, Sensor and Transducers 3/e,Elsevier (Newnes), 2001.

References:

1. M K Varma, "Introduction to Mechanics"-Universities Press, 2015
2. Prithwiraj Purkait, Budhaditya Biswas and Chiranjib Koley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1/e., McGraw Hill Education (India) Private Limited, 2013.

Course Outcomes:

After completion of this course, the student will be able to

1. describe the fundamental principles of acoustics with emphasis on physical mechanisms, law and relationships
2. apply the concepts of strain, internal force, stress and equilibrium to deformation of solids
3. explain the fundamental theory for the analysis of heat transfer processess in solids and liquids and to apply basic principles of heat transfer in design of refrigerators and heaters
4. estimate forces and moments in mechanical systems using scalar and vector techniques
5. outline the basic principle and operation of different types of sensors

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PHYS1021	PRINCIPLES OF QUANTUM MECHANICS	L	T	P	S	J	C
		3	1	0	0	0	4
Pre-requisite	**NIL**						
Co- requisite	**NIL**						
Preferable exposure	**NIL**						

Course Description:

This course is designed with principles of Quantum mechanics for advanced courses in their respective engineering branches. It introduces Quantum mechanics with relevant mathematical tools and provides a basis for further study of quantum mechanics. It also introduces basics of Qubits for Quantum computing applications.

Course Educational Objectives:

1. To introduce the basic principles of quantum mechanics.
2. To introduce wave equation and significance of wave function.
3. To teach solving the Schrödinger's equation for spinless particles moving in one-dimensional potential.
4. To develop an understanding of concepts of angular momentum.
5. To introduce Dirac bra-ket formalism and the concept of QUBITs.

UNIT 1 Introduction to Quantum Physics 10 Hours

Introduction, Classical Mechanics vs Quantum Mechanics, Planck's quantum theory (qualitative), Photo-electric effect. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them, Wave-particle duality, Heisenberg uncertainty principle: ground state energy of hydrogen atom.

UNIT 2 Properties of Matter Waves 8 Hours

Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities, and normalization.

UNIT 3 Quantum Tunneling 8 Hours

One dimensional infinitely rigid box-energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical tunnelling in one dimensional rectangular potential barrier, 1D linear harmonic oscillator (no derivation required, only eigen function, eigen values and zero-point energy).

UNIT 4 Quantum Properties of Electrons 9 Hours

Electron angular momentum, angular momentum operator, Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect, Stark Effect, Gyromagnetic Ratio and Bohr

Magneton (qualitative)

UNIT 5 Qubits for Quantum Computing 10 Hours

Introduction to Dirac Bra-Ket notation, Introduction to Pauli spin matrices, Quantum Superposition, Interference, Quantum Measurement, Decoherence, Entanglement, Bloch sphere, Qubits, and multiple qubits, Qubits Vs classical bits, representation of a qubit probability.

Textbooks:

1. Quantum Mechanics, G. Aruldhas, 2ndEdn. 2002, PHI Learning of India.
2. Quantum Mechanics, Satya Prakash, 2016, Pragati Prakashan.
3. Quantum Computing for Everyone, Chris Bernhardt, 2019, The MIT Press,

References:

1. Introduction to Quantum Mechanics, D.J. Griffith, 2ndEd. 2005, Pearson Education.
2. Quantum Computing: An Applied Approach, Jack D. Hidary, 2019,

Journal(s):

1. https://aapt.scitation.org/doi/full/10.1119/1.4897588
2. https://aapt.scitation.org/doi/full/10.1119/1.3639154

Websites

1. https://www.intechopen.com/online-first/73811
2. https://www.quantum-inspire.com/kbase/what-is-a-qubit/

Course Outcomes:

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

1. Explain the basic principles of quantum mechanics.
2. Interpret wave equation and significance of wave function.
3. Solve the Schrödinger's equation for spinless particles moving in one-dimensional potential.
4. Understand of concepts of angular momentum and spin.
5. Apply Dirac bra-ket formalism to the concept of QUBITs.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PHYS1241</td><td rowspan="2">PHYSICS OF OPTOELECTRONIC DEVICES</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">NIL</td></tr>
</table>

Course Description:

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibres and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors, and some widely used semiconductor devices for various applications.

Course Educational Objectives:

1. To introduce nature light and its properties.
2. To familiarize students with different semiconductors and its energy band gaps.
3. To introduce semiconductor physics and devices.
4. To impart knowledge about the semiconducting optical devices.
5. To demonstrate the properties of different semiconducting optical devices.

UNIT 1 Elements of light 8 Hours

Nature of light, Light sources, Black body, Colour temperature, Units of light, Radio metric and photometric units, Light propagation in media and waveguides, Electro-optic effects. Overview of luminescence: Photoluminescence, Cathodoluminescence, Electroluminescence, Injection-luminescence.

UNIT 2 Semiconductor Materials 10 Hours

Free electron theory of metals, Density of states in 1D, 2D, and 3D, Bloch’s theorem for particles in a periodic potential, Energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Occupation probability, Fermi level, Effective mass.

UNIT 3 Principles of Lasers 10 Hours

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Einstein coefficients, Population inversion, Transition rates (Fermi's golden rule), Optical loss and gain; semiconducting diode laser, applications of semiconductor Lasers.

UNIT 4 Solar cells and Photovoltaic devices 9 Hours

Charge carrier generation and recombination, p-n junction model and depletion capacitance, Photovoltaic effect, Physics of Solar Cells, Principle of solar energy conversion,

Conversion efficiency, Type of solar cells in use: Dye Sensitized Solar Cells, Thin film solar cells, Perovskite Solar cell.

UNIT 5 Semiconductor devices 8 Hours

Radiative recombination devices: Light-emitting diodes (LED), Organic Light Emitting Diodes (OLED) and its types, Photoelectric devices: Photodiodes. Photo conducting devices: Photodetectors and photoconductors, Photoresistors, Photo transistors.

Textbooks:

1. Jasprit Singh, Optoelectronics – An Introduction to materials and devices; McGraw Hill,1996.
2. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition 2019
3. Maurice Quillec, Materials for Optoelectronics; Springer Science, 1996.
4. S. C. Gupta, Optoelectronic Devices and Systems; Prentice Hall India, 2005.
5. P. Bhattacharya, Semiconductor optoelectronic devices; Prentice Hall India, 2006.

References:

1. Pyshkin, Ballato, Optoelectronics - Advanced Materials and Devices; InTech, 2013.
2. Manijeh Razeghi, Optoelectronic materials and device concepts; SPIE, 1991
3. Sun and Dalton, Introduction to Organic Electronic and Optoelectronic Materials and Devices; CRC Press, 2008.
4. J. Palais, Introduction to optical electronics; Prentice Hall, 1988.
5. Jasprit Singh, Semiconductor optoelectronics; McGraw-Hill, 1995.

Course Outcomes:

After completion of this unit, the student will be able to

1. Outline the properties of semiconductors
2. explain the occupation probability and Fermi level variation in different electronic materials
3. Know about the interaction of light with materials and its optical properties
4. Explain the conduction mechanism in semiconducting and optical devices.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">PHYS1041</td><td rowspan="2">MECHANICS AND MODERN PHYSICS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Co- requisite</td><td colspan="7">NIL</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">NIL</td></tr>
</table>

Course Description:

This course designed for students of Biotechnology to impart principles of Newtonian mechanics will help the students in understanding the oscillatory behavior of materials. It also introduces fundamentals of quantum mechanics – the essentials for understanding the behavior of properties of materials. Fundamentals of optics and electromagnetism in understanding the use in spectroscopy. An introduction to sensors will be useful for all the branches as an application of modern technology.

Course Educational Objectives:

1. To impart knowledge on damped and forced oscillations.
2. To familiarize students with the concepts of quantum mechanics
3. To impart knowledge concerning the wave properties of electromagnetic waves
4. To familiarize the students about the Maxwell's equations and its propagation
5. To outline the principles and working of few common sensing devices

UNIT 1 Fundamentals of Dynamics and Oscillations 10 Hours

Fundamentals of Dynamics: Reference frames. Inertial frames; Galilean transformations.
Galilean invariance. Review of Newton's Laws of Motion.
Oscillations: SHM, Simple Harmonic Oscillations. Differential equation of SHM and its solution. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor

UNIT 2 Modern Physics (Quantum Physics) 8 Hours

Introduction, matter waves and its properties, Davisson-Germer experiment, GP Thomson experiment, Heisenberg's uncertainty principle, Schrodinger's time independent wave equation, physical significance of wave function, particle in a one-dimensional infinite well, rectangular potential barrier (transmission coefficient), band theory of solids (qualitative), distinction between metals, insulators and semiconductors, introduction to Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstien statistics.

UNIT 3 Optics 10 Hours

Interference: Introduction, interference in thin films due to reflected light: interference in parallel-sided film and wedge-shaped film, Newton's rings. Diffraction: Introduction; Fraunhofer diffraction at single slit (qualitative only), diffraction due to N-slits (diffraction

grating) (qualitative only), determination of wavelength of light with a plane transmission grating.
Polarisation: Introduction; Double refraction –double refraction in calcite crystal, negative and positive crystals, Nicol's prism, Retarders (quarter and half¬wave plates).

UNIT 4 Maxwell`s equations and Electromagnetic wave propagation 8 Hours

Maxwell's equations (both differential and integral forms) and its physical significance, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization of EM waves.

UNIT 5 Sensors 9 Hours

Sensors (qualitative description only); Different types of sensors and applications; Strain and pressure sensors -Piezoelectric, magnetostrictive sensors, ultrasonic sensors; Fibre optic methods of pressure sensing; Temperature sensor -bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors

Textbooks:

1. Mechanics, D.S. Mathur, S.Chand and Company Limited, 2000.
2. A Text Book of Optics, 25/e, Brij Lal, M N Avadhanulu & N Subrahmanyam, 2012, S. Chand Publishing.
3. Ian R Sinclair, Sensor and Transducers 3rd eds, 2001, Elsevier (Newnes)
4. David J. Griffiths, "Introduction to Electrodynamics"-4/e, Pearson Education,2014
5. M.N. Avadhanulu, P.G. Kshirsagar, A Textbook of Engineering Physics, S.Chand, 2014.

References:

1. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
2. Prithwiraj Purkait, Budhaditya Biswas and Chiranjib Koley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1st eds., 2013 McGraw Hill Education (India) Private Limited.
3. Elements of Properties of Matter, D. S. Mathur, S. Chand Publishing

Journal(s):

1. https://aapt.scitation.org/doi/abs/10.1119/1.3317450
2. https://aapt.scitation.org/doi/full/10.1119/1.3639154

Course Outcomes:

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

1. Understand the concept of damped and forced oscillations.
2. Understand concepts of quantum mechanics
3. Understand interference, diffraction and polarization of light waves
4. Know about the maxwell's equations and its propagation
5. Use principles and working of few common sensing devices

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PROJ2999	CAPSTONE PROJECT – INTRODUCTION	L	T	P	S	J	C
		0	0	0	0	2	2
Pre-requisite	NIL						
Co- requisite	NIL						
Preferable exposure	NIL						

Course Educational Objectives:

1. To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Logistics

Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

1. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
2. Can be individual work or a group project, with a maximum of 3 students.
3. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

Course Outcomes:

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

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing

5. Synthesis the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PROJ3999	CAPSTONE PROJECT – FINAL	L	T	P	S	J	C
		0	0	0	0	6	6
Pre-requisite	PROJ2999						
Co- requisite							
Preferable exposure							

Course Educational Objectives:

1. To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Logistics:

Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

1. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
2. Can be individual work or a group project, with a maximum of 3 students.
3. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

Course Outcomes:

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

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing
5. Synthesis the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

PROJ2888	PROJECT EXHIBITION 1	L	T	P	S	J	C
		0	0	0	0	1	1

Co- requisite	
Preferable exposure	
Pre-requisite	

Course Educational Objectives:

To provide platform for the student to exhibit their project work to

1. Excite interested students in continuing/initiating in the work of interest
2. Attract startups/industry to commercialize the project work
3. acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

		L	T	P	S	J	C
PROJ3888	**PROJECT EXHIBITION 2**	**0**	**0**	**0**	**0**	**1**	**1**
Pre-requisite	PROJ2888						
Co- requisite							
Preferable exposure							

Course Educational Objectives:

To provide platform for the student to exhibit their project work to

- Excite interested students in continuing/initiating in the work of interest
- Attract startups/industry to commercialize the project work
- acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">VIVA3555</td><td rowspan="2">COMPREHENSIVE EXAMINATION</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Completion of minimum of six semesters</td></tr>
<tr><td>Co- requisite</td><td colspan="7"></td></tr>
<tr><td>Preferable exposure</td><td colspan="7"></td></tr>
</table>

Course Educational Objectives:

1. Designed to test the students on the electronics and communication engineering concepts, and tools, and the process of identifying and solving engineering problems.

UNIT 1 **Networks, Signals and Systems**

Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton"s maximum power transfer; ye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks and Network Synthesis {RL,RC,LC and RLC Synthesis}: Positive real functions, hurwitz polynomial, foster and cauer forms. Continuous-time signals: LTI System & Properties,Fourier series and Fourier transform representations, sampling and aliasing concepts and applications; Discrete-time signals: discrete time Fourier transform {DTFT}, DFT, FFT, Z-transform. Interconnection of systems; Filter design concepts, phase and group delay concepts

UNIT 2 **Electronic Devices and Circuits**

Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, LED, photo diode and solar cell; MOS Transistor Theory: nMOS, pMOS Enhancement Transistor, ideal I-V characteristics, MOS capacitor, C-V characteristics, DC transfer Characteristics of CMOS inverter. Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Special diodes, Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, tuned amplifiers, power and operational; Simple opamp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op-amp configurations; Function generators, 555 timers, open and closed loop applications of Comparators, Voltage Regulators, regulator protection methods, noise analysis of electronic circuits, PLLs and Data converters

UNIT 3 **Digital Circuits**

Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift- registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microcontroller {8051}: architecture, programming, memory and I/O interfacing.

UNIT 4 Electromagnetics

Electrostatics; Maxwell"s equations: differential and integral forms and their interpretation boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, Rader range equvation, Friss formula; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Wave Propagation, Antenna design considerations - Microstrip and Horn antennas. Basics of radar; Properties and characteristics of light sources {Laser and LED} and detectors; Light propagation in optical fibers.

UNIT 5 Control Systems

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Closed loop control system design by Nichols plot , PID controller design, Lag, lead and lag-lead compensation, States space models, states space equations and solutions, states space methods for controller designs and non-linear control systems and its applications.

UNIT 6 Communications

Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem. Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying {ASK, PSK, FSK}, QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; inter-symbol interference and its mitigation; Wireless Communication: Structure of a Wireless Communication Link, Modulation Techniques: QPSK, MSK, GMSK. Basics of TDMA, FDMA and CDMA.

Mode of Evaluation: 12 Quizzes with Multiple Choice Questions. Best 10 quizzes are considered for computing 100M. Student shall score atleast 80% in atleast 8 quizzes to be considered for grading

Course Outcomes:

The students will be able to

1. Apply knowledge of mathematics, science, and engineering
2. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care and safety, manufacturability, and sustainability

APPROVED IN:
BOS : 26-04-2021
SDG No. &
Statement: SDG
Justification:

ACADEMIC COUNCIL: 17-09-2021

BTEN1001	INTRODUCTION TO BIOTECHNOLOGY-I	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:
This course introduces the student to the basics of biology such as classification, cell structure, biomolecular structure, metabolism, function

Course Educational Objectives:

- Introduce the cellular basis of life.
- Provide the basis for classification of living organisms.
- Describe the important biomolecules
- Describe the applications of biomaterials
- Describe the different metabolic pathways

UNIT 1 **6 hours**

Introduction to Biology, Cellular basis of life, differences between prokaryotes and eukaryotes. Classification based on carbon and energy sources, Tools of molecular taxonomy

UNIT 2 **8 hours**

Biomolecules, structure and functions of proteins, nucleic acids, lipids and sugars. Structure and function of hemoglobin, antibodies and enzymes. Industrial applications of enzymes

UNIT 3 **10 hours**

Bioenergetics, Respiration: Glycolysis and TCA cycle, Electron transport chain and oxidative phosphorylation. Anaerobic respiration and Fermentation and its industrial applications Mechanism of photosynthesis, Light and dark reactions

UNIT 4 **12 hours**

Genetics: Mendel's laws of inheritance. Gene interactions- Epistasis, Incomplete & Codominance, Multiple alleles, Additive, complementation, Pleiotropism. Linkage, Crossing over. Gene mapping. Cell cycle and regulation. Mitosis and Meiosis

UNIT 5 **14 hours**

Human physiology – Membrane transport- Active and passive. Cell signaling and communication. Neurons – structure, function and types. Synapse-types, neurotransmitters, transmission of nerve impulse. Neuromuscular junctions. Muscle- structure, function and types.

Textbooks:

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2018.
2. Arthur T Johnson, Biology for Engineers, CRC press, 2011

References

1. Alberts et. al. The molecular biology of the cell, 6/e, Garland Science, 2014
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
3. John Enderle and Joseph Bronzino Introduction to Biomedical Engineering, 3/e, 2012.

Course Outcomes:

After the completion of the course the student should be able to

1. Explain classification of living organisms.
2. Explain cell as the basis of life
3. Explain the importance of various biomolecules
4. Summarize application of enzymes and fermentation in industry.
5. Analyze metabolic pathways

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
CO4																
CO5																

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

BTEN1021	INTRODUCTION TO BIOTECHNOLOGY-II	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:

This course introduces the student to the Applications of Biotechnology in plant , animal and industrial development

Course Educational Objectives:

1. Describe the concept of Central Dogma of Molecular Biology
2. Describe the transfer of genetic information.
3. Introduce recombinant DNA technology
4. Introduce the techniques used for modification of living organisms

UNIT 1 10 hours

Biotechnology: Concept, scope and importance. Origin of life-theories. Structure of bacterial, plant and animal cells-functions of cell organelles. Significance of biomolecules in biological systems

UNIT 2 12 hours

The central dogma of molecular biology. Concepts of genetic engineering, Restriction endonucleases, cloning vectors, methods of gene transfer. Polymerase Chain Reaction. Introduction to bioinformatics and biological databases

UNIT 3 12 hours

Biotechnology for Plant improvement: Strategies for engineering stress tolerance, transgenic plants. Micropropagation of novel varieties. Production of secondary metabolites and their importance. Molecular pharming.

UNIT 4 12 hours

Biotechnology for improvement of animals: Applications in animal husbandry, medicine and animal husbandry. Transgenic animals. Gene therapy and genetic counselling. Bioethics.

UNIT 5 14 hours

Industrial and Microbial Biotechnology: Overview of industrial fermentation process and products. Fermentation technology for production of Penicillin. Introduction to patents. Biotech industry in India and abroad.

Textbooks:

1. J.M. Walker and R. Rapley, Molecular Biology and Biotechnology, 5/e, Royal society of chemistry, 2009.
2. W. Godbey, An Introduction to Biotechnology, The Science, Technology nd Medical Applications, 1/e, Woodhead Publishing, 2014.

References

1. P.K. Gupta, Elements of Biotechnology, 2/e, Rastogi Publications, 2014.
2. B. Albert's, A. Johnson, J. Lewis, D. Morgan, M. Raff, K. Roberts and P.Walter, Molecular Biology of the Cell, 6/e, Garland Publishers, 2014.
3. H. Lodish, A. Berk, C. A. Kaiser, M. Krieger, A. Bretscher, H. Ploegh, Amon and M. P. Scott, Molecular Cell biology, 7/e, W.H Freeman and Company, 2014.

Course Outcomes:

After the completion of the course the student should be able to

1. Explain the scope and importance of biotechnology
2. Understand the application of biotechnology in transgenic plant development.
3. Understand the role of biotechnogy in animal husbandry and livestock improvement
4. Explain the potential of biotechnology in industry in strain improvement

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
CO4																
CO5																

APPROVED IN:

BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

FINA1031	PRINCIPLES AND PRACTICE OF BANKING	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:

The significance of the banking sector in India has been continuously upward for several decades. The sector is playing a role of a catalyst in the development of the economy. The Banks started playing a critical role in the social development process and became a partner in Government's welfare schemes and policies. Principles of and Practices of Banking course explores the fundamental principles and practices of banking and credit in India. It helps students to understand basics of banking and regulation to recent developments in Banking technology

Course Educational Objectives:

1. To understand the Indian financial system, role of commercial Banks, RBI in India and the regulations of Indian Banks.
2. To comprehend the banking Principles
3. To give the student adequate exposure to banking practice.
4. To acquaint and apply innovations in the banking sector.
5. To give an overall exposure to banking Principles and Practice.

UNIT 1 Banking System and Structure 9 Hours

Banking system and structure in India: Evolution of Indian Banks-Types of banks; Commercial Banks, Cooperative Banks, Role of RBI; Banking Regulation, Constitution, Objectives, Functions of RBI, Tools of Monetary control; Regulatory Restrictions on Lending. Types of Banking- Retail, Wholesale and International Banking.

UNIT 2 Risk management and Basel Accords 9 Hours

Introduction to Risk Management and Basel I, II &III Accords. Role and functions of CIBIL. Fair practices code for debt collection. Principles of Lending: Cardinal Principles, Non-fund-based limits, Credit appraisal Techniques. Cash management services and its importance.

UNIT 3 Functional Banks 9 Hours

Banker Customer Relationship: Types, Different Deposit Products & Services, Services to customers and Investors; PMLA Act; KYC Norms; Banker as lender: Types of loans, Overdraft facilities, Discounting of bills, Financing book Debts and supply bills- Charging of Security bills- pledge, mortgage

UNIT 4 Customer Protection 9 Hours

COPRA Act and its operational aspects; Banking Ombudsman Scheme; Role and duties Paying and collecting Banks; Banker Protection under Negotiable Instrument Act-Endorsement, Forged Instruments- Bouncing of Cheques and their implications; Operational aspects of opening and maintaining accounts of various types of account holders. Ancillary Services: Remittances & Safe Deposit lockers, Govt Business, EBT

UNIT 5 Banking Technology 9 Hours

Computer Systems: LAN,WAN, UPS, Core banking, Data warehousing, Data Mining. Digital Banking: ATMs, Electronic Kiosks-CDK, BNA, PBP; Cards – Types, Networks, Wallets; PPI. Electronic Banking – Internet & Mobile Banking. Trends In Communication Networks for Banking: EFT System, SWIFT, RTGS, NEFT, Automated Clearing System. Digital Payment Systems – NPCI

Textbooks:

1. Principles and Practices of Banking, IIFB, 5thEditionn 2021
2. Principles And Practices Of Banking (Paperback, N S TOOR & ARUNDEEP TOOR) 14th Edition

References:

1. Shekhar&Shekhar (2010),Banking Theory and Practice, New Delhi: Vikas Publishing House.
2. P.K. Srivastav(2011),Banking Theory and Practice, NewDelhi:Vikas Publishing House.
3. Sundaram& P.N. Varshney (2010), Banking Theory, Law and Practice, New Delhi:S.Chand& Co.
4. Padmalatha Suresh and Justin Paul (2013),Management of Banking and Financial Services, New Delhi: Pearson Education.

Journal(s):

1. GITAM Journal of Management, Visakhapatnam.
2. The Journal of Banking Studies, Mumbai.

Website(s):

1. https://www.icai.org/

Course Outcomes:

1. Student acquires knowledge about theoretical aspects of banking and
2. Student acquires knowledge about relationship between banker and customer
3. Student learns about the practicalities of banking and the latest trends in banking.
4. Students develops skills about legal aspects and negotiable instruments.
5. Student enhance knowledge about latest banking trends and technology.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">HRMG1021</td><td rowspan="2">HUMAN RESOURCE MANAGEMENT</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Co- requisite</td><td colspan="7">Nil</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Nil</td></tr>
</table>

Course Description:

Success in today's competitive business environment is increasingly a function of effective management of its resources, particularly human resources, which are the most valuable assets of an organization. The efficiency and quality of service of an organization depend on its employee's enthusiasm and satisfaction with their jobs, which are directly related to their sense of being treated fairly. To become a successful manager, it is imperative to understand human sensitivities and factors that motivate individuals. Human Resource Management course provides the basic tools required as an HR professional in an organization

Course Educational Objectives:

1. To Understand the fundamentals, evolution, function & challenges of HRM
2. To Explore the role of HRM in procurement, development of human resources
3. To Analyze the basic factors in designing the compensation and collective bargaining
4. To Evaluate safety and health and establish effective separation practices.

UNIT 1 — Introduction — 10 Hours

Introduction: Nature, scope and significance of HRM - Evolution of HRM – Recent trends in HRM – Functions of HRM – Challenges of HR managers.)

UNIT 2 — Procurement — 10 Hours

Procurement: Human Resource Planning – HR Forecasting methods - Job analysis and Job design – Recruitment - Selection – Induction.

UNIT 3 — Development — 10 Hours

Development: Identification of training needs - designing the training program – Methods of training – Difference between Training & Development.

UNIT 4 — Compensation and Integration — 10 Hours

Compensation and Integration: Introduction - Basic factors in determining pay rates – Basic, Supplementary and Executive Remuneration – types of employee benefits and services - Quality of work-life – Collective Bargaining.

UNIT 5 **Separation and maintaining** **10 Hours**

Separation and Maintaining: Communication and Counseling - Safety and Health – Internal mobility - Retirement and Retirement benefits..

Textbooks:

1. Gary Dessler & Biju Varkkey, "Human Resource Management," Pearson, New Delhi, 16th edition.
2. George W Bohlander, Scott A Snell, "Principles of Human Resource Management," Cengage Learning, 2017.16th edition.
3. Aswathappa, K., Human Resource and Personnel Management: Text & Cases, TMGH
4. Subba Rao, P., Personnel and Human Resource Management (Text & Cases), Himalaya

References:

1. Edwin B Flippo, "Personnel Management," Tata McGraw Hill Publishing, New Delhi, 1984
2. John H. Bernardin, "Human Resource Management - An Experiential Approach," Tata McGraw Hill, New Delhi, 2013
3. Mirza, Saiyadain, "Human Resource Management," Tata McGraw Hill, New Delhi, 2013
4. Gary Dessler & Biju Varkkey, "Human Resource Management," Pearson, New Delhi, 2015 14th edition.

Journal(s):

- Harvard Business Review, Harvard Business School Publication USA
- People Matters Online Magazine
- Human Capital Magazine
- Vikalpa, Indian Institute of Management, Ahmedabad

Course Outcomes:

On successful completion of this course, students will be able to:

- Understanding the concept of HRM and its importance.
- Describe the process of workflow analysis and identify why it is essential to HRM.
- Understand the concepts of Training and Development
- List various factors determining pay rates.
- Analyze the role of the supervisor in employee safety and minimize accidents at the workplace.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement: 8 Decent Work and Economic Growth

SDG Justification: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

MKTG3011	SALES AND DISTRIBUTION MANAGEMENT	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	Nil						
Co- requisite	Nil						
Preferable exposure	Nil						

Course Description:

Sales Management focuses on the sales techniques and the management of the sales force. The success of any sales and marketing department lies in the effectiveness of the Sales Force. The goal of the Sales Management course is to examine the elements of an effective sales force as a key component of the organization's total marketing effort. A successful Sales Manager needs to understand the fundamentals of the sales process, the relationship between sales and marketing, sales force structure and issues in recruiting, selecting, training, motivating, compensating and retaining sales people.

Course Educational Objectives:

1. To understand the planning and staffing needs in professional sales
2. To learn how to manage and motivate a professional sales team as a Sales manager
3. To analyse the key success factors for sales executive performance.

UNIT 1

Introduction to Sales Management - Evolution of Sales Management, importance of Sales Management, types of Selling, difference between Selling and Marketing, Modern Day Sales Activities, Selling Skills, Selling Strategies, Selling Process.

UNIT 2

Sales Planning and Budgeting: Sales planning process, sales forecasting methods, sales budgeting process, methods used for deciding sales budget, types of quotas and quota setting procedure, reasons for establishing or revising sales territories, routing and scheduling sales persons, market cost analysis.

UNIT 3

Sales Force Management: Recruitment and selection of the sales force, training the sales force, sales force motivation, sales force compensation, sales force control and evaluation.

UNIT 4

Introduction to Distribution Management -Definition, need for Distribution Channels, designing the Marketing Channels, Motivating and Evaluating Channel Members, Capturing the Customer requirements

UNIT 5

Managing Distribution Channels - Managing Channel Information Systems, reasons for Channel Conflicts, Managing Conflict, Managing, Ethical issues in Sales and Distribution Management

Textbooks:

1. Krishna K Havaldar, Vasnt M Cavale, Sales and Distribution Management, 2nd edition, Tata Mcgraw Hill, 2011.

References:

1. Tapan K. Panda &Sunil Sahadev (2011), Sales and Distribution Management 2nd edition Oxford Press.
2. S.L. Gupta, M.K.Rampal (2009) Cases in Sales and Distribution Management, Himalaya Publication house.
3. K.Sridhara Bhat (2011) Sales and Distribution Management, 1st, Himalaya Publication house.
4. S.A.Chunawalla (2012) Sales and Distribution Management, 3rd edition, Himalaya Publication house.
5. Dinesh kumar (2012) Marketing Channels ,Oxford Press.
6. Richard R Still, Edward W Cundiff, Norman &A P Govoni(2011) Sales and Distribution Management, 5th edition, Pearson Publications.
7. Spiro Stanton & Rich (2010) Management of Sales Force, 13th edition, Tata McGraw Hill.
8. Prof. M.V. Kulkarni (2010) Sales and Distribution Management, Everest Publishing House.
9. Anne T Coughlan etal (2011), Marketing Channels, 7th edition, Pearson education.
10. Mark W Johnston, Greg W Marshall (2009), Sales Force Management, 9th edition, Tata McGraw Hill.
11. Dr.S.L.Guptha (2010), Sales and Distribution Management, 2nd edition, Excel books.
12. PingaliVenugopal (2012) Sales and Distribution Management, Sage Publications

Journal(s):

- Indian Journal of Marketing & Journal of Advertising Research
- GITAM Journal of Management, GITAM Institute of Management, GITAM Deemed to be university, Visakahapatnam

- Harvard Business Review, Harvard Business School Publication Co. USA
- Vikalpa, Indian Institute of Management, Ahmedabad

Course Outcomes:

On successful completion of this course, students will be able to:

1. Students would be able to understand the planning and staffing needs in professional sales.
2. Students would learn how to manage and motivate a professional sales team, as a sales manager.
3. Students would be able to analyze the key success factors for sales executive performance.
4. Students would learn how to manage and motivate distribution channel members.
5. Students can manage distribution channels and manage conflicts

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:
BOS : 26-04-2021 **ACADEMIC COUNCIL: 17-09-2021**

SDG No. & Statement:

SDG Justification:

MKTG1001	MARKETING MANAGEMENT	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite							
Co-requisite							
Preferable exposure							

Course Description:

Marketing as a subject primarily caters to the consumerist instincts of an individual. The markets are driven by consumer behaviour, which has evolved and is much more demanding these days. Consumer satisfaction takes precedence for a business to be successful. This calls for managers to adopt creative and unique marketing strategies to gain a competitive advantage. Marketing Management equips managers with the required theoretical knowledge and practical skills to gain insights into the dynamic nature of the markets and then devise ways and means to manage them effectively.

Course Educational Objectives:

- To explain the conceptual framework of marketing and its applications in "the real world."
- To apply concepts of marketing to address problems and opportunities in the new marketing environment
- To illustrate the functionality and application of elements of Marketing Mix
- To create a suitable marketing plan for a product
- To assess the range of common strategies used with each of the various promotional mix tools.

UNIT 1 **9 hours**

Definition, Nature, Scope, and Importance of Marketing – Core Concepts -Need, Want, Desire, Demand, Value, Exchange; philosophies of Marketing- Product – Production - Sales – Marketing – Societal – Relational marketing Concept of Marketing Myopia. Product Vs. service – Recent Trends in Marketing: Social Media Marketing and Digital Marketing.

UNIT 2 **9 hours**

Factors influencing buyer behavior –five-step buyers decision process - Segmenting, Targeting and Positioning - Concept of Market Segmentation, Bases for Segmenting Consumer Markets, Targeting (T), Positioning (P) Value Proposition and USP

UNIT 3 **9 hours**

Elements of the marketing Mix – four P's, extended three Ps of services. Product Decisions: Product Concept -Classification of Products – Product Life Cycle Stages, New Product Development

UNIT 4 Pricing and Channels of Distribution 9 hours

Pricing Objectives – Factors Influencing the Pricing Policy – Pricing Methods, Channels of Distribution: Definition – Nature – Types-Functions and levels of distribution channels

UNIT 5 9 hours

Importance of Promotion – Managing Advertising – Sales Promotion –Personal Selling and Direct Marketing– Publicity and Public Relations. Integrated Marketing Communication (IMC), Social Marketing

TextBooks:

1. Philip Kotler, Gary Armstrong, and Prafulla Agnihotri, Principles of Marketing, Pearson India, 17th Edition. New Delhi: 2018.
2. Rajan Saxena, Marketing Management, Tata-McGraw Hill, Fifth Edition New Delhi:2015

References:

1. Ramaswamy and Namakumari -Marketing Management- Indian Context -Global Perspective, Sage Publications India Pvt Ltd; Sixth Edition 2018
2. C. B. Gupta and Dr. N. Rajan Nair, Marketing Management: Text and Cases 15th Edition, S. Chand, and Sons 2012
3. N Rajan Nair and Sanjith R Nair, Marketing – Revised Edition, Sultan Chand & Sons – Tb, 2017

Course Outcomes:

1. Discuss the core concepts of marketing
2. Explain the factors influencing buyer behaviour
3. Understand the concept of the marketing mix and service Mix
4. Explain the pricing methods in a business setting
   Understand the purpose of promotion for the business

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PSO2	PSO3	PSO4
CO1											
CO2											
CO3											
CO4											
CO5											

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :28TH APRIL, 2021 **ACADEMIC COUNCIL: 1ST APRIL, 2022**

SDG No. & Statement:

Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

SDG Justification:

<table>
<tr><td rowspan="2">OPTS2001</td><td rowspan="2">Production and Operations Management</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

The concept of production is the process through which goods and services are created. We can include both manufacturing and service organizations within the purview of production management. Thus, the essential futures of the production function are to bring together people, machines and materials to provide goods or services thereby satisfying the wants of the people. The scope of the production enables us to look at the problem of production management in a much wider perspective. This paper indicates the general applications of the techniques of management, machines and materials

Course Educational Objectives:

- To enable to the students to understand the basic principles of Production Management
- To help them apply techniques of Production Management

UNIT 1 **7 hours**

Production and Operations Management - Production and Operation Functions - Manufacturing Systems –Differences Between Manufacturing and Service Operations - Functions of Production and Operations Manager.

UNIT 2 **Production Planning and Control** **10 hours**

Steps in PPC - Techniques of Production Planning and Control

UNIT 3 **Plant Location and Layout Planning** **8 hours**

Location of Service Facilities -Location Decision -Types of Layout – Factors Affecting Plant Location.

UNIT 4 **Productivity** **10 hours**

Factors Affecting Productivity -Job Design -Process Flow Charts -Methods Study -Work Measurement.

UNIT 5 **Materials Management** **10 hours**

Costs Associated with Inventory - Economic Order Quantity - ABC Analysis – Just in-timeProduction. Quality Management: Acceptance Sampling -Control Charts – Quality Circle.

Text Books:

1. Aswathapppa & Bhat (2013), *Production and Operations Management*,New Delhi: HimalayaPublishing House.

References:

1. Everett E. Adam, Jr. and Ronals J. E. Ebert (2012),*Production and OperationsManagement: Concepts, Models and Behavior*,New Delhi: Prentice Hall of India.
2. S.N. Chary (2011), *Production and Operations Management*, New Delhi:Tata Mc-Graw Hill Publishing Co. Ltd.

Course Outcomes:

After completing the course. The students able to

1. Understand Basics of Production and Operations Management
2. Understand the phases and techniques of production Planning and Control
3. Enhance their skills in applying appropriate location and layout designs.
4. Enhance their skills in improving the productivity
5. Understands and applies inventory and quality procedures.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1											
CO2											
CO3											
CO4											
CO5											

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-05-2022<< date >> **ACADEMIC COUNCIL: 1st April, 2022**

SDG No. & Statement:SDG

Justification:

HRMG2001	ORGANIZATIONAL BEHAVIOR	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Practicing managers have long understood the importance of interpersonal skills to managerial effectiveness. Till about three decades ago, most business schools focused on the functional aspects of management – specifically finance, accounting and quantitative techniques. Though Organizational Behavior was a core course right from the inception of the BBA program, the focus was essentially on gaining a psychologically understanding of human behavior, and not on acquiring usable skills. In the last two decades, academia has come to realize the importance that an understanding of human behavior to managerial effectiveness. The course focuses majorly on conceptual knowledge, with emphasis on analytical and presentational skills

Course Educational Objectives:

- The objective of the course is to give to the students a foundation in understanding human behaviour at work.
- This is done in a three stage process. Stage one deals with individual behavior, stage two with group behaviour and stage three gives an overview of the organizational and performance related factors

UNIT 1 **7 hours**

Introduction Nature and Importance of Organizational Behavior - Management Functions, Roles and Skills – People Skills.

UNIT 2 **10 hours**

Foundations of Individual Behavior - The Perception process – Factors, Person Perception - Learning – Theories of Learning, Principles of Learning - Motivation – Primary and General Motives, Theories of Motivation – Maslow, Herzberg, Equity Theory, GoalSetting Theory – Expectancy Theory

UNIT 3 **10 hours**

Foundations of Group Behavior - Nature of Groups – Structure, Types, Stages of Group Development - Group Decision-Making – Groups vs. Individual, Groupthink, Group shift, Group Decision-Making Techniques.

UNIT 4 **10 hours**

Managing Group Behavior - Leadership – Nature and Importance, Theories-Trait theories, Behavioral Theories, Contingency Theories - Understanding Work Teams – Nature of Teams, Types of Teams, Effectiveness of Teams, Team Building - Conflict – Intrapersonal and Interpersonal Conflict

UNIT 5 **8 hours**

Foundations of Organizational Behavior - Organizational Structure – Work Specialization, Departmentalization - Span of Management, - Organizational Culture: Nature – Creating and Maintaining a Culture.

Textbooks:

1. Robbins S., JudgeT.A.Vohra N (2013), *Organizational Behavior*, New Delhi: Pearson Education.

References:

1. Moorehead and Griffin (2013),*Organizational Behavior*, New Delhi: AITBS.
2. Archana Tyagi (2011), *Organizational Behaviour*, New Delhi: Excel Books.
3. Gangadhara Rao, V.S.P. Rao &Narayana (2001), *Organizational Behaviour,* New Delhi: Konark Publishers. (Latest edition)
4. Newstrom & Keith Davis (2012), *Organizational Behaviour*, New Delhi: Tata Mc-Graw Hill Publishing Co.Ltd.

Course Outcomes:

1. To acquaint the students with the characteristics of human behavior in corporations and other organizations.

2. To explain various leadership, group dynamics, and employee incentive philosophies.

3. To describe organizational strategy, analyze organizational design and structure, and assess organizational culture.

4. To demonstrate changing and learning about teamwork and collaboration.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1											
CO2											
CO3											
CO4											

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :19-05-2022<< date >> **ACADEMIC COUNCIL: 1st April, 2022**

SDG No. & Statement: 8 Decent Work and Economic Growth

SDG Justification: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

HRMG1001	PRINCIPLES AND PRACTICE OF MANAGEMENT	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

One of the most important human activities is managing. Management can be traced back to ancient times whenever there was large-scale endeavor like great pyramids in Egypt, the Great Wall of China, Taj Mahal in India. All these required many people working in groups in a better-coordinated way to achieve a well-defined target over some time. In the present context, of globalization, because of the increasing role of large and complex organizations in the development of the economy, the concept of Management has become very significant for managing the business efficiently.

Course Educational Objectives:

- To understand theoretical aspects, processes and principles, the scope of Management and its application to modern management practice.
- To analyze how the field of Management has evolved and its significant contributions
- To learn various organizational structures and types for the optimum utilization of the available resources.
- To apply leadership theories and demonstrate leadership styles to getting things done through people.
- To validate various controlling techniques to enhance managerial practices to accomplish the predetermined goals of the organization.

UNIT 1 Management Nature and Concept 10 hours

Nature, Concept, Scope and Significance; Functions; Management: Art or Science or Profession;

Organization vs Administration vs Management, Schools of Management: Contributions of F.W. Taylor, Henry Fayol, Elton Mayo; Roles of Managers; Social Responsibility and Business Ethics.

UNIT 2 Planning 9 hours

Concept, Objectives, Types, Steps and Techniques; Making Planning Effective; Decision Making: Steps in Decision Making and Types; Management by Objectives (MBO).

UNIT 3 **Organizing** **10 hours**

Structure, Nature, Types of Organizations, Principles of Organizing; Departmentalization; Delegation; Decentralization of Authority; Span of Control - Line and Staff Functions; Staffing: Concept, Significance and Functions.

UNIT 4 **Leading** **9 hours**

Introduction, Characteristics of a Leader, Functions of a Leader; Leadership and Management; Principles of Leadership, Styles of Leaders.

UNIT 5 **Controlling** **9 hours**

Introduction, Concept of Controlling, Purpose of Controlling; Types of Control; Steps in Controlling; Techniques in Controlling.

TextBooks:

1. Harold Koontz & Heinz Weirich (2012), Management, a Global and Entrepreneurial Perspective, New Delhi: Tata McGraw Hill Publishing company.

References:

1. Dipak Kumar Bhattacharyya (2012), Principles of Management: Text and Cases, New Delhi: Pearson Publications.
2. Balasubramanian. N. (2012), Management Perspectives, New Delhi: MacMillan India Ltd.
3. Charles Hill, Steven Mc Shane (2012), Principles of Management, New Delhi: Tata Mac Graw Hill
4. Ricky W. Griffin (2012), Management, New Delhi: Cengage Learning.
5. Terry and Franklin (2011), Principles of Management. New Delhi: AITBS Publishers.
6. Robert Kreitner (2012), Principles of Management. New Delhi: Cengage, South-Western12 E

Course Outcomes:

1. can apply different managerial roles in Business organization
2. explain the importance of MBO in organization
3. aware the concept and principles of Organizing
4. analyze and apply different leadership styles
5. understand the concept and purpose of Controlling in Organizations

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PSO2	PSO3	PSO4
CO1											
CO2											
CO3											
CO4											
CO5											

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :28TH APRIL, 2021 **ACADEMIC COUNCIL: 1ST APRIL, 2022**

SDG No. & Statement:

SDG Justification:

The modules and topics mentioned in this course are designed to ensure quality management education which helps lifelong learning in understanding and managing the challenges of changes in the dynamic business environment.

Programme Core

EECE1011	ELECTRONICS WORKSHOP	L	T	P	S	J	C
		0	0	2	0	0	1
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This workshop will enable the student to know the basics of electronic components and devices, their identification and selection for a given circuit. This lab makes the student to operate and use electronic devices, wire and fabricate various circuits on his own. The testing of the circuits wired / fabricated can be tested with the knowledge of various sources and power supplies introduced. Mini project is carried out towards end of the lab, which will inculcate good practice of hands on experience and experiential learning.

CourseEducational Objectives:

- To introduce and make use of Active and Passive electronic components.
- To impart knowledge of regulated power supplies, function generators and CRO and their applications.
- To enable wiring / soldering practice simple electronic circuits using various components on breadboard / PCB.
- To teach students about Diode as a switch, transistor as a switch and hardware components of a simple computer.
- To introduce solar panels and their wiring.
- To introduce hardware components like SMPS, switches, ports, input and output devices of a simple computer.
- To wire and test a mini project.

List of Experiments

1. Study of resistance color codes, identification of active and passive electronic components.
2. Study and use of bread board trainer kit.
3. Study of multimeter, oscilloscope, function generation and regulated power supply.
4. Soldering of electronic components on PCBs.
5. Study of battery types, specifications, construction and ratings.
6. Study of semiconductor device (Diodes, Transistors, Thyristors) functionality and specifications
7. Study of Optoelectornic Devices (LEDs, Photoresistors, Photodiodes, Phototransistors)

8. Study of Basic Filter types and their design issues
9. Study of Voltage Regulators and Power Supplies
10. Study of Audio Electronic Circuits (Microphones, Preamplifiers, Mixer circuits)
11. Embedded System design with Arduino and Arduino IDE

Case Studies/Mini Projects
Any three design projects related to

- Power Supply Design
- Amplifier Design
- Signal Source Design
- Filter Design
- Electromechanical Design
- Arduino

TextBooks:

1. Louis E. Frenzel, Jr., Practical Electronic Design for Experimenters, Mc Graw Hill Publishers, 2020

References:

1. Paul Scherz, Simon Monk, Practical Electronics for Inventors, 4/e, Mc Graw Hill Publishers, 2021

CourseOutcomes:

After completion of this course, the student will be able to

1. decode the resistance / inductance / capacitance values & tolerances (L4).
2. understand and use RPS, voltmeter, ammeter, multimeter, function generator and CRO (L4).
3. study and use breadboard for various circuit wiring (L5).
4. fabricate simple circuits on a PCB and test them (L6).
5. understand various hardware parts of a computer (L2).
6. complete a mini project using Arduino and test it (L6).
7. List various electronic devices and list their specifications (L2)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE1021	SIGNALS AND SYSTEMS	L	T	P	S	J	C
		2	1	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	MATLAB, Transform Techniques						

Course Description:

Signals contain information about the behaviour or nature of some phenomenon and are functions of one or more independent variables. A system processes the signal for producing desired behaviour. Signal processing plays an extremely important and continually growing role in areas of science and technology such as communications, aeronautics and astronautics, acoustics, seismology, biomedical engineering and speech processing. This course introduces the basic concepts and mathematical tools required for signal processing..

Course Educational Objectives:

- To explain the mathematical representation /classification of continuous-time and discrete-time signals and systems
- To provide an understanding of characterization of linear-time invariant systems using impulse response and convolution function
- To familiarize the application of Fourier series, Fourier transform and their properties to continuous-time and discrete time signals and systems
- To impart the knowledge of Laplace and Z-transform and their properties to analyse continuous-time and discrete-time signals respectively.

UNIT 1 **Signals and Systems** 8 hours

Signals and Systems: continuous-time and discrete-time signals, transformations of the independent variable, exponential and sinusoidal signals, the unit impulse and unit step functions, continuous-time and discrete-time systems, basic system properties

UNIT 2 **Linear Time Invariant Systems** **7 hours**

Discrete-time LTI systems: the convolution sum, continuous time LTI systems: the convolution integral, properties of linear time-invariant systems

UNIT 3 Fourier analysis of Continuous Time Signals and Systems 9 hours

Fourier series representation of continuoustime periodic signals, convergence of the Fourier series, properties of continuous-time Fourier series (CTFS).Representation of Aperiodic signals: the continuous-time Fourier transform (CTFT), the Fourier transform for periodic signals. properties of the continuous-time Fourier transform, systems characterized by linear constant-coefficient differential equations.

UNIT 4 Fourier analysis of Discrete Time Signals and Systems 9 hours

Representation of aperiodic signals: the discrete-time Fourier transform, properties of the discrete-time Fourier transform, the Fourier transform for periodic signals, systems characterized by linear constant-coefficient difference equations.

UNIT 5 Analysis of CT and DT signals using Laplace/Z-Transform 7 hours

The Laplace Transform: the region of convergence (roc) for Laplace transforms, the inverse Laplace transform, properties of the Laplace transform.The Z-Transform: The region of convergence for the z-transform, the inverse-z transform, properties of the z-transform.

Simulation Assignments
This course shall involve at least 5 simulation assignments based on (but not limited to)

- Basics of MATLAB
- Generation of Continuous Time signals and Discrete Time Sequences
- Implementation of Continuous-Time and Discrete-Time Systems
- Reconstruction of Continuous Time Periodic Signals from their Fourier Series Coefficients
- Filtering and Fourier Transform Analysis of Continuous Time Signals

Textbooks:

1. Alan V. Oppenheim, S. Willsky with S.Hamid Nawab, Signals and Systems, 2/e, Pearson Education, 1997.

References:

1. Bhagawandas P. Lathi, Linear Signals and Systems, Oxford University Press, 2009

2. Simon Haykin, Barry Van Veen, Signals and Systems, 2/e, Wiley Student Edition, 2007

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Describe the mathematical model of continuous - time/discrete - time signals and systems and perform mathematical operations on signals (L2)
2. Determine the output response of continuous time/ discrete time LTI system using convolution integral and convolution sum (L2).
3. Analyse the characteristics of linear – time invariant systems(L4).
4. Derive the frequency domain representation of signals and systems using transform techniques(L3).
5. Determine the output response of LTI systems using CTFT and DTFT(L2).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE1031	NETWORK THEORY AND ANALYSIS	L	T	P	S	J	C
		2	1	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	EECE1001: Basic Electrical and Electronics Engineering						

Course Description:

This course aims to develop the basic concepts of network analysis, which are the pre-requisites for all the electronics engineering courses. The course deals with understanding various network reduction techniques such as source transformation, network theorems and apply these techniques to simplify different complex R-L-C networks. Design techniques of resonant circuits is imparted. Analysis and synthesis of two-port networks are dealt. Transient Response of complex electrical systems and design of stable system is also elaborated.

Course Educational Objectives:

- To impart knowledge about solving different complex circuits using various network reduction techniques such as source transformation, network theorems.
- To explain the analysis AC and DC transient response for complex R-L-C circuits.
- To familiarize AC steady state response for complex R-L-C series and parallel circuits and to analyze the circuits.
- To distinguish between series and parallel resonance and design resonant circuits.
- To acquaint the students with evaluation of two port network parameters.

UNIT 1 Introduction 8 hours

Introduction: Ohms law, Kirchoff's laws, series and parallel circuits, source transformations, delta-wye conversion, linearity and superposition theorem with simple examples, Thevenin's and Norton's theorem with simple examples, maximum power transfer theorem with simple examples. mesh, super mesh analysis, nodal, super node analysisdiscrete-time systems, basic system properties.

UNIT 2 Time Domain Analysis of Circuits 7 hours

Time domain analysis of circuits: transient analysis of first order and second order systems, initial and final conditions in networks. dc transients: source free and forced response of RL, RC and RLC circuits analysis using Laplace transform.

UNIT 3 Sinusoidal Steady-State Analysis 9 hours

Sinusoidal Steady-State Analysis: sinusoids, sinusoidal functions and complex functions, instantaneous power, average power, effective values of current and voltage, apparent power and power factor, complex power, phasors, phasor relationships for R, L and C and steady state analysis of RL, RC and RLC circuits.

UNIT 4 Resonance 9 hours

Series resonance, parallel resonance, bandwidth, selectivity, quality factor

UNIT 5 Two Port Networks 7 hours

Impedance parameters, admittance parameters, hybrid parameters and transmission parameters, relationships between parameters.

Textbooks:

1. M.E.VanValkenburg, Network Analysis, 3/e , Pearson Education, 1974
2. Sudhakar, ShyammohanS.Palli, Circuits & Networks: Analysis and Synthesis, 3/e, Tata McGraw Hill Publication, 2006.

References:

1. William H Hayt, Jack E Kimmerly and Steven M.Durbin, Engineering Circuit Analysis, 8/e, Tata McGraw Hill, 2013
2. A. Chakrabarti, Circuit Theory: Analysis & Synthesis, 3/e, Dhanpat Rai & Co, 2013.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. analyze basic AC and DC circuits using nodal, mesh analysis and network theorems, retransformation and several methods of simplifying networks .
2. understand the concept of graphical solution to transient electrical network in time domain analysis and apply Laplace Transform for steady state and transient analysis.
3. analyze sinusoidal or AC response of circuits and determine power and power factor of circuits
4. distinguish between series resonance and parallel resonance concepts and performance parameters
5. derive two port network parameters Z, Y, ABCD, h and their interrelationships and determine for different network functions (L6).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22^{nd}AC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE1041	ELECTRONIC DEVICES AND AMPLIFIER CIRCUITS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	EECE1001: Basic Electrical and Electronics Engineering, EECE1031: Network Theory and Analysis						
Preferable exposure	None						

Course Description:

Alternate Exposure : This course familiarizes the student with structure, operation, modelling and design of semiconductor devices and circuits. Laboratory experiments of this course includes hardware experiments, SPICE simulations and end-to-end circuit design using EDA/PCB design software. Study of these basic circuits is helpful to train the student to designamplifier circuits, digital switches and balanced amplifiers

Course Educational Objectives:

- To introduce the physical construction of bipolar junction transistors (BJTs) and metal oxide field effect transistors (MOSFETs)
- To impart the knowledge on design and simulation of current mirror circuits
- To familiarize the analysis of the input impedance, output impedance, voltage gain and bandwidth of MOSFET amplifier configurations.
- To explain the analysis and design of differential amplifiers
- To expose the student to semiconductor technology evolution, amplifier design principles and circuit analysis techniques

UNIT 1 — Bipolar Junction Transistors — 8 hours

Bipolar Junction Transistors: device structure and physical operation, current-voltage characteristics, the BJT as an amplifier and as a switch, BJT circuits at dc, biasing in BJT amplifier circuits, small-signal operation and models.

UNIT 2 — MOS Field-Effect Transistors — 7 hours

Device structure and physical operation, current-voltage characteristics, MOSFET circuits at dc, the MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits, small signal operation and models.

UNIT 3 **IC Design Philosophy** **9 hours**

IC Design Philosophy: comparison of the MOSFET and the BJT, IC biasing-current sources, current mirrors and current-steering circuits, current-mirror circuits with improved performance

UNIT 4 **Single Stage MOSFET amplifiers** **9 hours**

Single Stage MOSFET Amplifiers: basic MOSFET amplifier configurations, MOSFET internal capacitances and high frequency model, frequency response of the CS amplifier, discrete circuit MOS Amplifiers

UNIT 5 **Differential Amplifiers** **7 hours**

Differential Amplifiers: the MOS differential pair, small-signal operation of the MOS differential pair, other non-ideal characteristics of MOS differential amplifier, the MOS differential amplifier with active load.

ELECTRONIC DEVICES AND AMPLIFIER CIRCUITS LABORATORY

List of Experiments:

1. Current-Voltage Characteristics of BJT / Measurement of scale current & common emitter current gain.
2. Measurement of small signal parameters (gm, ro, rπ, re) of BJT at a given operating point Ic.
3. Design, Simulate and Implement BJT amplifier and Inverter logic gateCurrent-Voltage Characteristics of MOSFET / Measurement of threshold voltage.
4. Measurement of small signal parameters (gm, ro, gmb) of MOSFET at a given operating point (Id,Vds).
5. Design and simulation of basic NMOS current mirror, cascode NMOS current mirror and current steering circuit.
6. Design, Simulation and Implementation of Common Source Amplifier for Gain, Power dissipation requirements.
7. Design, Simulation and Implementation of Common Drain Amplifier (Voltage Buffer) for Gain, Output Impedance, Level Shift requirements.
8. Analysis and Verification of Basic NMOS Differential Pair for Gain, Input Common Mode Range, Maximum Input differential voltage requirements.
9. Design, Simulation and Implementation of Differential Amplifier with active current mirror load for gain, power dissipation CMRR requirements.
10. Design, Simulation and PCB fabrication of BJT Astable Multivibrator Circuit.

Textbooks:

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013

References:

1. Behzad Razavi, Fundamentals of Microelectronics, 2/e, Wiley Student Edition, 2013
2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, 10/e, Pearson Education, 2009
3. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Describe the device structure/physical operation, analyze BJT/MOSFET circuits using their large signal and small signal models (L1).
2. Distinguish between discrete component circuit design and integrated circuit design and appreciate the relative merits and demerits of BJT and MOSFET devices (L2).
3. Design current mirror circuits given the output resistance, voltage headroom and output current requirements (L5).
4. Derive the low frequency and high frequency characteristics of common source, common gate, common drain amplifiers (L4).
5. Analyze and design differential amplifier circuits for gain and linearity requirements (L4/L6).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE2001</td><td rowspan="2">RANDOM SIGNALS AND NOISE</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>0</td><td>2</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">MATLAB, EECE1021: Signals and Systems</td></tr>
</table>

Course Description:

This course allows characterization of randomness in measured quantities and signals. This characterization allows modelling of noise sources in communication systems and further helps in designing analog and digital communication systems that transfer information in the presence of noise

Course Educational Objectives:

- To introduce the notion of probability as a tool to characterize random events.
- To impart the knowledge of characterizing and modeling random measurements as random variables.
- Model random signals as random processes and characterize them in time domain and frequency domain.
- To explain the classification of noise sources and modelling of noise performance of systems.
- To expose the student to mathematical tools involved in analysing

UNIT 1 Probability and Random Variables 8 hours

Basics of Probability, Conditional Probability, Random Variables, Functions of a Single Random Variable, Mean, Variance, and Characteristic Function, Functions of Two Random Variables, Jointly Gaussian Random Variables, Central Limit Theorem.

UNIT 2 Random Processes 12 hours

Random Processes: Basic Concepts, Description of Random Processes, Statistical Averages, Stationary Processes, Random Processes and Linear Systems, Random Processes in the Frequency Domain: Power Spectrum of Stochastic Processes, Transmission over LTI Systems, Gaussian and White Processes, Gaussian Processes, White Processes

UNIT 3 **Characterization of Noise** **10 hours**

Noise – Sources and Classification, Thermal Noise, Shot Noise, Noise Equivalent Bandwidth of a Filter, Noise Figure and Equivalent Noise Temperature of Two-Port Networks, Narrowband Noise Representation.

Simulation Assignments

This course shall have the below simulation assignments (but not limited to)

a) Generation and Histogram evaluation of uniformly distributed and Gaussian distributed random numbers and plotting their histograms

b) Generation of discrete random variables with a specified probability mass function

c) Analyse the effect of transformation of random variables (both analytical and simulation approaches)

d) Model a given random measurement as one of the known random variables and identify the parameters

e) Compute the autocorrelation function and power spectral density of random signals at the input and output of a linear system

Textbooks:

1. P. Ramakrishna Rao, Communication Systems, 2/e, Tata Mcgraw Hill Publications, 2018.
2. Proakis, Salehi, Communication Systems Engineering, 2/e, Pearson Education, 2010

References:

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.
2. Athanasios Papoulis, S. Unnikrishna Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.
3. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Characterize random events and measurements using probability and random variables (L3)
2. Model random signals as random processes and describe their characteristics using autocorrection function and power spectral density functions respectively (L4)
3. Identify different sources of noise in electronic systems (L2)
4. Characterize electronic systems by their noise figure and noise temperature
5. Use the notion of noise measures to carry out link budget analysis of communication links

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE2011	ANALOG COMMUNICATIONS	L	T	P	S	J	C
		2	0	0	0	0	2
Pre-requisite	None						
Co-requisite	EECE2001: Random Signals and Noise						
Preferable exposure	MATLAB, EECE1021: Signals and Systems						

Course Description:

This course reviews the properties of Fourier Transform and exposes the fundamental concepts of modulation. Analog modulation schemes involving amplitude, angle are reviewed followed their implementation aspects in broadcasting systems

Course Educational Objectives:

- To introduce the need for modulation to communicate signals
- To familiarize the generation and detection of different analog modulation schemes
- To impart knowledge of specifications and real-world applications of analog broadcasting systems
- To expose the noise performance analysis and comparison of analog modulation schemes.

UNIT 1 Fourier Transforms and Signal Transmission Through Systems 3 hours

Electromagnetic Spectrum, Ranges and Application Areas , Continuous-Time Fourier Transform, Convolution and Correlation, Hilbert Transform, Signal Transmission through Systems. Need for Modulation

UNIT 2 Amplitude Modulation 10 hours

Amplitude Modulation, Demodulation of AM Signals, AM Broadcast Transmitters, AM Broadcast Receivers, Double Sideband Suppressed Carrier (DSB-SC) Modulation, Single Sideband Modulation, Single Sideband Transmission and Reception, Compatible Single Sideband (CSSB) System, Communication Receivers, Vestigial Sideband Modulation, Comparison of Various Varieties of Amplitude Modulation

UNIT 3 Angle Modulation 10 hours

Angle Modulated Signals, Narrowband Angle Modulation, Spectrum of an Angle-Modulated Signal, Power of an Angle-Modulated Signal and Effective Bandwidth, Generation of Wideband Angle-Modulated Signals, effects of Channel Non-Linearities on FM Signals, Detection of FM Signals, FM Broadcasting, FM Transmitters and Receivers, Radio and Television Broadcasting: AM Radio Broadcasting, FM Radio Broadcasting, Television Broadcasting

UNIT 4 Noise in Analog Communication Systems 4 hours

Noise Performance of AM and FM Systems, Effects of Transmission Losses and Noise in Analog Communication Systems

Simulation Assignments

This course shall involve simulation experiments on the below topics (but not limited to)

a) Modulation Property of Fourier Transform

b) Generation of Amplitude Modulated waveforms with different modulation index

c) Simulink modelling of Amplitude and Phase Modulation Generation/Detection schemes

d) Time-Domain and Frequency Domain Analysis of different analog modulation schemes

Textbooks:

1. P. Ramakrishna Rao, Communication Systems, 2/e, Tata McGraw Hill Publications, 2018.
2. Proakis, Salehi, Communication Systems Engineering, 2/e, Pearson Education, 2010.
3. Lathi, Modern Analog and Digital Communication Systems, 4/e, Oxford University Press, 2012.

References:

1. Simon Haykin, Michael Moher, Introduction to Analog and Digital Communications, 2/e Wiley, 2007
2. Simon Haykin, Communication Systems 4/e, Wiley, 2001
3. Kennedy,David, Electronic Communication System 4/e, Tata McGraw Hill,2012

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Explain the time domain and frequency domain description of different AM modulations schemes and compare them (L2).
2. Compare various modulation schemes like AM, DSBSC, SSB,VSB in terms of power and bandwidth efficiency (L4).
3. List the specifications and design concerns of broadcasting systems employing analog modulation schemes (L3)
4. Compare the noise performance of different modulation schemes (L3)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE2021	DIGITAL LOGIC DESIGN	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Digital Logic Design is an introductory course which provides the basic concepts involved in the design and analysis of digital circuits for computing systems. A digital circuit is constructed using basic building blocks: logic gates and flip-flops. This course deals with the design of various combinational and sequential circuits used to build more complex computing systems.

Course Educational Objectives:

- To introduce number systems, conversion used for representing numbers in computational structures
- To familiarize the implementation of simple logical operations using Combinational circuits
- To acquaint the student with the design of combinational and sequential logic circuits with practical design examples
- To expose different types of memories used in digital systems
- To impart the design of synchronous and asynchronous digital systems
- To demonstrate the use of standard chips and PLDs in building digital computational structures

UNIT 1 **Binary Systems and Logic Gates** 10 hours

Binary Systems: digital systems, binary numbers, number base conversions, octal and hexadecimal numbers, complements, signed binary numbers, binary codes, binary logic. Boolean Algebra and Logic Gates: basic definitions, axiomatic definition of boolean algebra, basic theorems and properties of boolean algebra, boolean functions, canonical and standard forms, digital logic gates.

UNIT 2 **Simplification of Boolean functions** 10 hours

Simplification of Boolean functions: The map method, four-variable map, five-variable map, product of sums simplification, don’t-care conditions, NAND and NOR implementation, exclusive-OR function

UNIT 3 **Combinational Logic Circuit Design** 6 hours

Combinational Logic: combinational circuits, analysis procedure, design procedure, binary adder-subtractor, decoders, encoders, multiplexers. Memories: random-access memory, memory decoding.

UNIT 4 **Sequential Logic Circuit Design** 9 hours

Synchronous Sequential Logic: sequential circuits, latches, flip-flops, analysis of clocked sequential circuits, state reduction and assignment, design procedure. Registers and Counters: registers, shift registers, ripple counters, synchronous counters, ring counter.

UNIT 5 **Implementation of Digital Logic Circuits** 5 hours

Transistors as Switches, NMOS Logic Gates, CMOS Logic Gates, MOS Implementation of static latches and flipflops. Programmable Logic Devices: Programmable Logic Array, Programmable Array Logic, Complex Programmable Logic Devices, Field Programmable Gate Arrays. FPGA Design Flow

List of Laboratory Experiments:

1. Verification of Truth Tables of Logic gates and implementation of Basic gates using Universal Gates
2. Implementation of the given Boolean functions using logic gates in both SOP and POS form.
3. Simplification of the given Boolean function using K-map and implement using logic gates.
4. Realization and verification of Full adder and Full Subtractor using logic gates.
5. Implementation of the given function using decoder and logic gates.
6. Implementation of the given function using Multiplexer and logic gates.
7. Verification of State Tables of SR, D, JK and T-Flip-Flops.
8. Verify the operation of Shift Registers using D flip-flops.
9. Design and verify the operation of 4-bit and Mod-N Ripple Counters using JK flip-flops.
10. Verilog Modelling and Simulation of 1-bit full adder, 2 X 4 Decoder, Mod-13 Counter.
11. Study of PLA, CPLD, FPGA Datasheets and appreciating their architectural highlights.
12. FPGA Implementation of 1-bit full adder, 2 X 4 Decoder, 4-Bit Counter.

Textbooks:

1. Michael D. Ciletti, M. Morris Mano, Digital Design, 5/e, Pearson Education, 2014
2. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, 7/e, Oxford University Press, 2013

References:

1. ZviKohavi, Switching and Finite Automata Theory, 2/e, Tata McGraw-Hill, 2008
2. John F. Wakerly, Digital Design Principles and Practices, 4/e, Pearson Education, 2008
3. Charles Roth, Jr., Larry Kinney, Fundamentals of Logic Design, 7/e, Cengage Learning, India, 2013.
4. Weste, Harris, CMOS VLSI Design, 4/e, Pearson Education, 2014

Course Outcomes:

Upon successful completion of the course, students will be able to

1. convert any number into different base representations(L2).
2. simplify logic expressions using Boolean laws and realize using basic and universal logic gates(L3).
3. design combinational circuits for the given specifications(L4).
4. design synchronous sequential circuits for the given specifications (L4)
5. differentiate asynchronous and synchronous counters and implement Multiplexers and D flip flops using CMOS technologies(L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE2031</td><td rowspan="2">ANALOG CIRCUITS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">EECE1041: Electronic Devices and Amplifier Circuits</td></tr>
</table>

Course Description:

This course equips the student with design principles of electronic system building blocks including feedback, oscillators, output stages, frequency selective filters, wave shaping circuits. Laboratory experiments of this course shall include hardware experiments, SPICE simulations and end-to-end circuit design using EDA/PCB design software. Skills learnt in this course shall help the student in improving existing circuits using negative feedback, building power Amplifiers, signal processing circuits etc.

Course Educational Objectives:

- To acquaint the students with the advantages and techniques of different negative feedback circuit configurations.
- To introduce the basic principles of oscillator circuits and design/simulate discrete component and op-amp oscillator circuits.
- To impart knowledge on analysis of the linearity, power efficiency and power dissipation of different output stages/power amplifiers
- To explain the basics and design of analog frequency selective filters using Butterworth and Chebyshev approximations
- To demonstrate the design of non-linear wave shaping circuits

UNIT 1 **Feedback** **8 hours**

Feedback Amplifiers: The general feedback structure, properties of negative feedback, basic feedback topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, shunt-shunt and shunt-series feedback amplifiers, determining loop gain.

UNIT 2 **Oscillators** **6 hours**

Oscillators: Basic principles of sinusoidal oscillators, op amp RC oscillator circuits, LC and crystal oscillators.

UNIT 3 Output Stages and Power Amplifiers 7 hours

Output Stages and Power amplifiers: Classification of output stages, class A output stage, class B output stage, class AB output stage, power BJTs, class C output stage, MOS power transistor.

UNIT 4 Analog Filter Design 9 hours

Filter Transmission, Types, and Specification, The Filter Transfer Function, Butterworth and Chebyshev Filters, First-Order and Second-Order Filter Functions, The Second-Order LCR Resonator. Active Filter Design.

UNIT 5 Multivibrator Circuits 7 hours

Bistable Multivibrators, Generation of Square and Triangular Waveforms Using Astable Multivibrators, Monostable Multivibrator, Integrated-Circuit Timers, NonlinearWaveform-Shaping Circuits

List of Laboratory Experiments:

1. Feedback Amplifier - calculation of gain, input resistance, output resistance with and without feedback, frequency response characteristic.
2. Design and Implementation of Two stage RC Coupled amplifier.
3. Oscillators (Colpitts, RC phase-shift, Wein-bridge)
4. Class A power amplifier.
5. Class B Push - pull power amplifier.
6. Tuned voltage amplifier.
7. Analysis and simulation of RC differentiator/integrator
8. Bistable/Monstable/Astablemultivibrators with 555 timer
9. Operational Amplifier Circuits (Adders, Integrators, Differentiators, Filters).
10. Op-amp based AM/FM Modulator/Demodulator Circuits.
11. Data Converters
12. Active Filter Design

Textbooks:

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013.
2. D Choudhury Roy, Shail B. Jain, Linear Integrated Circuits, New Age International, 2003.

3. RamakanthGayakward, Op-Amps and Linear Integrated Circuits, 4/e, Pearson Education, 2007.

References:

1. Behzad Razavi, Fundamentals of Microelectronics, 2/e, Wiley Student Edition, 2013.
2. R.F Coughlin, F.F Driscoll, Op-Amps and Linear Integrated Circuits, 6/e, Pearson Education, 2008.
3. S. Salivahanan, V.S. KanchanBhaskaran, Linear Integrated Circuits, Tata Mc- Graw Hill, 2008.
4. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3/e, Tata Mc-Graw Hill, 2002.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. analyse the characteristics of different negative feedback amplifier configurations (L4).
2. choose and design negative feedback circuits to improve the characteristics of given open loop amplifier (L3).
3. describe the basic principle of sinusoidal oscillators and identify the usage of different oscillator circuits (L1).
4. design analog filters for the given design specification (L5).
5. design different wave shaping circuits for signal processing applications

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE2041	CONTROL SYSTEMS	L	T	P	S	J	C
		2	1	0	0	0	3
Pre-requisite	MATH1021: Transform Techniques						
Co-requisite	None						
Preferable exposure	MATLAB						

Course Description:

In everyday life many applications of control like control of temperature in air conditioners, water level maintenance, steering of car course etc., a never-ending list are encountered. These controls may be manual or automatic. Human body is an excellent example of automatic control system. Control system engineering deals with set of devices that control the behaviour of other devices or systems to achieve desired results. This course introduces the student to the principles and applications of control systems in everyday life.

Course Educational Objectives:

- To expose various concepts of block diagram reduction techniques
- To create mathematical modelling of the system.
- To demonstrate stability of the system in time domain.
- To impart knowledge on stability of the system in frequency domain.
- To get acquainted with state variable analysis.

UNIT 1 Introduction 8 hours

Introduction: Concepts of control systems, different examples of control systems, open loop and closed loop control systems and their differences, block diagram representation of systems considering electrical systems as examples, block diagram algebra, representation by signal flow graph, reduction using Mason's gain formula, feedback characteristics, effects of feedback

UNIT 2 Mathematical Modelling and Control System Components 7 hours

Mathematical Modelling and Control System Components: Introduction to mathematical modelling of physical systems, impulse response and transfer functions, equations of electrical networks, modelling of translational and rotational mechanical systems, time response of first and second order systems with standard input signals, time domain specifications, steady state error and error constants.

UNIT 3 Stability 9 hours

Concept of stability, Routh Hurwitz criterion, construction of root locus, correlation between time and frequency responses, determination of frequency domain specifications, effects of P, PI, PD and PID Controllers.

UNIT 4 Stability of Control Systems 9 hours

Stability of control systems from Bode plots, polar plots and Nyquist plots, all pass and minimum phase systems, numerical examples.

UNIT 5 State Variable Analysis 7 hours

State, state variables, state variable representation, transfer function form to state variable form (diagonal form), state variable form to transfer function form, transfer function form to canonical form.

Textbooks:

1. Benjamin C. Kuo, Automatic Control Systems, 7/e , Prentice Hall of India, 1997
2. M. Gopal, Control Systems Engineering, 3/e, Wiley Eastern Ltd., TMH, 2008.

References:

1. Ogata, Modern Control Engineering , 2/e, Prentice Hall of India, 2011.
2. R.C. Sukla, Control Systems, 3/e, Dhanpatrai and Sons,1998.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Solve numerical on block diagrams reduction techniques (L3)
2. Represent the mathematical model of a given system (L2).
3. Determine the response of different order systems for various step inputs (L4).
4. Analyse the stability of the system (L4).
5. Comprehend solution of state equation (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE2051	ELECTROMAGNETIC WAVES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	MATH1011: Several Variable Calculus						
Co-requisite	None						
Preferable exposure	MATLAB						

Course Description:

The concept of electromagnetism is evolved from static electric and magnetic fields when time is added as fourth dimension. Electromagnetism is the principle with which all electrical machines function. Electromagnetism is used as a mode of propagation of energy at very frequencies. This is a foundation course for understanding the concept of wave transmission in free space or in any media carrying data / message / voice / audio from transmitter to receiver.

Course Educational Objectives:

- To demonstrate the concepts of static electric and magnetic fields and their importance in electromagnetics
- To impart the knowledge of basic characteristics of an electromagnetic field.
- To explain the principle of transmission of energy using electromagnetic wave
- To familiarize the electromagnetic fields and mechanism of transmission of energy in free space / dielectric medium

UNIT 1 Electrostatics 8 hours

Electrostatics: Coulomb's law, electric field intensity, field due to a line charge, electric flux density, Gauss's law, electric potential, potential gradient, energy stored, Laplace's and Poison's equations

UNIT 2 Magnetostatics 7 hours

Magnetostatics: steady current, Biot-Savart's law, static magnetic field due to line current, magnetic flux density, Ampere's circuital law, Lorentz force equation, magnetic vector potential, energy stored.

UNIT 3 Time-varying fields and Maxwell's equations 9 hours

Time-varying fields and Maxwell's equations: time varying fields, Faraday's law of electromagnetic induction, displacement current, Maxwell's equations in point form and integral form, boundary conditions of electromagnetic fields, polarization, magnetization.

UNIT 4 Uniform Plane Wave: 9 hours

Uniform Plane Wave: wave equation, wave propagation in free space, wave propagation in conductor and dielectrics, Poynting theorem, skin effect, wave polarization, direction cosines.

UNIT 5 Plane Waves at Boundaries and in Dispersive Media 7 hours

Plane Waves at Boundaries and in Dispersive Media: reflection of uniform plane waves by perfect conductor – normal and oblique incidence, standing wave ratio, reflection and transmission of uniform plane waves by perfect dielectric – normal and oblique incidence.

Textbooks:

1. William H. Hayt, Engineering Electromagnetics, 8/e, Tata McGraw Hill, 2012.
2. Matthew N.O. Sadiku, Elements of Electromagnetics, 4/e, Oxford University Press, 2014.

References:

1. E. C. Jordan, EM Waves and Radiating Systems, PHI, 2/e Prentice Hall, 2012
2. David K. cheng, Field and Wave Electromagnetics, 2/e, Pearson Education, 1989
3. Electromagnetics with Applications, J.D. Kraus, D. A. Fleish, 5/e, McGraw Hill, 1999

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Apply vector calculus to understand the behaviour of static electric fields in standard configurations. (L3)
2. Apply vector calculus to understand the behaviour of static magnetic fields in standard configurations. (L3)
3. Describe and analyze electromagnetic wave propagation in free-space, conductor and dielectric media. (L2)
   justify the concept of electromagnetic waves in terms of transporting energy or information (L6)

4. Describe the reflection of plane wave at normal and oblique incidence in free space and dispersive media (L4).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

		L	T	P	S	J	C
EECE3001	**DIGITAL SIGNAL PROCESSING**	**3**	**0**	**2**	**0**	**0**	**4**
Pre-requisite	EECE1021: Signals and Systems						
Co-requisite	None						
Preferable exposure	MATLAB, Python						

Course Description:

Unprecedented developments in the interpersonal communications and on demand entertainment is enabled with the Digital Signal Processing (DSP) engineering. DSP is the heart of digital revolution that brought music players, mobile phones, etc. into every walk of common man life. It unified the electronics, communications, and computer science. All electronic systems today use powerful DSP concepts as their foundations. A thorough understanding of digital signal processing fundamentals and techniques is imparted in this course.

Course Educational Objectives:

- To introduce the frequency analysis of discrete time LTI systems
- To identify different hardware structures for IIR systems
- To explain the numerical computation of DFT / FFT along with their properties and applications
- To expose the design of IIR filters
- To expose the design of FIR filters

UNIT 1 **Discrete Time Systems** 8 hours

Transform Analysis of Discrete Time LTI Systems: Frequency response of LTI systems. System Functions for Systems Characterized by Linear Constant Coefficient Difference Equations: Stability, causality, impulse response for rational system functions. Structures for IIR Discrete Time Systems: Direct, parallel and cascade form.

UNIT 2 **Discrete Fourier Transform** 7 hours

The Discrete Fourier Transform (DFT): Representation of periodic sequences. The discrete Fourier series, Fourier representation of finite duration sequences, the discrete Fourier Transform (DFT), computation of DFT, properties of the DFT, circular convolution and linear convolution using DFT, overlap-add method, overlap-save method.

UNIT 3 **Fast Fourier Transform** 5 hours

Fast Fourier Transform (FFT): Radix-2 decimation-in-time and decimation-in-frequency FFT algorithms, inverse FFT.

UNIT 4 **Design of IIR Filters** 9 hours

Design of IIR Filters: Design of analog prototypes from digital filter specifications using Butterworth and Chebyshev approximations, design of IIR filters from analog filters, Butterworth filters and Chebyshev filters design using impulse invariance, bilinear transformation

UNIT 5 **Design of FIR Filters** 8 hours

Design of FIR Filters: Linear discrete time systems with generalized linear phase, design of linear phase FIR filters using window functions (rectangular, Hamming, Hanning, Blackman and Kaiser) frequency sampling technique.

List of Laboratory Experiments:

Part 1: Digital Signal Processing System Design/Simulation with MATLAB (Using MATLAB/Octave/Python)

1. Generation of discrete time signals in time domain.
2. Implementation of discrete time systems in time domain.
3. Frequency analysis of discrete time signals using DTFT.
4. Frequency analysis of discrete time systems using DTFT
5. Discrete Fourier transform (DFT) and properties
6. FIR filter design.
7. IIR filter design.

Part 2: Real-Time Digital Signal Processing Implementation (Using TMS320C6478 LCDK Kit)

1. Study of TMS320C6478 DSK and code composer studio.
2. Sinusoidal waveform generation.
3. FIR filter implementation on LCDK Kit.
4. IIR filter implementation on LCDK Kit.
5. Mini project on DSP (Example: DTMF generation and detection using correlation processing/FFT).

Textbooks:

1. A.V. Oppenheim, R. W. Schafer, Digital Signal Processing Prentice Hall of India, 2004.

References:

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4/e, Pearson Education, 2007.
2. Sanjay K. Mitra, Digital Signal Processing- A Computer Based Approach, 4/e, Tata Mc Graw Hill Publications, 2011
3. Ifeachor E.C, Jervis B.W, Digital Signal Processing – A Practical Approach, 2/e, Pearson Education, 2002

Course Outcomes:

Upon successful completion of the course, students will be able to

1. list the advantages of digital signal processing over analog signal processing (L1)
2. describe discrete time signals and generate them using MATLAB
3. describe the frequency domain analysis of discrete time signals and systems and carry out the analysis using MATLAB
4. realize a digital filter in different forms and compare their complexity
5. compute the DFT/IDFT of a sequence and understand the complexity issues
6. design a digital FIR/IIR filter for given design specification and implement design using MATLAB

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE3011	DIGITAL COMMUNICATIONS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	EECE1021: Signals and Systems						
Co-requisite	None						
Preferable exposure	MATLAB, EECE2011: Analog Communications						

Course Description:

Noise-free and reliable long-distance communication has become a reality due to the advances in digital communications. This course introduces the process of analog-to-digital conversion and elaborates on techniques communicating digital data in both power limited and bandlimited channels. Noise performance of various digital modulation schemes is also introduced to create insight on choice of proper digital modulation technique for a particular application

Course Educational Objectives:

- To expose the student to advantages of digital communication over analog communications
- To represent information in analog signal using digital samples using sampling, quantization and encoding
- To elaborate the Understanding Inter Symbol Interference and methods to mitigate its effect
- To expose the student to digital passband modulation techniques and illustrate power vs bandwidth trade-offs
- To compare the noise performance of different digital modulation schemes

UNIT 1 Analog to Digital Conversion 8 hours

Advantages of Digital Communication over Analog Communication Systems. Analog to Digital Conversion: sampling process, pulse modulation schemes- pulse amplitude, pulse width, pulse position modulation. pulse code modulation (PCM), differential pulse code modulation, delta modulation, time division multiplexing.

UNIT 2 Baseband Transmission Of Digital Data 7 hours

Baseband Transmission of Digital Data: The Intersymbol Interference Problem, The Nyquist Channel, Raised-Cosine Pulse Spectrum, Baseband Transmission of M-ary Data, The Eye Pattern.

UNIT 3 Digital Band-Pass Modulation Techniques 9 hours

Binary Amplitude-Shift Keying, Phase-Shift Keying, Frequency-Shift Keying, Summary of Three Binary Signalling Schemes, Noncoherent Digital Modulation Schemes, M-ary Digital Modulation Schemes, Mapping of Digitally Modulated Waveforms onto Constellations of Signal Points.

UNIT 4 Noise in Digital Communications 5 hours

Bit Error Rate, Detection of a Single Pulse in Noise, Optimum Detection of Binary PAM in Noise, Optimum Detection of BPSK, Detection of QPSK and QAM in Noise, Optimum Detection of Binary FSK, Differential Detection in Noise, Summary of Digital Performance

UNIT 5 Spread Spectrum and OFDM Communication Techniques 8 hours

Spread Spectrum Modulation: Pseudo-noise sequences, notion of spread spectrum, direct sequence spread spectrum with coherent binary phase shift keying, Frequency hop spread spectrum. Introduction to Orthogonal Frequency-Division Multiplexing, Modulation and Demodulation in an OFDM System, Applications of OFDM.

List of Laboratory Experiments:

1. MATLAB Simulation of Sampling and reconstruction of analog signals.
2. MATLAB Implementation of Uniform Quantizer and quantization noise analysis
3. MATLAB Simulation of DPCM scheme
4. PCM transmission
5. Simulation of Baseband Transmission and Equalization using MATLAB Simulink
6. MATLAB Simulink modelling of ASK Generation and Detection
7. MATLAB Simulink modelling of PSK Generation and Detection
8. MATLAB Simulink modelling of FSK Generation and Detection
9. Simulation and Noise Performance Analysis of Digital modulation schemes using MATLAB/Simulink/ LABVIEW/MULTISIM.
10. Real-Time Implementation of Digital Modulation Schemes on SDR Kits

11. MATLAB Implementation of Spread Spectrum and Orthogonal Frequency Division Multiplexing Systems

Textbooks:

1. Simon Haykin, Michael Moher, Introduction to Analog and Digital Communications, 2/e Wiley, 2007.
2. Proakis, Salehi, Fundamentals of Communication Systems, 2/e, Pearson Education, 2017

References:

1. Simon Haykin, Communication Systems 4/e, Wiley, 2001.
2. Proakis, Salehi, Communication Systems Engineering, 2/e, Pearson Education, 2010.
3. P. Ramakrishna Rao, Communication Systems, 2/e, Tata Mcgraw Hill Publications, 2018.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Describe the sampling of analog signals and their reconstruction in time and frequency domain
2. Explain the time division multiplexing of analog telephone signals using pulse code modulation
3. Describe the different carrier modulation schemes and compare their BER performance and bandwidth requirements
4. Derive the Nyquist criterion for distortion less baseband transmission.
5. Distinguish between band-limited and power–limited systems and their constraints.
6. Describe the generation and detection of DS and FH spread spectrum, OFDM systems

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3022</td><td rowspan="2">ANTENNA ANALYSIS AND DESIGN</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">EECE2051: Electromagnetic Waves</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">MATLAB</td></tr>
</table>

Course Description:

In today's world, all modes of communications are tending towards wireless. Any wireless device is to be equipped with antenna, which converts the energy suitably for radiation into free space or vice versa. Concepts of radiation and various types of antennas based on various classifications are introduced in this course. Synthesis of antennas, that is, building an antenna array for generating a desired radiation pattern is also presented.

Course Educational Objectives:

- To introduce the basic characteristics and fundamental parameters of antennas
- To familiarize the concepts of wire antennas
- To acquaint the student with knowledge of high frequency antennas
- To impart knowledge about types of antenna arrays and their analysis and synthesis
- To introduce antennas for mobile communications

UNIT 1 **Antenna Characteristics** 5 hours

Introduction, historical advancements, types, radiation mechanism, review of fundamental parameters – radiation pattern, power density, intensity, directivity, gain, beam width, band width, efficiency, polarization, impedance, effective height, equivalent areas, Friis transmission equation

UNIT 2 **Wire Antennas** 5 hours

Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area and Effective Height, Natural Current Distributions, Far Fields

UNIT 3 **Aperture Antennas** 5 hours

Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, Endfire Arrays, EFA with

Increased Directivity, BSAs with Non-uniform Amplitude Distributions – General Considerations and Binomial Arrays.

UNIT 4 **Antenna Arrays and Synthesis** 9 Hours

Antenna Synthesis: Introduction, Continuous Sources, Schelkunoff Polynomial Method and Fourier transform Method

UNIT 5 **Antennas for Mobile Applications** 8 hours

Antennas for Mobile Communication: Introduction, Characteristics of MSAs, Feeding Techniques, Methods of Analysis Regularly Shaped Broadband MSAs: Introduction, RMSAs

Text Books:

1. Contantine A. Balanis, Antenna Analysis and Design, 3/e, Wiley Publications, 2009.
2. Broadband Microstrip Antennas, Girish Kumar,K. P. Ray, Artech House antennas and propagation library)

References:

1. A.R. Harish, M. Sachidananda, Antennas and Wave Propagation, 1/e, Oxford University Press, 2007.

List of Experiments

The laboratory component shall include the below experiments (but not limited to)

1. Design and measure all the antenna parameters and polarization of half wave dipole antenna (Using HFSS)
2. Design and measure all the antenna parameters and polarization of quarter wave monopole antenna (Using HFSS)
3. Design and measure all the antenna parameters and polarization of a horn antenna (Using HFSS)
4. Design an N-element linear array and plot its antenna radiation pattern and measure the antenna parameters (Using MATLAB)
5. Design an N-element broadside and end fire array and plot their radiation pattern (Using MATLAB)
6. Design a linear array for given specifications using Schelkunoff polynomial method (Using MATLAB)
7. Design and measure all the antenna parameters and polarization of microstrip patch antenna (Using HFSS)
8. Design and measure all the antenna parameters of microstrip patch antenna array (Using HFSS)
9. Design Project / Case Studies

Course Outcomes:

Upon successful completion of the course, students will be able to

Explain the radiation mechanism of an antenna and its fundamental parameters and observe practically the radiation pattern of antennae(L2).

1. Distinguish the wired antennas based on their field components(L2).
2. Examine the radiation pattern of aperture antennas theoretically and practically(L3).
3. Explain how to improve the strength and directivity of antenna using antenna arrays (L2).
4. Identify the requirement of microstrip and smart antenna in applications(L2).
5. design micro strip antenna using simulation software (L6).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-01-23 **ACADEMIC COUNCIL: 22ndAC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE3031	COMMUNICATION NETWORKS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	EECE3011: Digital Communications						

Course Description:

This course introduces the student to the fundamental principles and tools used in building data communication networks. This course shall augment other courses that require networking services including Internet of things, Wireless Networks and Wireless Sensor networks.

Course Educational Objectives:

- To introduce the basics of computer network technology, typical network scenarios, layering models and service descriptions
- To familiarize the principles and usage of networking applications including web, HTTP, DNS and socket programming
- To acquaint the principles and design issues of transport layer services and the protocols supporting these services for different network applications
- To acquaint the data plane and control plane aspects of network layer
- To demonstrate the data link layer aspects and physical layer technologies enabling the internet

UNIT 1 Computer Networks and the Internet 8 hours

Services description and definition of protocol, Network Edge and Network Core. Delay, Loss and Throughput in Packet-Switched Networks, Protocols layers and their service models.

UNIT 2 Application Layer 7 hours

Wire Antennas: Infinitesimal dipole, small dipole antenna, half wavelength dipole, region of separation, ground effects, image theory.

UNIT 3 Transport Layer 9 hours

Transport Layer: Introduction to transport layer services, multiplexing and demultiplexing, connectionless transport: UDP, principles of reliable data transfer, connection-oriented transport: TCP.

UNIT 4 **Network Layer** **8 Hours**

Network Layer (Data Plane): Overview of network layer, Internet Protocol: IPv4, Addressing, IPv6. Network Layer (Control Plane): Routing algorithms, Internet control message protocol (ICMP).

UNIT 5 **Link Layer and LANs:** **8 hours**

Link Layer and LANs: Introduction to the link layer, error detection and correction techniques, multiple access links and protocols, switched local area networks. Wireless links and network characteristics, 802.11 Wireless LANs.

List of Laboratory Experiments:

1. Basic Networking: Network interface exercises, ARP exercises, Exercises with ICMP and ping, Exercises with IP address and subnets mask
2. Bridges, LANs and the Cisco IOS: Exercises on Cisco IOS, A simple bridge experiment, Spanning tree exercises, Exercise on the Cisco IOS web browser UI
3. Static and dynamic routing: A simple router experiment, RIP exercises, Routing experiments with ICMP, OSPF exercise, Static routing experiment, Traceroute experiment
4. UDP and its applications: Using the sock program, UDP exercises, Path MTU discovery exercise, Exercises with FTP and TFTP
5. TCP IP and its applications: Exercises on TCP connection control, Exercise on TCP interactive data flow, Exercise on TCP bulk data flow, Exercises on TCP timers and retransmission
6. The Web, DHCP: Socket programming, HTTP exercises, DHCP exercises

Textbooks:

1. J. F. Kurose and K. W. Ross, “Computer Networking – A top down approach featuringthe Internet”, 5/e, Pearson Education, 2017

References:

1. L. Peterson and B. Davie, “Computer Networks – A Systems Approach”, 5/e, Elsevier India, 2011
2. B. A. Forouzan, “Data Communications and Networking”, 4/e, Tata McGraw Hill, 2013.
3. Andrew Tanenbaum, “Computer networks”, 7/e, Prentice Hall, 2015.

4. D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall of India, 2007

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Describe the notion of services, protocols, layering and fundamentals metrics of data networks(L1)
2. Appreciate the need and operation of different application layer protocols and their services(L1).
3. Explain the different transport layer services, protocols and their operation(L4).
4. Demonstrate the architecture of internet and identify the use of different routing algorithms (L4).
5. Compare the capabilities and use of different MAC layer protocols, devices employed in different physical layer technologies (L4).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3041	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	EECE2021: Digital Logic Design						

Course Description:

Electronic gadgets became part and parcel of a common man these days. Microcontroller is an essential heart of any electronic gadget. It is the device which is responsible for the operation the gadget whatever may be the application of use. Microprocessor is that component which drives the microcontroller. Essential features of the microprocessor as well as the microcontroller are introduced in this course. Interfacing this controller with many a number of peripherals is also treated elaborately

Course Educational Objectives:

- To familiarize the concepts and architecture of 16 bit microprocessor 8086
- To explain assembly language programming of 8086 microprocessor
- To demonstrate the architecture, instruction set and programming of 8051 microcontroller
- To impart the knowledge of C programming to interface various peripherals like data converters, timers, serial port etc
- To demonstrate microcontroller based embedded system

UNIT 1 **8086 Architecture** **8 hours**

The Processor 8086: Register organization of 8086, architecture of 8086, signal description of 8086, physical memory organization, I/O addressing capability.

UNIT 2 **Instruction Set and Interrupts** **7 hours**

Instruction Set and Interrupts: Addressing modes of 8086, instruction set of 8086, assembly language programs (example programs), interrupts and interrupt service routines, interrupt cycle of 8086, non-maskable interrupt, maskable interrupt (INTR).

UNIT 3 8051 Microcontroller 5 hours

Introduction to Microcontroller 8051: Intel family of 8 bit microcontrollers, architecture, signal description, register set of 8051, important operational features of 8051, program status word (PSW).

UNIT 4 Programming 8051 Timers and Serial Ports 9 Hours

Programming 8051 Timers and Serial Port: Basic registers of timer, modes of operation, programming timers in C (examples), Basics of serial communication, baud rate in 8051, SBUF, SCON, serial port programming in C (examples).

UNIT 5 Interfacing 8051 with ADC/DAC 8 hours

Interfacing of Peripherals to 8051: ADC 0808/0809 chip with 8 analog channels, programming ADC 0808/0809 in C, DAC interfacing DAC 0808, programming DAC in C. Introduction to ARM Processor: The ARM family history, ARM family variations.

List of Laboratory Experiments:

1. Experiments with Microprocessor 8086 using Assembler:
2. Arithmetic operations on 8 bit and 16 bit operands.
3. Transfer block of data from one memory location to another memory location.
4. Programs using monitor routines.
5. Compute maximum, minimum and sorting (ascending and descending).
6. Generate Fibonacci series, average of N numbers and factorial of N.

Experiments with Microcontroller 8051 using Keil-C51:

1. Arithmetic operations on 8051.
2. Transfer given string serially with suitable baud rate.
3. Generation of waveforms using timers of 8051.
4. Interface DAC with 8051 to generate waveforms.
5. Interface ADC with 8051 to read analog data and display read data.

Simulation Experiments with ARM Development System

1. Demonstration of ARM Development System and Tools

2. Basic Experiments involving memory and I/O interfacing

Textbooks:

1. AK Ray, KM Bhurchandi, Advanced Microprocessors and Peripherals, 2/e,Tata McGraw Hill Publications, 2009.

2. Muhammad Ali Mazidi, Janice Gillispie, Mazidi, Rolin D. Mc Kinlay, The 8051 Microcontroller and Embedded Systems using Assembly and C, Second Edition, Pearson Education, 2002

3. Muhammad Ali Mazidi, Sarmad Naimi, SepehrNaimi, Janice Mazidi, ARM Assembly Language Programming &Architecture, Pearson Education, 2002

References:

1. Barry B. Brey, The Intel Microprocessors: Architecture, Programming and Interfacing, 8/e, Pearson Education, 2008.

2. Kenneth J. Ayala, 8086 Micro Processor: Programming and Interfacing the PC, 1/e, Delmar Cengage Learning, 2007.

3. Douglas V Hall, Microprocessors and Interfacing: Programming and Hardware, 2/e, Tata Mc Graw Hill, 2006.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Summarize the concepts of architecture, instruction set and addressing modes of 8086 microprocessor.

2. Develop programs of 8086 microprocessor to perform various tasks and verify the programs with 8086 kits.

3. Differentiate between microprocessor and microcontroller and understand the basics of 8051 microcontroller and perform experiments with microcontroller 8051 using Keil-C51.

4. Interpret the interfacing of microcontroller with different peripheral devices such as timers, serial port, ADC and DAC etc. and verifying it practically using trainer kits.

5. Identify the architectural highlights of ARM processors.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3051	VLSI DESIGN	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	EECE2021: Digital Logic Design						
Co-requisite	None						
Preferable exposure	SPICE						

Course Description:

VLSI Design allows large number of electronic devices to be integrated in a single small chip resulting in high speed of operation and low power dissipation. This has dramatically improved the evolution of telecommunication systems and electronic appliances. This course introduces the student to the two popular VLSI design methodologies including FPGA design and full custom IC design. FPGAs are used in the design of low-volume digital integrated circuits with reconfigurability and less design time. Full custom methodology allows high-volume design of integrated circuits with low area, high speed and ultra-low-power dissipation. Further, students will be exposed to industry-standard FPGA boards and IC design tools.

Course Educational Objectives:

- To introduce the design flow of integrated circuits using hardware description languages and programmable logic devices.
- To explain the architecture and usage of different types of programmable logic devices including PLAs, PLDs, CPLDs and FPGAs
- To describe semiconductor technology evolution, the different steps of IC fabrication process and appreciate the role of mask layout in the design process.
- To provide an understanding of the constraints imposed by fabrication engineer and learn to prepare mask layouts as per design rules
- To comprehend the design of combinational and sequential circuits from MOS schematic to layout.

UNIT 1 **Modeling Digital Circuits with HDLs** 10 hours

VLSI Design Methodologies: Computer Aided Design: Hardware description languages, Verilog description of combinational circuits, Verilog modules, Verilog assignments, procedural assignments, modeling flip-flops using always block, delays in Verilog, compilation, simulation, and synthesis of Verilog code, Verilog data types and operators, simple synthesis examples, Verilog models for multiplexers, modeling registers, counters and finite state machines using Verilog always statements, behavioral and structural Verilog, testing a Verilog model

UNIT 2 **Programmable Logic Devices** 6 hours

Programmable Logic Devices: Simple programmable logic devices (SPLDs), Complex programmable logic devices (CPLDs), Field programmable gate arrays (FPGAs), implementing functions in FPGAs.

UNIT 3 **Full Custom IC Design** 7 hours

IC Design Technology: Integrated Circuit (IC) era, Metal Oxide Semiconductor (MOS) and related VLSI technology, basic MOS transistors, enhancement mode transistor action, NMOS fabrication, CMOS fabrication, comparison of NMOS, CMOS, BICMOS, GaAs technologies. Basic Electrical Properties of MOS Circuits: Drain current vs drain-source voltage relationships, MOS transistor threshold voltage, pass transistor, NMOS inverter, CMOS inverter

UNIT 4 **MOS Circuit Design Process** 9 Hours

MOS Circuit Design Process: MOS Layers, stick diagrams, design rules and layout, 2µm micron based design rules, layout diagrams, symbolic diagrams. CMOS Circuit and Layout Design using Static Complementary CMOS Logic Style. Delay and Power Analysis of CMOS Logic Circuits

UNIT 5 **Subsystem Design and Layout** 8 hours

Subsystem Design and Layout: Some architectural issues, switch logic, gate (restoring) logic, examples of structured design, parity generator, multiplexers, general logic function block. Design of Latches and Flipflops using Static Complementary CMOS

List of Laboratory Experiments:

Part 1: FPGA Implementation of Digital Circuits

1. Verilog modelling, simulation and FPGA implementation of combinational logic circuits: basic gates, multiplexer, comparator, adder/subtractor.
2. Verilog modelling, simulation and FPGA implementation of combinational building blocks: Multipliers, decoders, address decoders, parity generator, ALU.
3. Verilog modelling, simulation and FPGA implementation of sequential logic circuits: D-Latch, D-Flip flop, registers.
4. Verilog modelling, simulation and FPGA implementation of sequential building blocks: Ripple counters, synchronous counters, shift registers (serial-to-parallel, parallel-to-serial)

5. Verilog modelling, simulation, and FPGA implementation of finite state machines: Mealy state machine, Moore state machine,

6. Digital system design examples: GCD processor example, arithmetic multiplier.

Part 2: Full Custom Design of Digital Circuits

Full custom IC design flow: Schematic, symbol, simulation, layout, Design Rule Checking (DRC), layout vs. schematic (LVS), RC Extraction (RCX) and post layout simulation of

1. CMOS inverter
2. NAND gate
3. Complex Gates
4. One-bit full adder
5. D-flip flop.
6. Delay and Power Analysis of CMOS Digital Circuits

Textbooks:

1. Charles H. Roth, Lizy Kurian John, ByeongKil Lee, Digital Systems Design using Verilog, 1/e, Cengage Learning, 2016

2. Douglas A, Pucknell, Kamran Eshraghian, Essentials of VLSI Circuits and Systems, 1/e, Prentice Hall, 2012.

3. Weste, Harris, CMOS VLSI Design, 4/e, Pearson Education, 2014

References:

1. Kang, Leblibici, CMOS Digital Integrated Circuits, 3/e, Tata McGraw Hill, 2001.

2. Jan M. Rabaey, Digital Integrated Circuits, 2/e, Pearson Education, 2002.

3. Jackson, Hodges, Analysis and Design of Digital Integrated Circuits, 3/e, Tata McGraw Hill, 2010

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Model combinational/sequential logic circuits and their testbenches at different levels of abstraction in Verilog (L3).

2. Describe and compare the architectures of different programmable logic devices (L2).

3. Explain the evolution of IC technology and its fabrication process (L1).

4. Derive the stick diagram and mask layout for a given MOS circuit (L5).

5. Build combination and sequential building blocks at the subsystem level using different MOS circuit styles (L5).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

PPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

Programme Elective

		L	T	P	S	J	C
EECE1071	**BATTERY TECHNOLOGIES**	**3**	**0**	**0**	**0**	**0**	**3**
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Educational Objectives:

- To understand the fundamental concepts and principles of battery technologies
- To identify the selection of appropriate battery types for specific requirements
- To develop problem-solving skills related to designing and optimizing battery systems.
- To analyse the performance and durability of various batteries
- To explore emerging trends in the context of energy storage and electric vehicles

Course Contents:

UNIT 1: Primary and Secondary Batteries 7 hours

Definition and basic concept of primary batteries. Historical development and early types (zinc-carbon, alkaline) Electrochemical reactions in primary batteries, Anode, and cathode processes. Types of Primary Batteries, Types of Secondary Batteries, Advantages, and limitations.

UNIT 2: Lithium Based Batteries 7 hours

Components of Lithium-ion cell and their functions, Working of Lithium-ion cell, Types of Lithium-ion cell and their comparison, Lithium-ion battery safety-mechanisms, Cathode & Anode materials.

UNIT 3: **Solid State Batteries 8 hours**

Basic design and operation, Battery parameters and state of the art characterization techniques, Cathode and Anode materials for solid state batteries, Electrolytes for solid state batteries

UNIT 4: Battery Comparison, Manufacturing, and Packaging 9 hours

Battery comparison related to performance, durability, and safety of these batteries in the electric vehicle applications. manufacturing aspects of cylindrical, pouch and prismatic cells, modules, and packs for electric vehicle applications.

UNIT 5: Batteries and Electric Vehicles 9 hours

Electric Vehicle Operation, Battery Basics, Introduction to Electric Vehicle Batteries, Fuel Cell Technology, Choice of a Battery Type for Electric Vehicles. Battery thermal characteristics and challenges, Active and passive cooling strategies for batteries, Thermal runaway prevention and mitigation. Battery sizing, Understanding of SOC, Cell balancing, BMS topologies, SoC estimation.

Textbooks:

1. Nalini, B., Abhilash, K.P., Nithyadharseni, P., 2022. Solid State Batteries-Design, Challenges and Market Demands. Springer International Publishing
2. Reddy, T.B., 2011. Linden's handbook of batteries. McGraw-Hill Education.
3. Díaz-González, F., Sumper, A. and Gomis-Bellmunt, O., 2016. Energy storage in power systems. John Wiley & Sons.
4. Scrosati, B., Abraham, K.M., van Schalkwijk, W.A. and Hassoun, J. eds., 2013. *Lithium batteries: advanced technologies and applications*. John Wiley & Sons.
5. Scrosati, B., Garche, J. and Tillmetz, W. eds., 2015. *Advances in battery technologies for electric vehicles*. Woodhead Publishing.

Course Outcomes: At the end of this course the student should be able to:

- Describe various types of battery mechanism based on electro chemical reactions (L1)
- Classify different types of batteries based on type of design and material used (L2)
- Apply mathematical formulas for designing the batteries and their parameter calculation(L3)
- Analyze performance, durability, and safety procedures for manufacturing of

batteries(L4)
- Evaluate a problem description in electric vehicles and predict optimal choice of battery configuration (L5)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

EECE2141	TELECOMMUNICATIONS FOR SOCIETY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Introduction
A large number of telecommunication technologies are serving different needs of the society including landline telephones, mobile phones, Bluetooth, Wi-Fi, infrared, optical and satellite systems. This course gives a introductory overview of features, equipment, capabilities and operation of the above communication technologies.

Course Objectives:

- To acquaint the students to telephone network system using tradition, internet systems used for voice/fax communication
- To familiarize the students to cellular wireless networks, their evolution, services, data rates and systems
- To expose the student to different personal and medium-haul wireless networks including Bluetooth, Zigbee, Wi-fi and RFID systems
- To provide an understanding of optical networks that connect different telephone, wireless, ISPs and other networks together to provide ultra high data rate communication over long distances
- To familiarize the students to satellite communication systems that provide long distance over the horizon wireless communication, television broadcasting and location services

Module I **7hours**
Telecommunication Systems: Telephones, Telephone System, Facsimile, Internet Telephony.

Module II **7 hours**
Cell Phone Technologies: Cellular Telephone Systems, A Cellular Industry Overview, 2G and 3G Digital Cell Phone Systems, Long Term Evolution and 4G Cellular Systems, Base Stations and Small Cells.

Module III **7 hours**
Wireless Technologies: Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless Networks, WiMAX and Wireless Metropolitan-Area Networks, Infrared Wireless, Radio-Frequency Identification and Near-Field Communications, Ultrawideband Wireless, Additional Wireless Applications.

Module IV **7 hours**

Optical Communication: Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers, Wavelength-Division Multiplexing, Passive Optical Networks, 40/100-Gbps Networks and Beyond.

Module V **7 hours**

Satellite Communication: Satellite Orbits, Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Navigation Satellite Systems

Text Book(s)

1. Louis E. Frenzel Jr., Principles of Electronic Communication Systems, 4/e, Mc Graw Hill Publications, McGraw-Hill Education, 2016.

References

1. Wayne Tomasi, Electronic Communication Systems, 5/e, Pearson Education, 2009.
2. Wayne Tomasi, Advanced Electronic Communication Systems, 4/e, Pearson Education, 2013.
3. Dennis Roddy, Electronic Communications, 4/e, Pearson Education, 2003.

Course Outcomes

Upon successful completion of the course, students will be able to

- Describe the landline telephone network system and enumerate the different services (L2)
- Explain the cellular wireless networking systems, their evolution, services, data rates and systems (L2)
- Identify the proper wireless communication technology for a given application depending on distance, datarate, portability requirements. (L3)
- List the different sources, channels and detectors for optical communication and enumerate the data rates achieved with different technologies (L3)
- demonstrate the knowledge, operation and services of different satellite and local technologies (L2)

EECE2151	ELECTRONIC APPLIANCES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Introduction:

This course provides a bird's eye view of physical construction, specifications, and applications of different electronic appliances we see around in our daily life. Extensive emphasis is placed on cell phone technology, networking equipment, digital audio and video equipment and industrial control devices.

Course Objectives

- to familiarize the student to the concepts of cellular networks, digital modulation techniques, wireless transmission methods and location technology
- to expose the student to different long-haul and short-haul networks, their distance limitations, transmission rates and physical channel characteristics
- to acquaint the knowledge of standards, equipment and quality of digital audio used in personal audio and broadcast audio applications
- to familiarize the format of digital video signals and acquaint the different video transmission and storage technologies
- to impart the knowledge of electronic application used for industrial automation and control

Module I **7 hours**

Cell Phones: Introduction, The Cellular Concept, What 's Inside a Cell Phone? What Type of Cell Phone Do You Have?, Digital Modulation and Wireless Transmission Methods Access Methods and Duplexing, OFDMA, A Look Inside a 3G Cell Phone, The Latest Cell Phone Technology, Mobile TV, Location Technology

Module II **7 hours**

Networking: Introduction, Is Everything Networked? Types of Networks, Network Interconnection Methods, Wired Networking Technologies, Types of Cables, Ethernet, How Is Ethernet Used? SONET, Optical Transport Network, How the Internet Works, Wireless networks, Broadband Technology.

Module III **7 hours**

Audio Electronics: Introduction, The Nature of Sound, Digital Audio, AV Receiver, Special Sound Applications.

Module IV **7 hours**

Video Technology: Introduction, Video Fundamentals, 3D Television, Cable Television, Satellite TV, Cellphone TV, Closed circuit TV, Digital Video Discs.

Module V **7 hours**

Industrial Control: Introduction, Open and Closed loop control, Sensors, Output devices, Thyristors, Programmable Logic controllers.

Text Book(s)

1. Louis E. Frenzel Jr., Electronics Explained, Elsevier Publications, 2010.

References

1. Wayne Tomasi, Electronic Communication Systems, 5/e, Pearson Education, 2009.

Course Outcomes

Upon successful completion of the course, students will be able to

- list the different specifications and transmission/location technologies used by cell phones (L2)
- choose the appropriate networking technology for internetworking based on distance, datarate, channel characteristics (L3)
- enumerate the different audio transmission/storage standards used in personal and audio receiver devices (L3)
- describe the format of digital video signals and choose an appropriate video transmission and storage technologies based on capacity and quality requirements (L2)
- elaborate the usage of different devices used for industrial automation and control (L2)

EECE2161	PRACTICAL ELECTRONICS	L	T	P	S	J	C
		2	1	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Introduction:
Many engineering products integrate electronic circuitry for converting physical signals into electrical quantities and vice versa. This course introduces the operation of (and design using) electronic components and systems. The course further demonstrates the usage and design of electronic components including amplifiers, filters, power supplies, oscillators, and actuators

Course Objectives:

- To demonstrate the use of electronic measurement/testing devices and passive components used in electronic system design
- To acquaint the different choices for power supply design based on ampere-hour rating and their design aspects
- To familiarize the different circuit topologies for amplifying demonstrate the sensing and actuation of physical quantities and their interfacing with Raspberry PI.
- To familiarize the different types of filters and their design aspects
- To demonstrate the usage and design aspects of electromechanical systems and signal sources

Unit – I 8 Hours

Common Circuit Design Techniques: Testing and Measurement Devices: Drawing Circuits, Series-Dropping Resistor, Voltage Dividers, Special Sensor Resistors, Potentiometers, Variable Voltage Dividers, Transistor Switches. Design Examples and Projects

Unit – II 8 Hours

Power Supply Design: Power Supply Choices and Specifications, Common Voltages, Designing a Battery Supply, Ampere-Hour Ratings, Battery Supply Design Procedure, Specifying a Linear Supply, Linear Supply Design Procedure, Linear Supply Design Example, Design Projects

Unit – III 8 Hours

Amplifier Design: Amplifier Types, Specifying Amplifiers, A Microphone Amplifier, Designing with Op Amps, Primary Op Amp Application Circuits, Differential Amplifier, Power, Amplifiers, Design Projects

Unit – IV 8 Hours

Filter Design: Types of Filters, Filter Specifications, Filter Design Guidelines, Filter Response Options, RC Filter Design, Bandpass LC Filters, Band Reject Filters. Design Project

Unit – V 8 Hours

Signal Source Design: Signal Source Specifications, Sine Wave Oscillators, Clock Oscillators, Multivibrators, Frequency Synthesizers, Design Project. **Electromechanical Design:** Switches, Relays, Solenoids, Motors, Motor Control, Servo Motors, Design Project

Text Books

1. Louis E. Frenzel, Practical Electronic Design for Experimenters, Mc Graw Hill Publications, 2020.

References

1. Simon Monk, Hacking Electronics, Mc Graw Hill Publications, 2017
2. Simon Monk, Electronics Cookbook,

Course Outcomes

Upon successful completion of the course, students will be able to

- demonstrate the use of electronic measurement/testing devices and passive components used in electronic system design (L2)
- choose the appropriate power supply system specifications for an electronics application and design the relevant circuit. (L4)
- choose and design the appropriate amplifier circuit topology for speech, instrumentation or high-power applications (L3)
- derive the appropriate specifications for a filter based on noise / interference signals and design the relevant circuit (L4)
- describe the usage of different electromechanical systems and signal sources (L2)

EECE2171	**ARDUINO FOR BEGINNERS**	**L**	**T**	**P**	**S**	**J**	**C**
		2	**0**	**2**	**0**	**0**	**3**
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Introduction

This course exposes engineering (or non-engineering students) to simple way of building low cost, easy to use, embedded computing systems using Arduino for their products. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards can read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

Course Objectives

- To expose the student to the Arduino board, specification, and IDE for developing embedded control systems.
- To familiarize the different types of displays and their utility in different applications
- To demonstrate the use of different actuators and their interfacing with Arduino.
- To familiarize the different communication modules available for interfacing with Arduino and relaying sensed data over the internet.
- To impart the knowledge of building embedded hardware and software projects with emphasis on community service and engagement.

Unit – I **6 Hours**

Introduction to Arduino UNO, Board features and Specifications, IDE Software and LED Blinking. Switch and Sensor Interfacing: Temperature Sensor, Humidity Sensor, Ultrasonic Distance Sensor, Accelerometer and Gyroscope

Unit – II **5 Hours**

Interfacing Arduino with Displays: Liquid Crystal Displays, 7-segment displays, 8x8 dot matrix displays

Unit – III **5 Hours**

Interfacing Arduino: Servo and Stepper Motors, DC Motors, Infrared sensor, RFID Applications

Unit – IV **5 Hours**

Programming Arduino : Interfacing with SD Card Module, Screen Displays, Touch Screen, Camera

Unit- V **5 Hours**

Communication Systems with Arduino: Interfacing Arduino with Bluetooth, GNSS, nRF24L01 radio transceiver modules

List of Experiments

The laboratory component shall involve the use of Arduino Boards and Modules to carryout the below experiments (but not limited to)

1. LED Blinking and Switch Sensing
2. Interfacing Arduino with Temperature and Ultrasonic Distance Sensor
3. Interfacing Arduino with LCD and 7-segment displays
4. Interfacing Arduino with Servo and Stepper Motors
5. Data Sensing and Logging into SD Card
6. Interfacing Arduino with Bluetooth
7. Interfacing Arduino with NRF24L01 Radio Module
8. Two mini projects

TextBooks

1. Neil Cameron, Arduino Applied, Comprehensive Projects for Everyday Electronics, Apress, 2019
1. Simon Monk, Programming Arduino, Getting Started with Sketches, Mcgraw hill publications, 2016Rajesh Singh, Anita Gehlot, Bhupendra Singh, Sushabhan Choudhury, Arduino meets MATLAB: Interfacing, Programs and Simulink, Bentham Science Publishers, 2018

References

1. Simon Monk, Programming Arduino, Next Steps, Mcgraw Hill Publications, 2018
2. Simon Monk, Hacking Electronics, 2/e, Mc Graw Hill Publications, 2019
3. https://in.mathworks.com/discovery/arduino-programming-matlab-simulink.html
4. Mitsuo Hirata, Ivan Godler, Control System Design: Getting Started with Arduino and MATLAB, Techshare, 2016

Course Outcomes:

Upon successful completion of the course, students will be able to

- enumerate the different features of the Arduino board, list their specifications, and demonstrate the use of IDE for developing embedded control systems (L2)
- compare the different displays and demonstrate their interfacing with Arduino (L3)
- demonstrate the use of different actuators and their interfacing with Arduino (L3)
- analyze the proper communication modules for a particular application based on data rate, distance, cost considerations (L3)
- design and build embedded hardware and software project with relevance to community service and engagement (L4)

<table>
<tr><td rowspan="2">EECE2181</td><td rowspan="2">RASPBERRY PI FOR BEGINNERS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">Arduino for Beginners</td></tr>
</table>

Course Introduction:
This course exposes engineering (or non-engineering students) to simple way of building low cost, high performance heavy weight embedded computing systems using Raspberry PI for their products. The Raspberry Pi is a debit card-sized low-cost computer that connects to a computer Desktop or TV and uses a standard mouse and Keyboard. It has a dedicated processor, memory, and a graphics driver, just like a PC. It also comes with its operating system, Raspberry Pi OS, a modified version of Linux

Course Objectives:

- To expose the student to the Raspberry PI board, specification, and python library support for developing embedded control systems (L2)
- To familiarize the basic python language constructs, programming environment and different libraries for application development (L3)
- To demonstrate the sensing and actuation of physical quantities and their interfacing with Raspberry PI.
- To familiarize the different communication modules available for interfacing with Raspberry PI and relaying sensed data over the internet.
- To impart the knowledge of building embedded hardware and software projects with emphasis on community service and engagement.

Unit – I **6 Hours**
Raspberry PI Setup and Management: Introduction to Raspberry PI, Board features and Specifications, Raspberry Pi Setup and Management, Operating System Installation and Interfacing with VGA. Setting up IP Adresss, Wifi connection and Network printing

Unit – II **5 Hours**
Python: Running Python Programs from the Terminal, Variables, Reading input and displaying output, Strings and Manipulation, Operators and looping structures, Creating and Manipulating lists and dictionaries.

Unit – III **5 Hours**
Interfacing Raspberry PI with GPIO: Installing RPI.GPIO library, controlling hardware (LED, Servo Motors, DC Motors.

Unit – IV **5 Hours**
Interfacing Raspberry PI with Sensors and Actuators: Resistive Sensor, Temperature Sensor, ADCs

Unit- V **5 Hours**
Setting up Raspberry PI Webserver, Publishing to Webservices, Robot Car

List of Experiments

The laboratory component shall involve the use of Raspberry PI 4 boards to carryout the below experiments (but not limited to)

1. LED Blinking and Brightness control
2. Controlling Relays and Motors using User Interfaces
3. Measuring and Displaying Light, Temperature, Acceleration, Distance
4. Setting up webserver on Raspberry PI
5. Publishing to Web Services
6. Interfacing with Camera and Touch Screen
7. Design Projects
    a. Home Automation System
    b. Robot Car

TextBooks

1. Simon Monk, Raspberry Pi Cookbook, Oreilly Publications, 2018.
2. Simon Monk, Programming Raspberry PI, Getting Started with Python, 3/e, Mcgraw hill publications, 2017

References

5. John C. Shovic, Raspberry Pi IoT Projects: Prototyping Experiments for Makers, Apress, 2016
6. Colin Dow, Internet of Things Programming Projects, Packt Publishing, 2018.
7. https://in.mathworks.com/discovery/raspberry-pi-programming-matlab-simulink.html
8. https://www.youtube.com/watch?v=kTXzaBOrEXY&list=PLn8PRpmsu08rl1WhIlK-gj2H-6koUAHoh&index=12

Course Outcomes

Upon successful completion of the course, students will be able to

- List the specifications of the Raspberry PI board, programming environment and python library support for developing embedded control systems (L2)
- Develop python applications using built in libraries for interfacing with Raspberry PI peripherals (L3)
- demonstrate the sensing and actuation of physical quantities and their interfacing with Raspberry PI (L4)
- interface the different communication modules available for interfacing with Raspberry PI and develop applications for relaying and obtaining the data from the internet (L4)
- design and build embedded hardware and software projects with emphasis on community service and engagement

<table>
<tr><td rowspan="2">EECE3121</td><td rowspan="2">INFORMATION THEORY AND ERROR CONTROL CODING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">EECE3011: Digital Communications</td></tr>
</table>

Course Description:

This course provides a basic understanding of the measure of information, source coding, channel capacity and channel coding techniques. Source coding is used to compress the size of the data generated from digital source by reducing redundancy. Channel capacity is a much-used metric for the maximum amount of traffic or signal that can move over a particular infrastructure channel. Channel coding is used for error detection and/or error correction by adding some redundant bits to source coded data in order to improve performance.

CourseEducational Objectives:

- To introduce the principles and applications of information theory in terms of probability and entropy and practical aspects of data compression and source coding techniques.
- To explain the quantitative measure of information which may be used in order to build efficient solutions to communication engineering problems such as calculating the capacity of a communication channel with and without noise.
- To explain linear block codes, cyclic codes and convolution coding techniques for channel performance improvement against errors.
- To describe suitable error control coding technique for burst error correction.

UNIT 1 Source Coding 9 hours

Introduction to information theory, uncertainty and information, average mutual information and entropy, source coding theorem, Huffman coding, the Lempel-Ziv algorithm.

UNIT 2 Channel Capacity and Coding 5 hours

Channel models, channel capacity, information capacity theorem, the Shannon limit, Channel Coding, Type of errors.

UNIT 3 **Linear Block Codes** **12 hours**

Linear Block Codes for Error Correction: Introduction to error correcting codes, basic definitions, matrix description of linear block codes, parity check matrix, decoding of a linear block code, syndrome decoding. Cyclic Codes: Introduction to cyclic codes, polynomials, the division algorithm for polynomials, a method for generating cyclic codes, burst error correction, cyclic redundancy check (CRC) codes.

UNIT 4 **Convolutional Codes** **6 hours**

Convolutional Codes: Introduction to convolutional codes, tree codes and trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function.

UNIT 5 **Turbo and LDPC Codes** **10 hours**

Turbo Codes: Code concatenation, Concatenating codes in parallel, Iterative decoding of turbo codes, implementing MAP. Low density parity check codes: Codes with sparse parity check matrix. Decoding and encoding algorithms, High level architecture for LDPC decoders

Textbooks:

1. Ranjan Bose, Information Theory, Coding and Cryptography, 2/e, Tata McGraw- Hill, 2010.
2. Simon Haykin, Communication Systems, 4/e, John Wiley and Sons, 2002.
3. Yuan Zing, Practical Guide to Error Control Coding with MATLAB, Artech Book Publishers, 2010.

References:

1. Amitabha Bhatacharya, Digital Communication, Tata McGraw-Hill, 2006.
2. William Stallings, Cryptography and Network Security Principles and Practices, 3/e, Pearson Education, 2007.
3. Bruce Carlson, Paul B. Crilly, Communication Systems, 5/e, Tata McGraw Hill, 2009.
4. R.P Singh and S.D. Sapre, Communication Systems,2/e by Tata McGraw-Hill,2007

CourseOutcomes:

1. Determine the amount of information per symbol, information rate and Entropy of a discrete memory less source (L4).
2. Design lossless source codes for discrete memory less source to improve the efficiency of information transmission (L5)

3. Evaluate the information capacity of discrete memory less channels and determine possible code rates achievable on such channels (L6)
4. Understand control of burst errors (L2).
5. Apply linear block codes, cyclic codes and convolutional codes for error correction and error detection (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE3131	WIRELESS COMMUNICATIONS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	EECE3011: Digital Communications						
Preferable exposure	MATLAB						

Course Description:

Wireless communication involves the transmission of information over a distance without the help of wires, cables or any other forms of electrical conductors. Wireless communication is playing a vital role in present day communications. Wireless communication can be used for cellular telephony, wireless access to the internet, wireless home networking, and so on.

Course Educational Objectives:

- To understand about Radio wave propagation
- To study about fading and multipath effects on propagation
- To study and understand the different diversity techniques
- To understand about the cellular concepts
- To study about spread spectrum techniques in wireless communications

UNIT 1 Mobile Radio Propagation: Large Scale PathLoss 9 hours

Introduction of RADIO wave propagation, Free space propagation model, The Three Basic Propagation Mechanisms, Reflection, Ground Reflection(Two Ray) model, Diffraction, Scattering, Outdoor Propagation models, Okumura model, Hata model, Indoor Propagation models.

UNIT 2 Mobile Radio Propagation: Small Scale fading and multipath 9 hours

Small scale multipath propagation, Impulse Response Model of a multipath channel, parameters of the Mobile multipath channel, Types of small-scale fading, Rayleigh and Ricean Distributions.

UNIT 3 Diversity Techniques 9 hours

Derivation of Selection Diversity Improvement, Derivation of Maximal Ratio Combining Improvement, Practical Space Diversity Considerations, Selection Diversity, Feedback and Scanning Diversity, Maximal Ratio Combining, Equal Ratio Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

UNIT 4 Cellular Concept-System Design Fundamentals 9 hours

Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity,Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems.

UNIT 5 Multiple Access Techniques for Wireless Communications 9 hours

Introduction, Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access, Space Division Multiple Access.

Textbooks:

1. Rappaport Thoedore S., Wireless Communications, Principles and Practice, 2/e, Prentice Hall of India, 2003

References:

1. Haykin, S., Moher M., Modern Wireless Communications,1/e, Pearson Education, 2011.
2. Kamilo Feher, Wireless Digital Communications, 1/e, Prentice Hall of India, 1995.
3. Lee W.C.Y., Mobile Cellular Telecommunication, 2/e, Tata McGraw Hill, 2002.
4. Proakis J.G., Digital Communications, 5/e, Tata McGraw Hill, 2013.

Course Outcomes:

1. Describe about Radio wave propagation (L2)
2. Can explain about the effects of multipath and fading. (L2)
3. Can explain about different diversity techniques (L2)
4. Can analyse the Cellular System Design(L3)
5. Can understand the significance of spread spectrum in wireless communications(L2)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE 3141	FIBER OPTIC COMMUNICATIONS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	MATLAB						

Course Description:

Recent years have seen an exponential increase in demand for large bandwidth and high data rate applications. This is driven by rapid advances in the field of fiber optic communications. An exhaustive understanding of optical fibers and fiber optic communications is necessary to communication engineers to address future needs of high data rate communications. This course introduces the student to optical fibers, optical sources and detectors, couplers and connecters, wavelength division multiplexing, modulation techniques and applications of fiber Optics.

Course Educational Objectives:

1. To understand principle of light transmission in optical fibers.
2. To introduce types of optical fiber and its channel impairments
3. To familiarize the optical sources, detectors, couplers and connectors
4. To introduce modulation techniques, types of noise and detection
5. To explain the design considerations of fiber optic communication systems.

UNIT 1 Optic Fiber Waveguides 9 hours

Introduction, Ray theory, Step – Index Fiber, Graded – Index Fiber, optical fiber configurations, Attenuation, Pulse Distortion and Information Rate in Optic Fibers, Construction of Optic Fibers, Optic Fibers, Optic Fiber Cables.

UNIT 2 Light Sources and Detectors 9 hours

Light-Emitting Diodes, Light-Emitting – Diodes Operating Characteristics, Laser Principles, Laser Diodes, Laser-Diode Operating Characteristics, Distributed – Feedback Laser Diode, Optical Amplifiers, Fiber Laser, Principles of Photo detection, Photomultiplier, Semiconductor Photodiode, PIN Photodiode, Avalanche Photodiode, comparison between photodetectors.

UNIT 3 Couplers and Connectors 9 hours

Principles, Fiber end Preparation, Splices, Connectors, Source Coupling, Distribution Networks and Fiber Components, Distribution Networks, Directional Couplers, Star Couplers, Switches, Fiber Optical Isolator, Wavelength- Division Multiplexing.

UNIT 4 Modulation, Noise and Detection: 9 hours

Light-Emitting-Diode Modulation and Circuits, Laser-Diode Modulation and Circuits, Analog-Modulation Formats, Digital-Modulation Formats, Optic Heterodyne Receivers, Thermal and Shot Noise, Signal-to-Noise Ratio, Error Rates, Modal Noise, Amplifier Noise, Laser Noise, and Jitter, Additional Noise Contributors, receiver Circuit Design.

UNIT 5 System Design and Fiber Optical Applications 9 hours

Analog System Design, Digital System Design, power budget and rise time budget calculations, Applications of Fiber Optics.

Textbooks:

1. Joseph. C. Palais, "Fiber Optic Communications", Pearson Education, Asia, 2002.
2. John Powers," Fiber Optic Systems" Irwin Publications, 1997.
3. Howes M.J., Morgan, D.V," Optical Fiber Communication", John Wiley.1992.
4. John M.Senior, "Optical Fiber Communication: Principles and Practice", 2/e, Pearson Education, 2006

References:

1. Gerd Keiser, Optical Fiber Communications, 4/e, Tata McGrawHill, 2008.
2. S. C. Gupta, Text Book on Optical Fibre Communication and its Applications, Prentice Hall of India, 2005.
3. D. K. Mynbaev, Gupta, Scheiner, Fiber Optic Communications, Pearson Education, India, 2005.

Course Outcomes:

1. Describe the advantages and applications of Fiber Optic Communications (L3).
2. Distinguish between the various modes of operation of Optical fibers (L2).
3. Identify the various causes for signal degradation due to losses, dispersion, polarization (L2).
4. Describe the optical detectors, couplers and connecters and their applications in Fiber optic communications(L4).
5. Illustrate the importance of Wavelength Division Multiplexing (L4).
6. Design analog and digital links(L6)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE3151	SATELLITE COMMUNICATIONS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	MATLAB						

Course Description:

The satellites are an essential part of telecommunication systems worldwide, which carry large number of data, telephone traffic in addition to television signals. This course deals with the satellite inventions, frequency allocation to different regions worldwide, and gives information about satellite orbits, satellite launching methods, design of satellite and satellite subsystems, satellite link over the earth, satellite application in communication, internet and remote sensing.

Course Educational Objectives:

1. To introduce invention of satellite and developments in worldwide.
2. To explain the basics of orbital mechanics, the types of satellite orbits, the location of ground stations, and the look angles from ground stations to the satellite
3. To provide the knowledge of various modulation and multiplexing techniques in satellite communication.
4. To familiarize the link budget for satellite performance
5. To examine concepts of propagation losses in satellite networking for voice and internet communication, data networks, and scientific data.

UNIT 1 Overview of Satellite Systems 9 hours

Over view of satellite system: Introduction, Frequency allocation to satellite services, INTELSAT, INSAT.

UNIT 2 Orbits & Launching 9 hours

Introduction, Kepler's laws, Orbital Elements, Tracking and orbit determination, orbital correction/control, satellite launch systems, multistage rocket launchers and their performance.

UNIT 3 Elements of Communication Satellite Design 9 hours

Spacecraft subsystems, reliability considerations, spacecraft integration, Satellite Antennas/Access, Satellite onboard processing

UNIT 4 Satellite Link Design 9 hours

Performance requirements and standards, design of satellite links, Satellite Access (Deletion part), Satellite based personal communication.

UNIT 5 Earth Station Design 9 hours

Configurations, antenna and tracking systems, satellite broadcasting. Satellite applications in remote sensing (Radarsat).

Textbooks:

1. Dennis Roddy, Satellite Communications, 4/e, Tata McGraw Hill, 2006.
2. T. Pratt, S. W. Bostian, Satellite Communication, 2/e, John Wiley and Sons,2006.

References:

1. Dharma Raj Cheruku, Satellite Communication, 1/e, IK International Publishing, 2010.
2. D. C. Agarwal, Satellite Communication, 1/e, Khanna Publishers, 1991.

Course Outcomes:

1. Understand the basic information about satellite communications system (L2)
2. Identify the frequency allocations to satellite services, orbital mechanism substations(L4).
3. Design the communication link and its budget for satellite (L4).
4. Explain about earth station receivers and its main subsystems (L5).
5. Identify the remote sensing applications (L3).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE4001	WIRELESS NETWORKS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	EECE3031: Communication Networks						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Any sort of communication i.e., data or voice or video is wireless these days. Internet of Things (IoT) basically is dependent on wireless networks. Thus, networking is also to be wireless for ease of operation and compatibility. Networking may be limited to very small space or extending across continents. All possible networking systems and their architecture are introduced in this course. The evolution of cellular communication networks starting from 1G to 4G (LTE and LTE advanced) is also elaborated.

Course Educational Objectives:

1. To understand wireless LAN Technology.
2. To study the Internet of Things and Bluetooth technology.
3. To familiarize the principles of cellular networks and evolution of cellular networks.
4. To explore the advancements in 4G LTE and LTE Advanced
5. To describe the mobile applications and mobile IP.

UNIT 1 Wireless LAN Technology 10 hours

IEEE 802 architecture, IEEE 802.11 architecture and services, IEEE 802.11 medium access control, IEEE 802.11 physical layer, gigabit Wi-Fi, other IEEE standards, IEEE 802.11 wireless LAN security.

UNIT 2 Bluetooth and IEEE 802.15 9 hours

The Internet of Things, Bluetooth motivation and overview, Bluetooth Specifications, Bluetooth high speed and Bluetooth smart, IEEE 802.15, ZigBee 402.

UNIT 3 Cellular Wireless Networks 8 hours

Principles of cellular networks, first-generation analog, second-generation TDMA, second-generation CDMA, third-generation systems.

UNIT 4 Fourth Generation Systems and LTE-Advanced 9 hours

Purpose, motivation, and approach to 4G, LTE architecture, evolved packet core, LTE resource management, LTE channel structure and protocols, LTE radio access network, LTE Advanced. tropospheric error, multipath.

UNIT 5 Mobile Applications and Mobile IP 9 hours

Mobile application platforms, mobile app development, mobile application deployment, mobile IP.

Textbooks:

1. Cory Beard, William Stallings, Wireless Communication Networks and Systems, Pearson Education, 2016.
2. William Stallings, Wireless Communication and Networking, 2/e, Pearson Education, 2005.

References:

1. Theodore S. Rappaport, Wireless Communications, Principles and Practice, 2/e, Prentice Hall of India, 2002.
2. Kaveh Pahlaven, P. Krishna Murthy, Principles of Wireless Networks, 1/e, Pearson Education, 2002.
3. Kamilo Feher, Wireless Digital Communications, 1/e, Prentice Hall of India, 1999.

Course Outcomes:

1. Describe about the different WLAN technologies (L2).
2. Explain the concepts of Internet of Things and Bluetooth (L2)
3. Illustrate about IEEE 802.15, ZigBee 402 (L3).
4. Explain the principles of cellular networks and its evolution(L2)
5. Demonstrate the motivation towards 4G, LTE architecture resource management and protocols

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3161	GLOBAL POSITIONING SYSTEMS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

"The course is structured to introduce students to the basic principles of locating features on the Earth's surface. While it is a compulsory course for students in remote sensing, it also meets the needs of students in the earth sciences and other location-based disciplines. It is also expected to expose to hands-on training in the use of locational equipment like compass-clinometer, handheld GPS and GNSS.

Course Educational Objectives:

1. To Introduce the basic principles of Global Positioning System
2. To understand the signal structure of GPS and other navigation systems
3. To introduce different coordinate frames and time references
4. To understand the principle involved in position determination
5. To understand the Integration of GPS sensors with different real time applications.

UNIT 1 Overview of GPS 9 hours

Basic concept, system architecture, space segment, user segment, GPS aided Geo-augmented navigation (GAGAN) architecture.

UNIT 2 GPS Signals and other constellations 9 hours

Signal structure, anti-spoofing (AS), selective availability, multi constellation: GALILEO constellation and signal structure, GLONASS constellation and signal structure.

UNIT 3 GPS Coordinate Frames and Time References 8 hours

Geodetic and geo centric coordinate systems, ECEF coordinate world geodetic 1984 (WGS 84), GPS time.

UNIT 4 GPS Orbits and Satellite Position Determination 9 hours

GPS orbital parameters, description of receiver independent exchange format (RINEX), observation data and navigation message data parameters, GPS position determination. GPS error sources – clock error, ionospheric error, tropospheric error, multipath.

UNIT 5 Integration of GPS with Sensors 10 hours

GPS/Inertial Integration, the Kalman Filter, GPSI Integration Methods, Sensor Integration in Land Vehicle Systems: Generic vehicle navigation system architecture, Generic vehicle tracking system architecture. Generic emergency messaging system architecture.

Textbooks:

1. B. Hoffman Wellenhof, H. Liehtenegger, J. Collins, GPS Theory and Practice, Springer Wien, 2001.
2. GottapuSasibhushana Rao, Global Navigation Satellite Systems, Tata McGraw Hill Education, 2010.

References:

1. B.Parkinson, J.Spilker, Jr., GPS Theory and Applications, Vol. I, II, AIAA, 370 L'Enfant Promenade SW, Washington, DC 20024, 1996.
2. James Ba, Yen Tsui, Fundamentals of GPS Receivers A Software Approach, John Wiley and Sons, 2001
3. GPS Principles and Applications, Second Edition Elliott D. Kaplan, Christopher J. Hegarty, Norwood : Artech House, 2005.

Course Outcomes:

1. Identify GPS components and their functions
2. Interpret the navigational message and signals received by the GPS satellite and Galileo.
3. Analyse GPS coordinate frames and time references.
4. Understand different GPS orbital parameters, Position finding and Identify error sources in GPS observations.
5. Integration of GPS with different real time applications.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE4011	SOFTWARE DEFINED NETWORKS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	EECE3031: Communication Networks						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course is to expose the students to the most recent technological developments in mobile communication systems. The course is intended to understand the basic concepts of cellular and mobile communications, various elements in the design of a cellular system and describes the advances in mobile communications. The case studies such as how to improve the coverage area, reduce the interference, frequency and channel assignment towards real time applications also developed in the course.

Course Educational Objectives:

1. To understand and analyse transmission of electrical energy using conducting medium
2. To analyse transmission lines and their parameters using Smith chart
3. "To classify the guided wave solutions- TE, TM."
4. To introduce strip lines and their characteristics
5. To provide an understanding of various microwave components.
6. To explain the measurement of the parameters of waveguide components.

UNIT 1 Introducing SDN 8 hours

SDN Origins and Evolution – Introduction – Why SDN? - Centralized and Distributed Control and Data Planes - The Genesis of SDN

UNIT 2 SDN Abstractions 8 hours

How SDN Works - The Openflow Protocol - SDN Controllers: Introduction – General Concepts - VMware - Nicira - VMware/Nicira - OpenFlow-Related - Mininet - NOX/POX - Trema - Ryu - Big Switch Networks/Floodlight - Layer 3 Centric - Plexxi - Cisco OnePK

UNIT 3 Programming SDN'S 8 hours

Network Programmability - Network Function Virtualization - NetApp Development, Network Slicing

UNIT 4 SDN Applications and Use Cases 8 hours

SDN in the Data Center - SDN in Other Environments - SDN Applications - SDN Use, Cases - The Open Network Operating System 3

UNIT 5 SDN'S Future and Perspectives 8 hours

SDN Open Source - SDN Futures

Textbooks:

1. Paul Goransson and Chuck Black, Software Defined Networks: A Comprehensive Approach Morgan Kaufmann Publications, 2014
2. Thomas D. Nadeau & Ken Gray, SDN - Software Defined Networks by O'Reilly, 2013

References:

1. SiamakAzodolmolky, Software Defined Networking with OpenFlow Packet Publishing, 2013
2. Feamster, Nick, Jennifer Rexford, and Ellen Zegura. "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review 44.2 (2014): 87-98.
3. Kreutz, Diego, et al. "Software-defined networking: A comprehensive survey." Proceedings of the IEEE 103.1 (2015): 14-76.
4. Nunes, Bruno AA, et al. "A survey of software-defined networking: Past, present, and future of programmable networks." Communications Surveys & Tutorials, IEEE 16.3 (2014): 1617-1634.
5. Sasindu Wijeratne, Ashen Ekanayake, Sandaruwan Jayaweera, DanukaRavishan and Ajith Pasqual ”Scalable High Performance SDN Switch Architecture on FPGA for Core Networks.”2019,Pp no:1

Course Outcomes:

1. Discuss the input impedance, characteristic impedance and reflection coefficient of a transmission line
2. Analyse VSWR, input impedance, reflection coefficient of a transmission line using Smith chart and impedance matching techniques using quarter wave transformer and single stub
3. Describe the construction of a microstrip line and determine its parameters
4. Determine solutions to wave equations leading to TE and TM modes of transmission in a rectangular waveguide

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3171	TRANSMISSION LINES AND WAVEGUIDES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	EECE2051: Electromagnetic Waves						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Transmission of any signal requires a medium for communication. This medium may be guided or free space. The guided media can be of many forms based on the frequency of operation. Various types of the guided media of communication are treated and elaborated in this course. Performance analysis of all types of transition lines, stripline and waveguides are presented to enable the selection of suitable line for a given application.

Course Educational Objectives:

1. To understand and analyse transmission of electrical energy using conducting medium
2. To analyse transmission lines and their parameters using Smith chart
3. "To classify the guided wave solutions- TE, TM."
4. To introduce strip lines and their characteristics
5. To provide an understanding of various microwave components.
6. To explain the measurement of the parameters of waveguide components.

UNIT 1 **Transmission Lines** 8 hours

Transmission line parameters, transmission line equations, transmission line examples, input impedance, characteristic impedance, reflection coefficient, VSWR, RF lines

UNIT 2 **Smith Chart and Applications** 8 hours

Graphical methods and applications, Smith chart construction, application, measurement of VSWR, impedance, reflection coefficient, quarter wave transformer, single stub matching techniques.

UNIT 3 **Strip Lines** 8 hours

Introduction, microstrip line, characteristic impedance of microstrip line, losses in microstrip line, quality factor Q of micro strip line.

UNIT 4 **Waveguides** 8 hours

Introduction, microwave frequencies. Rectangular Waveguides: Solutions to wave equations, TE Modes, TM modes, power transmission, power losses, excitation of Modes

UNIT 5 Waveguide Components 8 hours

Introduction to scattering parameters and their properties, wave guide tees, H-plane Tee, E-plane Tee and Magic Tee, directional coupler, Faraday rotation, ferrite devices, gyrators, isolators, circulators and their properties

Text Books:

1. B. Hoffman Wellenhof, H. Liehtenegger, J. Collins, GPS Theory and Practice, Springer Wien, 2001.
2. GottapuSasibhushana Rao, Global Navigation Satellite Systems, Tata McGraw Hill Education, 2010.

References:

1. B.Parkinson, J.Spilker, Jr., GPS Theory and Applications, Vol. I, II, AIAA, 370 L'Enfant Promenade SW, Washington, DC 20024, 1996.
2. James Ba, Yen Tsui, Fundamentals of GPS Receivers A Software Approach, John Wiley and Sons, 2001
3. GPS Principles and Applications, Second Edition Elliott D. Kaplan, Christopher J. Hegarty, Norwood : Artech House, 2005.

Course Outcomes:

1. Discuss the input impedance, characteristic impedance and reflection coefficient of a transmission line
2. Analyse VSWR, input impedance, reflection coefficient of a transmission line using Smith chart and impedance matching techniques using quarter wave transformer and single stub
3. Describe the construction of a microstrip line and determine its parameters
4. Determine solutions to wave equations leading to TE and TM modes of transmission in a rectangular waveguide
5. Explain the operation of a rectangular cavity resonator and compute its quality factor
6. Identify different microwave waveguide components and determine their scattering matrix

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3181	EMI AND EMC TECHNIQUES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	EECE2051: Electromagnetic Waves						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Electromagnetic Pollution is a major concern in today's world. This course is designed for understanding Electro Magnetic Interference and to provide knowledge related to sources of EMI and aspects of EMC measurements about radiated emissions and radiated susceptibility are necessary to know about radiation levels. This course focuses on understanding the concept of coupling mechanisms of EMI and immunity to conducted EMI and EMC standards.

Course Educational Objectives:

1. To understand the concepts of electro-magnetic interference and electro-magnetic compatibility.
2. To impart the knowledge of sources of EMI and their constraints.
3. To illustrate concepts of EMC measurements.
4. To develop the skill to analyse Electro-Magnetic Interference and aspects of EMC and its Standards.

UNIT 1 Natural and Nuclear Sources of EMI/EMC 9 hours

Electromagnetic environment, history, concepts, practical experience and concerns, frequency spectrum conservations, an over-view of EMI/EMC, natural and nuclear sources of EMI

UNIT 2 EMI from Apparatus, circuits and Open Area Test Sites 12 hours

Electromagnetic emissions, noise from relays and switches, non-linearities in circuits, passive inter-modulation, crosstalk in transmission lines, transients in power supply lines, electromagnetic interference (EMI), open area test sites and measurements

UNIT 3 Radiated and Conducted Interference Measurements and ESD 12 hours

Anechoic chamber, TEM cell, GH TEM cell, characterization of conduction Currents/voltages, conducted EM noise on power lines, conducted EMI from Equipment, immunity to conducted EMI detectors and measurements. ESD, Electrical fast transients/bursts, electrical surges

UNIT 4 Grounding, Shielding, Bonding and EMI Filters 9 hours

"Principles and t ypes of grounding, shielding and bonding, characterization of filters, power lines filter design"

UNIT 5 Cables, Connectors, Components and EMC standards 6 hours

EMI suppression cables, EMC connectors, EMC gaskets, isolation transformers, optoisolators, national and international EMC standards

Textbooks:

1. V.P. Kodali, Engineering Electromagnetic Compatibility, 2/e, IEEE Press, 2000

References:

1. Clayton R Paul, Introduction to Electromagnetic Compatibility, John Wiley and Sons, 2010
2. Electromagnetic Interference and Compatibility IMPACT series, IIT Delhi (Units1- 9)

Course Outcomes:

1. Describe the electromagnetic interference and the concept of different coupling mechanisms of EMI
2. Understand how to conduct radiated and conducted interference measurements
3. Explain about characteristics of EMI filters
4. Describe the significance of EMC standards
5. Determine EMI from apparatus and circuits

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3191	RADAR SYSTEMS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	MATLAB						

Course Description:

This course introduces the basic concepts and principles used in radar system. The course also explores different types of radars and their operation with schematic and analytical approach. The course describes applications of different radars used for military and civilian applications.

Course Educational Objectives:

1. To understand the basics of radar and study the effect of various parameters on the performance of radar.
2. To analyse how the Doppler frequency shift is used for measuring the velocity of a moving target.
3. To estimate the position of the target using CW and MTI radars.
4. To interpret various radar tracking systems.
5. To determine the signal-to-noise ratio, receiver noise, probability of detection and false alarms

UNIT 1 Introduction to Radar 9 hours

Radar equation, radar block diagram and operation, radar frequencies, applications of Radar, prediction of range performance, minimum detectable signal, receiver noise, probability density functions, signal to noise ratio, integration of radar pulses, transmitter power, Pulse repetition frequency and range ambiguities.

UNIT 2 CW and FMCW Radars 8 hours

The Doppler effect, CW radar, Frequency-modulated CW radar: range and Doppler measurement, FMCW altimeter; multiple frequency CW radar. Radar Clutter: Introduction to radar clutter, surface clutter radar equation, sea clutter, detection of targets in sea clutter

UNIT 3 MTI and Pulse Doppler Radar 8 hours

Introduction, Pulse radar with Doppler information, MTI radar with delay-line canceler, MTI radar with power-amplifier and power-oscillator transmitter, Delay-line cancelers: blind speeds, double cancellation; staggered PRFs, range-gated Doppler filter, Limitations to MTI performance, Non-coherent MTI, pulse Doppler radar.

UNIT 4	**Tracking Radar**	**6 hours**

Tracking with radar, sequential lobing, conical scan, monopulse tracking radar amplitude comparison monopulse radar with one angular coordinate, phase comparison monopulse radar, low-angle tracking, tracking in range, comparison of trackers

UNIT 5	**Radar Receivers and detection of Radar signals in noise**	**9 hours**

Radar Receivers and detection of Radar signals in noise: The radar receiver, noise figure, radar displays, duplexers, receiver protectors, matched filter receiver, pulse compression Special Purpose Radars-Synthetic aperture radar (SAR), Over-The-Horizon Radar, air-surveillance radar, electronic counter-counter measures.

Textbooks:

1. MerillISkolnik, Introduction to Radar Systems, 3/e, Tata McGraw Hill, 2001.

References:

1. Mark A. Richards, James A. Scheer and William A. Holm, Principles of Modern radar: Basic principles, 1/e, Yes Dee Publishing Pvt. Ltd., 2012.
2. Byron Edde, Radar: Principles, Technology, Applications,1/e, Pearson Education, 1993
3. Simon Kingsley, Shaun Quegan, Understanding Radar Systems, 1/e, SciTech,1999.
4. M A Richards, J A Scheer, W. A. Holm, Principles of Modern M A Richards, J A Scheer, W. A. Holm, Principles of Modern Radar-Basic Principles, 1/e, Yesdee, 2010.

Course Outcomes:

1. Identify different segments of a Pulse radar and the function of each block and explain the effect of various parameters on the performance of radar
2. Illustrate the concepts of CW, FMCW radars and the effect of radar clutters on Doppler radars
3. Distinguish between MTI and pulse Doppler radars
4. Compare various tracking systems
5. Recognize the need of radar receivers and analyze some special purpose radars

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3201</td><td rowspan="2">MICROWAVE ENGINEERING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">EECE2051: Electromagnetic Waves</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Microwave frequencies are extensively used in domestic, telecommunications, commercial, industrial, defence, aeronautical fields. Generation of microwave energy at various frequency bands and at various power levels is the basic requirement of the usage of these frequencies. Such generation techniques are elaborated in this course. Measurement techniques of all parameters of microwaves which are vital at designing or analysing a system are essentially enumerated in this course.

Course Educational Objectives:

1. To understand the concept of negative resistance devices used for amplification at microwave frequencies
2. To study and analyse the Linear beam tube devices commonly used in microwaves subsystems i.e. Two cavity Klystron and Reflex Klystron.
3. To explain the operation of microwave devices using slow-wave structures like Helix traveling wave tube.
4. To analyse the operation of crossed-field device, Conventional Magnetron.
5. To study the measurement of different microwave parameters like impedance, frequency, wavelength, guided wavelength, VSWR etc at gigahertz frequencies using the microwave bench setup.

UNIT 1 **Transferred Electron Devices** **10 hours**

Introduction, GUNN effect diodes (GaAs diode), GUNN diode principle of operation (RWH theory). Avalanche Transit Time Devices: Introduction, Operation of IMPATT Diode, Operation of TRAPATT diode, parametric amplifiers, applications.

UNIT 2 **Microwave Linear Beam Tubes** **9 hours**

High frequency limitations of conventional tubes, Klystrons, Re-entrant cavities, velocity modulation process, bunching process, reflex Klystron, velocity modulation, power output and efficiency

UNIT 3 Helix Traveling Wave Tubes 8 hours

Slow wave structures, amplification process, convection current, axial electric field, wave modes, gain considerations

UNIT 4 Microwave Crossed Field Tubes 8 hours

Magnetron oscillator types, principle of operation of cylindrical magnetron, equations of electron motion, cyclotron angular frequency, pi mode separation.

UNIT 5 Microwave Measurements 10 hours

Introduction, microwave bench measurement setup, frequency and wavelength measurements, measurement of power, VSWR, impedance, coupling factor, directivity, isolation of a directional coupler.

Textbooks:

1. Samuel Y. Liao, Microwave Devices and Circuits, 3/e, Prentice Hall of India, 2003
2. Sushrut Das, Microwave Engineering, 1/e, Oxford University Press, 2015

References:

1. R.E. Collins, Foundations for Microwave Engineering, 2 /e, John Wiley & Sons, 2009
2. GottapuSasibhushana Rao, Microwave and Radar Engineering, 1/e, Pearson Education, 2014
3. M Kulkarni, Microwave and Radar Engineering, 1/e, Pearson Education, 2014

Course Outcomes:

1. Explanation about the principle of operation of Transferred Electron Devices, Avalanche Transit Time Devices and Parametric Devices
2. Recognition of the limitations of existing vacuum tubes at microwave frequencies and performance of linear beam tubes such as Two cavity Klystron and Reflex Klystron
3. Evaluation of the performance of microwave tubes with slow wave structures such as Helix traveling wave tube
4. Analysis of the performance of crossed field microwave tubes such as Magnetron.
5. The student will be able to conduct experiments for measuring frequency, wavelength, power, VSWR, impedance of microwave circuits

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE4022	RF CIRCUIT DESIGN	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable exposure							

Course Description:

This course mainly concentrates on the RF and microwave concepts, Smith chart analysis, amplifier and oscillator circuit design at RF frequency and applications of RF circuits

Course Educational Objectives:

1. To understand Basic RF frequency advantages and circuit design process.
2. To impart the knowledge of basic resonant and impedance matching circuits
3. To explain the use of smith chart for calculating certain parameters.
4. To explore the design of RF amplifiers.
5. To understand RF oscillators and their design process.

UNIT 1 — Introduction to RF and Microwave concepts and applications — 8 hours

Introduction, Reasons for using RF/Microwaves, RF/Microwave applications, Radio frequency waves, RF and Microwave circuit design, General active circuit block diagrams

UNIT 2 — RF Electronics Concepts — 8 hours

Introduction, RF/Microwaves versus DC or low AC signals, EM spectrum, Wave length and frequency, Resonant circuits, Impedance transformers, RF impedance matching, Three element matching.

UNIT 3 — Smith Chart and its Applications — 8 hours

Introduction, A valuable graphical aid the smith chart, Derivation of smith chart, stability circles, Description of two types of smith charts, Smith charts circular scales, Smith charts radial scales, the normalized impedance-admittance (ZY) smith chart introduction

UNIT 4 — RF and Microwave Amplifiers — 8 hours

Introduction, Types of amplifiers, Small signal amplifiers, Multistage small signal amplifier design, High-power amplifiers, Microwave power combining/dividing techniques, Signal distortion due to inter modulation products, Multistage amplifiers

UNIT 5 RF and Microwave Oscillator Design 8 hours

Introduction, Oscillator versus amplifier design, Oscillation conditions, Design of transistor oscillators, Generator-tuning networks

List of Experiments

The laboratory component shall involve design and simulation of below systems (but not limited to) using AWR Microwave Office or Advanced Design Systems (ADS) Software

1. Design of IF amplifier
2. Design of Mixer
3. Design of low noise amplifier
4. Design a sub circuit of a microwave circuit.
5. Design of Power amplifier
6. Design of Microwave components and passive circuits
7. Design of E, H junctions.
8. Impedance calculation of transmission line.
9. Frequency response of FET
10. Design layout of passive circuit.
11. Design Magic-T junctions.
12. Design of Microwave filters.

Textbooks:

1. Mathew M. Radmanesh, "Radio Frequency and Microwave Electronics", Prentice hall,2001.
2. Joseph Helszain,"Microwave Engineering, Active and Non-reciprocal Circuits", McGraw HillInternational Edition, 1992

References:

1. R.E. Collins, Foundations for Microwave Engineering, 2 /e, John Wiley & Sons, 2009
2. GottapuSasibhushana Rao, Microwave and Radar Engineering, 1/e, Pearson Education, 2014
3. M. Kulkarni, Microwave and Radar Engineering, 1/e, Pearson Education, 2014

Course Outcomes:

1. Explain different types of Smith charts used for RF and Microwave circuit design
2. Determine wave length and frequency

3. Evaluate the normalized impedance-admittance using Smith chart
4. Design Multi stage small signal amplifier
5. Explain Signal distortion due to inter modulation products
6. Describe construction of Generator-tuning networks

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3212</td><td rowspan="2">ARM SYSTEM DEVELOPMENT</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7"></td></tr>
</table>

Course Description:

The emphasis of this course is to familiarize with the advanced 32-bit ARM microcontroller architecture, programming and develop applications. This course provides the knowledge of LPC2148 microcontroller architecture and pipelining concept used in it. Programming of LPC 2148 with polling and interrupt methods are emphasized. The students are exposed to the interfacing external peripheral devices.

Course Educational Objectives:

1. To provide a clear understanding on the RISC and CISC and ARM philosophy.
2. To program ARM 32 microcontroller in assembly language.
3. To familiarize the pipelining concept used in advanced microcontrollers.
4. To describe the concepts of peripheral interfacing with ARM microcontroller.
5. To introduce programming with embedded C.

UNIT 1 Introduction to ARM 7 Architecture 8 hours

The RISC design philosophy, ARM design philosophy, embedded system hardware- AMBA bus protocol, embedded system software- applications. ARM core data flow model, Registers, CPSR-Processor modes.

UNIT 2 ARM Instructions Set 8 hours

Fundamentals of ARM instructions, Barrel shifter, Classification and explanation of instructions with examples-Data processing, Branch, Load-store, SWI and Program Status Register instruction, Introduction to THUMB, Differences between ARM and THUMB, Register usage in Thumb.

UNIT 3 Exception Handling 9 hours

ARM processor exceptions and modes, vector table, exception priorities, link register offsets. Interrupts- assigning interrupts, interrupt latency, IRQ and FIQ exceptions with example- code for enabling and disabling IRQ and FIQ exceptions, Comparison between exception and interrupts. Interrupt handling schemes- nested interrupt handler, non-nested interrupt handler. Basic interrupt stack design

UNIT 4 Introduction to ARM7 Microcontroller 9 hours

LPC2148 ARM 7 microcontrollers, Features of LPC2148, Architecture of LPC2148, addressing mode, Memory organization, ARM register model, programmer model, oscillator, PLL, CPSR, SPSR,3stage pipelining.

UNIT 5 Interfacing with ARM 8 hours

LED,GPIO programming with embedded C, LCD interfacing, programming of LCD, ADC, Interfacing of LM35 temperature sensor, DAC, Timers, ART programming, transfer of a character and receive of a character program.

List of Experiments

1. LED Blinking using LPC2148 (Slow GPIO)
2. LED Blinking using PLL in LPC2148
3. LED Blinking using Timers
4. LED Blinking using Interrupts
5. Serial Communication with ARM7 using Polling
6. Serial Communication using Interrupts
7. Interfacing LPC2148 with ADC
8. Preemptive Task Based Scheduling – using VxWorks
9. Demonstration on the use of Interrupt Service Routines
10. Case Study / Socially Relevant Design Project

Text Books:

1. Mathew M. Radmanesh, "Radio Frequency and Microwave Electronics", Prentice hall,2001.
2. Joseph Helszain,"Microwave Engineering, Active and Non-reciprocal Circuits", McGraw Hill International Edition, 1992 **References:**
3. R.E. Collins, Foundations for Microwave Engineering, 2 /e, John Wiley & Sons, 2009
4. Gottapu Sasibhushana Rao, Microwave and Radar Engineering, 1/e, Pearson Education, 2014
5. M. Kulkarni, Microwave and Radar Engineering, 1/e, Pearson Education, 2014

References:

1. R.E. Collins, Foundations for Microwave Engineering, 2 /e, John Wiley & Sons, 2009
2. GottapuSasibhushana Rao, Microwave and Radar Engineering, 1/e, Pearson Education, 2014
3. M. Kulkarni, Microwave and Radar Engineering, 1/e, Pearson Education, 2014

Course Outcomes:

1. Understand the ARM philosophy and ARM data flow model (L1).
2. Analyse and understand ARM instruction set and THUMB instruction set (L4).
3. Understand the exception, interrupts and interrupt handling schemes (L2).
4. Describe the architectural features of LPC2148 microcontrollers (L2).
5. Explain the hardware and interfacing peripheral devices to LPC2148 (L2).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3221	INTERNET OF THINGS	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The Internet of Things (IoT) is a network of a wide variety of devices like vehicles, humans, soil etc. These devices gather data using sensors, which can be used for monitoring or control. This course is an introduction to the embedded devices, communication protocols used in IoT.

Course Educational Objectives:

- Introduce the fundamental concepts of IoT and physical computing
- Illustrate diverse methods of deploying smart objects and connect them to network.
- Expose the student to a variety of embedded boards and IoT Platforms
- Familiarize the student with application program interfaces for IoT.
- Enable students to create simple IoT applications.

UNIT 1 **5 hours**

Introduction to Internet of Things (IoT): Introduction and Definition of Internet of Things, IoT Growth, Application Areas of IoT, Characteristics of IoT, Things in IoT, IoT Stack, Enabling Technologies, IoT Challenges, IoT Levels, IoT vs. Cyberphysical Systems, IoT vs WSN

UNIT 2 **6 hours**

Introduction to Sensors, Microcontrollers, and Their Interfacing: Introduction to Sensor Interfacing, Types of Sensors, Controlling Sensors through Webpages, Microcontrollers

UNIT 3 **6 hours**

Protocols for IoT – Messaging and Transport Protocols: Messaging Protocols, Transport Protocols (Li-Fi, BLE), Protocols for IoT – Addressing and Identification: Internet Protocol Version 4 (IPv4), Internet Protocol Version 6 (IPv6), Uniform Resource Identifier (URI)

UNIT 4 **5 hours**

Cloud for IoT: IoT with Cloud – Challenges, Selection of Cloud Service Provider for IoT Applications, Introduction to Fog Computing, Cloud Computing: Security Aspects, Case Study: How to use Adafruit Cloud?

UNIT 5 **6 hours**

Data Analytics – Visualizing the Power of Data from IoT, Data Analysis, Machine Learning, Types of Machine Learning Models, Model Building Process, Modelling Algorithms, Model Performance.

Application Building with IoT: Smart Perishable Tracking with IoT and Sensors, Smart Healthcare – Elderly Fall Detection with IoT and Sensors, IoT–Based Application to Monitor Water Quality

Smart Warehouse Monitoring, Smart Retail

List of Experiments (2 Hours each)

1. Blinking led with Arduino using software delay, LED Control with switch
2. Temperature measurement using LM35 and display both on LCD and serial monitor
3. Control DC motor with H-bridge and as well as PWM
4. Raspberry pi installation and led control
5. DHT11 sensor interfacing to Raspberry pi and Transfer the data to Thingspeak server
6. Interfacing camera and raspberry pi
7. Accelerometer ADXL345 with i2c with raspberry pi
8. Nodemcu to control LED with thinger.io
9. With Nodemcu HTTP protocol get and post
10. With nodemcu Webserver control led
11. MQTT protocol using Nodemcu
12. Blinky app with led control

Textbooks:

1. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, Internet of Things, Wiley India, 2019

References:

1. Simon Monk, Programming Arduino: Getting Started with Sketches, Mc Graw Hill Publications, 2011
2. Simon Monk, Programming the Raspberry Pi, Getting Started with Python, Mc Graw Hill Publications, 2015
3. Simon Monk, Hacking Electronics: Learning Electronics with Arduino and Raspberry Pi, Mc Graw Hill Publications, 2017
4. Manoj R. Thakur, NodeMCU ESP8266 Communication Methods and Protocols : Programming with Arduino IDE Amazon Media, 2018.

Course Outcomes

Upon successful completion of the course, students will be able to

1. enumerate the characteristics and challenges in IoT application areas (L1)
2. choose an appropriate sensor for measuring a physical quantity and interface the data to a computing system (L3)
3. elaborate the role of different IoT protocols, used for data communication between different IoT devices and cloud (L3)
4. choose an appropriate cloud service provider and design/choose the security requirements for an IoT application (L4)
5. apply the different data mining and machine learning algorithms for analyzing the data collected from sensor nodes

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3231	IOT ARCHITECTURE AND PROTOCOLS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	EECE3031: Communication Networks						

Course Description:

The purpose of this course is to impart knowledge on IoT Architecture and various protocols, study their implementations

Course Educational Objectives:

1. To Understand the Architectural Overview of IoT
2. To Understand the various IoT Protocols (Datalink, Network,Transport, Session, Service)

UNIT 1 Designing the Architecture of an IP-based Internet of Things 9 hours

IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Physical/link Layer, Network Layer, Transport Layer, Appllication Layer.

UNIT 2 Interoperability 8 hours

Cloud IoT platform architecture, REST Architectures, The Richardson maturity model

UNIT 3 IoT Data Link Layer & Network Layer Protocols 10 hours

PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), WirelessHART,ZWave,Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL,CARP

UNIT 4 Transport & Session Layer Protocols 10 hours

Transport Layer: TCP, MPTCP, UDP, DCCP, SCTP,TLS, DTLS, Session Layer: HTTP, CoAP, XMPP, AMQP, MQTT, REST, Websocket

UNIT 5 Service Layer Protocols & Security 8 hours

Service Layer: one M2M, ETSI M2M, OMA, BBF, Security in IoT Protocols: MAC, 802.15.4 , 6LoWPAN, RPL, Application Layer

Textbooks:

1. Internet of Things: Architectures, Protocols and Standards,SimoneCirani, Gianluigi Ferrari, Marco Picone, Luca Veltri.
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
3. Peter Waher, “Learning Internet of Things”, PACKT publishing, BIRMINGHAM – MUMBAI 3. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
4. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1stEdition, VPT, 2014. (ISBN: 978-8173719547)

References:

1. Misra, S., Mukherjee, A., & Roy, A. (2021). Introduction to IoT. Cambridge: Cambridge University Press. doi:10.1017/9781108913560
2. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
3. Hersent, Olivier, David Boswarthick, and Omar Elloumi. The internet of things: Key applications and protocols. John Wiley & Sons, 2011.

Course Outcomes:

1. Understand the concepts of IoT Architecture Reference model and IoT reference architecture.
2. Understand the concept of Cloud IoT Architecture.
3. Analyze various IoT Data Link & Network layer Protocols.
4. Analyze various IoT Transport & Session layer Protocols.
5. Analyze various IoT Service layer Protocols.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3241	IOT APPLICATIONS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	EECE3221: Internet of Things						

Course Description:

This course will introduces application areas of IoT technologies by conducting Industrial case studies and IoT Standards,IoT legal perspectives at design phase

Course Educational Objectives:

1. Introducing the application areas of IoT technologies by conducting Industrial case studies
2. Processing the knowledge on IoT Standards and IoT legal perspectives at design phase

UNIT 1 Smart Water and Environment 6 hours

Smart Environment: Forest Fire Detection, Air Pollution, Snow Level Monitoring, Landslide and Avalanche Prevention, Earthquake Early Detection. Smart Water: Potable water monitoring, Chemical leakage detection in rivers, Swimming pool remote measurement, Pollution levels in the sea, Water Leakages, River Floods

UNIT 2 Smart Metering and Smart Cities 6 hours

Smart Cities: Parking, Structural Health, Noise Urban maps, Smart Phone Detection, Electromagnetic Field Levels, Traffic Congestion, Smart Lighting, Waste Management, Smart Roads. Smart Metering : Smart Grid, Tank level, Photovoltaic Installations, Silos Stock Calculation

UNIT 3 Smart Health ,Home Automation, Retail and Logistics 10 hours

Home Automation: Energy and Water Use, Intrusion Detection Systems. Health: Fall Detection, Medical Fridges, Sportsmen Care, Patients Surveillance, Ultraviolet Radiation Smart Retail: Supply Chain Control, NFC Payment, Intelligent Shopping Applications, Smart Product Management. Logistics: Quality of Shipment Conditions, Item Location, Storage Incompatibility Detection, Fleet Tracking

UNIT 4 Smart Industrial control and Agricultural 10 hours

Industrial Control: M2M Applications, Indoor Air Quality, Temperature Monitoring, Ozone Presence, Indoor Location, Vehicle Auto-diagnosis, Perimeter Access Control, Liquid Presence, Radiation Levels, Explosive and Hazardous Gases. Agricultural: Green Houses, Golf Courses, Meteorological Station Network, Compost, Hydroponics, Offspring Care, Animal Tracking, Toxic Gas Levels

UNIT 5 IoT Legal Perspectives and Standardization 8 hours

Self-Regulation, International Legal Framework, Security and Privacy: Privacy Enhancing Technologies, Legal Challenges for a Privacy Framework, Responsibility for Violations of Privacy, Tackling Environmental Concerns
Standardization:ISO, IEC, ETSI, IEEE, IETF, ITU-T, OASIS, OGC and one M2M

Textbooks:

1. Ovidiu Vermesan, Peter Friess, Internet of Things From research and innovation to market deployment, 2014, River Publishers Series in Communication, USA.
2. Introduction to IoT by Sudip Misra, Anandarup Mukherjee, CAMBRIDGE, 2021 Edition
3. Internet of Things and its Applications: Made simple (English Edition)

References:

1. Ovidiu Vermesan, Peter Friess, Internet of Things Converging Technologies for Smart Environments and Integrated Eco Systems, 2013, River Publishers Series in Communication, USA.
2. Libelium Inc, Internet of Things: Case Studies, http://www.libelium.com/resources/case-studies, White papers, Spain.

Course Outcomes:

1. Explore Smart Water & Environment applications and IoT Use Cases and IoT Use Cases
2. Investigate Smart Metering & Smart Cities applications and IoT Use Cases
3. Investigate Smart Health ,Home Automation , Smart Retail & Logistics applications and IoT Use Cases
4. Comprehend the Smart Industrial control & Agricultural applications and IoT Use Cases
5. Understand the standardization of IoT and IoT Legal perspectives

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3242	WIRELESS SENSOR NETWORKS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course aims to provide fundamentals of wireless sensor networks and its application to critical real time.

Course Educational Objectives:

1. To learn basic principles behind a Wireless Sensor Network.
2. To study network protocols, services and applications.
3. To study the importance localization, secure aggregation, security.
4. To study simulation of wireless networks.
5. To understand the routing protocols.

UNIT 1 Basics of WSN Vs Ad HoC 10 hours

Basics of Ad Hoc Networks and their applications, enabling technologies, classification of Ad-hoc networks, Overview of different challenges in implementing Ad Hoc Networks, Overview of different solutions proposed for overcoming the challenges in these networks, self-organizing behavior, Properties, Differences between the self-organizing systems and the conventional ones, Mechanisms for ensuring self-organization in MANETs, Co-operation in MANET's, Dealing with misbehaviors in MANETs, Incentive mechanisms for countering misbehaviors, Basic concepts of wireless sensor networks, Features of MWSNs ,Different types of MWSNs, Human-Centric Sensing. Case study: The great duck island experiment.

UNIT 2 Introduction to Sensor Node 9 hours

Architecture and components of a sensor node, Characteristics and requirements of sensor node, Design challenges, Different sensing scenarios using WSN, Challenges in implementing WSNs, Sensor-web introduction, Types of sensor node behavior, Security of WSN, Operating systems and execution environments, Some examples of sensor nodes, Optimization goals and figures of merit, Gateway concepts, Case study: Design of SWAN sensor node.

UNIT 3 MAC Protocols 9 hours

Need for MAC protocols for MANETs, Classification of MAC protocols ,Hidden and exposed terminal problems ,MAC protocols MACA ,MACAW, DBTMA, MARCH, MAC protocols for sensor networks, Routing challenges in MANET's Proactive, reactive, and hybrid routing protocols, Examples routing protocols, Factors in performance evaluation, Issues with the adoption of ad hoc routing protocols for WSN, Data-centric routing, Position-based routing, Data aggregation Clustering-based routing algorithm.

UNIT 4 Coverage and Topology 8 hours

Hours Coverage problem in WSNs, Types of coverage, OGDC coverage algorithm, Placement problem, Basics of topology management in WSNs, Different classifications of topology management algorithms, Topology discovery, sleep-cycle management, and clustering.

UNIT 5 IoT Legal Perspectives and Standardization 9 hours

Hours Sensor network platform and tools, operating systems for WSN, Hardware-Berkeley motes, Programming challenges, Node level software platforms, Node level simulators.

Textbooks:

1. Ovidiu Vermesan, Peter Friess, Internet of Things From research and innovation to market deployment, 2014, River Publishers Series in Communication, USA.
2. Introduction to IoT by Sudip Misra, Anandarup Mukherjee, CAMBRIDGE, 2021 Edition
3. Internet of Things and its Applications: Made simple (English Edition)

References:

1. Ovidiu Vermesan, Peter Friess, Internet of Things Converging Technologies for Smart Environments and Integrated Eco Systems, 2013, River Publishers Series in Communication, USA.
2. Libelium Inc, Internet of Things: Case Studies, http://www.libelium.com/resources/case-studies, White papers, Spain.

Course Outcomes:

1. Compare and contrast Ad hoc and wireless sensor networks, describe existing applications of wireless sensor networks.
2. Explain node architecture and software aspect of WSN.
3. Illustrate various network level protocols for MAC and routing.
4. Analyze control, clustering, localization, positioning.
5. Distinguish between the various hardware, software platforms that exist for sensor networks.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3251</td><td rowspan="2">SENSORS AND SIGNAL CONDITIONING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course gives an understanding of how the physical parameters are transduced into proportional electrical signals. The knowledge acquired in this course is helpful in advanced courses like Bio medical Instrumentation , Analytical Instrumentation, Opto Electronic Instrumentation. The course helps the students to develop an understanding of how the sensors are to be selected, calibrated and incorporated into an automated process system.

Course Educational Objectives:

1. To provide basic knowledge sensors and transducer technology and measurement systems.
2. Expose studenst to various sensors and transducers for measuring different quantities.
3. To provide better familiarity with the Theoretical and Practical concepts of Transducers
4. To provide familiarity with different sensors and their applications in real life.

UNIT 1 Introduction to Measurement System 8 hours

Introduction to measurement systems, Static characteristics of MS: Accuracy, precision, Linearity, Hysteresis, Threshold, Repeatability, Reliability, Maintainability, Span, Calibration. Sources of errors, Dynamic characteristics of M.S, - Zero order, first order instruments and their responses for impulse, step, ramp & sinusoidal Inputs and frequency response. Basics of signal conditioning: signal amplifictaion, filtering, Instrumentation amplifier.

UNIT 2 Resistive Sensors 8 hours

Introduction to Sensors, Introduction to Transducers, Classicificationof Transducers, Resistive sensors: Potentiometers ,Strain gauges and types, Bridge configuration, compensation. Resistive Temperature Detectors (RTD), Thermistors, Light-Dependent Resistors (LDR), Signal conditioning for resistive sensors: measurement of resistance , voltage dividers, Wheatstone bridge. Balance and deflection measurements

UNIT 3 Reactive Sensors 8 hours

Reactance variation and Electromagnetic Sensors : Variable & Differential, Inductive sensors – Reluctance variation, Eddy current, Linear Variable Differential Transformers (LVDT), Rotary Variable Differential Transformer(RVDT). Variable Capacitive Transducers: Capacitance Principles, Capacitive Displacement Transducers, Capacitive Hygrometer and Capacitive Proximity Sensors, Signal conditioning for reactance variation sensors : problems and alternatives, ac bridges, carrier amplifiers.

UNIT 4 Self Generating Sensors 8 hours

Self-generating sensors: Thermoelectric Sensors, Piezoelectric Sensors, Pyroelectric sensors, Photovoltaic sensors , Electrochemical sensors, Signal conditioning for self-generating sensors: chopper and low-drift amplifiers, offset and drifts amplifiers , electrometer amplifiers.

UNIT 5 Digtal Sensors, Semicondcutor Device Sensors 9 hours

Digital sensors: Position Encoders, Variable Frequency Sensors – Quartz Digital Thermometer, Vibrating Wire Strain Gauges, Vibrating Cylinder Sensors. Sensors based on MOSFET Transistors, Charge coupled Sensors. MEMS Overview: Unique Characteristics of MEMS, Typical Application Areas of MEMS, MEMS Accelerometer, Optical MEMS, MEMS as a switch, MEMS Micro actuators. Principles of micro sensors: MEMS for Pressure, Force and Temperature Measurement.

Textbooks:

1. Doeblin E.O, "Measurement Systems – Applications and Design" , McGraw Hill International, 4th Edition, 1990.
2. Patranabis D, "Principles of Industrial Instrumentation", TMH, 2nd Edition, 1997.
3. "Murthy D V S, ""Transducers and Instrumentation"", PHI, 1995"
4. Ramon Pallas-Areny, John G. Webster, "Sensors and Signal Conditioning", , John Wiley & Sons, 2nd Edition.
5. Graham M. Brooker, "Introduction to Sensors for Ranging and Imaging" Scitech Publishing 2009

References:

1. A K Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons
2. Ian Sinclair, "Sensors and Transducers", Elsevier, 3rd Edition, 2011
3. John P. Bentley, "Principles of Measurement Systems", Pearson Education, 3rd Edition, 2000.
4. Julian Garder, Vijay K. Varadan, "Microsensors, MEMS and Smart Devices" John Wiley & Sons Ltd. (2006).

5. Jon Wilson , “Sensor Technology Handbook”, Newnes 2005.

Course Outcomes:

1. Identify suitable sensors and transducers for real time applications.
2. Translate theoretical concepts into working models.
3. "Design the experimental applications to engineering modules and practices.
4. Design engineering solutions to the Industry/Society needs and develop products.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE4031	IOT SECURITY	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	EECE3221: Internet of Things						

Course Description:

The Internet of Things (IoT) is a network of a wide variety of devices like vehicles, humans, soil etc. These devices gather data using sensors, which can be used for monitoring or control. This course is an introduction to the embedded devices, communication protocols used in IoT.

Course Educational Objectives:

1. To learn the concepts about Internet of things
2. "The purpose of this course is to expose students to new developments in the areas of cybersecurity for the Internet of Things (IoT)"
3. To learn the security principles and methodologies for Internet of Things

UNIT 1 Introduction: Securing The Internet of Things 8 hours

Security Requirements in IoT Architecture - Security in Enabling Technologies -Security Concerns in IoT Applications. Security Architecture in the Internet of Things -Security Requirements in IoT - Insufficient Authentication/Authorization - InsecureAccess Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT. Vulnerabilities – Secrecy and Secret-Key Capacity -Authentication/Authorization for Smart Devices - Transport Encryption – Attack & Fault tree

UNIT 2 Identity & Access Management Solutions for IoT 8 hours

"Identity lifecycle – authentication credentials – IoT IAM infrastructure – Authorization with Publish / Subscribe schemes – access control "

UNIT 3 Privacy Preservation and Trust Models for IoT 8 hours

"Concerns in data dissemination – Lightweight and robust schemes for Privacy protection – Trust and Trust models for IoT – self-organizing Things - Preventing unauthorized access."

UNIT 4 Cryptographic Fundamentals for IoT 8 hours

Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes –Digital Signatures – Random number generation – Cipher suites – key management fundamentals – cryptographic controls built into IoT messaging and communication protocols – IoT Node Authentication

UNIT 5 Cloud Security for IoT 8 hours

Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud IoT security controls – An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing

Textbooks:

1. "Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren "
2. "Johnson Jr, C. Richard, William A. Sethares, and Andrew G. Klein, "Software receiver design: build your own digital communication system in five easy steps," Cambridge University Press, 2011."
3. "A. Narayanan et al., "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction," Princeton University Press, 2016"

References:

1. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies," O'Reilly, 2014
2. "T. Alpcan and T. Basar, "Network Security: A Decision and Game-theoretic Approach," Cambridge University Press, 2011."

Course Outcomes:

1. Ability to understand the Security requirements in IoT.
2. Understand the cryptographic fundamentals for IoT
3. "Ability to understand the authentication credentials and access contro"
4. Understand the various types Trust models and Cloud Security.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE4032</td><td rowspan="2">CLOUD BASED IOT</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This module provides an overview of the Internet of Things (IoT) and Cloud Computing concepts, infrastructures and capabilities. This will help students gain the necessary knowledge to construct IoT systems and use cloud services for processing and storage of the data produced by the IoT devices. Emphasis will be placed on the architecture and design of IoT systems, the different technologies (wireless/mobile/sensor) governing system implementation and the migration of the data to the Cloud for processing. Students will gain practical experience in the development of Cloud-based IoT systems and exposure to appropriate hardware and software platforms that underpin such development.

Course Educational Objectives:

1. Evaluate industry-leading systems and technologies for public and private cloud infrastructure
2. Learn how to use cloud services for IoT applications.
3. Implement cloud features to secure and harden the cloud infrastructure

UNIT 1 **Introduction to cloud computing** **8 hours**

Characteristics of Cloud computing – Cloud Models – Cloud Services – IaaS, PaaS, SaaS, DaaS– Cloud based services and applications

UNIT 2 ***Cloud Services and Platforms*** **8 hours**

Compute Services, Storgae Services, Database services, Application Services, Content Delivery Services, Analutics Services, Deployment and Management Services, identity and Access management services : Amazon Web Services, Google Cloud Platform, Windows Azure

UNIT 3 **Cloud Application Architectures** **9 hours**

Development environments for service development: Amazon, Azure, Google Appcloud platform in industry

UNIT 4 **Privacy and Security** **10 hours**

Application Design- Machine Image Design-privacy design –Database management, Security Concerns, Risk Issues, and Legal Aspects of Cloud Computing- Cloud Data Security.

UNIT 5 **IoT Cloud- Case Study** **10 hours**

Case Study: Arduino IoT Cloud with NodeMCU, IBM Watson IoT Platform, Google Cloud IoT Core, Microsoft Azura IoT, Amazon Web Service (AWS) IoT Core.

Textbooks:

1. ArshdeepBahga, Vijay Madisetti, “Cloud Computing: A Hands-On Approach”, A HANDSON APPROACH Text Book series, 2013.
2. "RajkumarBuyya, Christian Vecchiola, S.ThamaraiSelvi,""Mastering Cloud Computing: Foundations and Applications Programming"", Elsevier publication, 2013"

References:

1. Reese, G. (2009). Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009).
2. Thomas Erl, ZaighamMahmood, and Ricardo Puttini,Cloud Computing Concepts, Technology & Architecture, PRENTICE HALL,2013
3. John R. Vacca, “Cloud Computing Security: Foundations and Challenges”, CRC Press, 2016.

Course Outcomes:

1. To understand the differences between traditional deployment and cloud computing.
2. Students able to learn about cloud services and cloud platforms.
3. Able to understand the different IoT cloud services.
4. To learn how to build a transactional web application for the cloud or migrate one to it.
5. Design the IoT cloud application in different cloud platforms

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE3261	REAL TIME SIGNAL PROCESSING	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	MATLAB, CSEN1001: Problem Solving and Programming with C, EECE3001: Digital Signal Processing						

Course Description:

The course provides knowledge of DSP theory, algorithms and techniques that are applicable to the design of contemporary real-time embedded systems. Topics in both classical and statistical DSP methods are covered including optimal filtering, spectral estimation and adaptive filtering with applications in analysis

Course Educational Objectives:

1. Express concepts of real time concepts, architecture and addressing modes of TMS320C6x processor.
2. Express instructions and interrupts of TMS320C6x Processor
3. Emphasize on data formats and constraints of DSP processors.
4. Present how to realize FIR and IIR filters.
5. Emphasize on adaptive filtering algorithms and optimization schemes.

UNIT 1 Introduction to Real Time Signal Processing 9 hours

Introduction: Introduction to real time concepts, Signal Processing and DSP systems, Comparison between general purpose and DSP processors. Architecture:TMS320C6x Architecture, Functional Units, Fetch and Execute, Packets, Pipelining, Registers. Addressing modes: Linear and Circular Addressing Modes

UNIT 2 C6x Processor 9 hours

Instruction Set of the C6x Processor:TMS320C6x Instruction Set-Assembly Code Format, Types of Instructions, Assembler Directives, Timers, Interrupts- Interrupt Control Registers, Interrupt Acknowledgment, Multichannel Buffered Serial Ports, Direct Memory Access.

UNIT 3 Data representation of DSP Processors 9 hours

Data representation of DSP Processors: Data Types, Floating-Point Format, Q-format Number Representation, Finite Word Length Effects on Fixed-Point DSPs, Overflow and Scaling, Real time implementation considerations, Memory Considerations, Code Improvement, Constraints: Memory Constraints, Cross-Path Constraints, Load/Store Constraints, Pipelining Effects with More Than One EP within an FP.

UNIT 4	**FIR and IIR Filters**	**9 hours**

"Finite Impulse Response Filters: Introduction to the z-Transform, Mapping from s-Plane to z-Plane, Difference Equations, Discrete Signals, FIR Filters, FIR Lattice Structure, Window Functions, Hamming Window, Hanning Window, Blackman Window, Kaiser Window.
Infinite Impulse Response Filters:IIR Filter Structures, Direct Form I Structure, Direct Form II Structure, Direct Form II Transpose, Cascade Structure, Parallel Form Structure."

UNIT 5	**Adaptive Filters**	**9 hours**

Introduction, Adaptive Structures, Adaptive Linear Combiner, Performance Function Searching for the Minimum Code Optimization:Introduction to optimization, Optimization Steps, Procedure for Code Optimization, Software Pipelining for Code Optimization, and Execution Cycles for Different Optimization Schemes.

List of Experiments

1. To study about DSP Processors and architecture of TMS320C6713 DSP processor
2. Introduction to MATLAB and Code Composer Studio.
3. Write a MATLAB Program for the generation of basic signals such as unit impulse, unit step, ramp, exponential, sinusoidal and cosine.
4. To study matrix multiplication using code composer studio.
5. Evaluate 4 point DFT of and IDFT of x(n) = 1, $0 \leq n \leq 3$; 0 elsewhere.
6. Implement FFT algorithm.
7. Verify Blackman and Hamming windowing techniques.
8. Implement IIR Butterworth analog Low Pass for a 4 KHz cut off frequency.
9. Verify Circular Convolution using code composer studio.
10. Verify linear convolution of two sequence using code composer studio.
11. To implement Tone Generation.
12. To implement floating point arithmetic.
13. Write a MATLAB program to design a FIR Low pass, High pass, Band pass, Band stop filter using Rectangular window.

14. Write a MATLAB program to design Chebyshev Type-I (Low pass filter, High pass, Band pass& Band stop filter).

15. Real-time audio or image processing applications

Textbooks:

1. Boca Raton, Real-Time Digital Signal Processing from MATLAB to C with the TMS320C6x DSPs CRC Press, (2011)

2. RulphChassaing and Donald Reay, "Digital Signal Processing and Applications with the C6713 and C6416 DSK", Second edition, A John Wiley and Sons, Inc., Publication. ISBN 9780471704065

References:

1. Kuo, woonseng-s gen, "Digital Signal Processors: Architectures, Implementations, and Applications", Pearson education.

2. B. Venkataramani, M. Bhaskar, "Digital signal processors architecture, programming and applications", TMH Edition

Course Outcomes:

1. Understand the real world applications, architecture and addressing modes of DSP processors.
2. Understand instructions and interrupts of TMS320C6x processor.
3. Analyze data formats and constraints related to DSP Processors
4. Realize FIR and IIR filters
5. Analyse adaptive filtering algorithms and optimization schemes for improving performance.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE3271	DIGITAL IMAGE PROCESSING	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

UNIT 1 Digital Image Fundamentals and Transforms 10 hours

Elements of Visual perception, Image sensing and Acquisition , Imaging in different bands, Digital Image Representation: Black and White, Gray scale and colour Images, Relationship between pixels, Image transformations: 2D-DFT, DCT, DST, Hadamard, Walsh, Hotelling transformation, 2D-Wavelet transformation, Wavelet packets. Examples and case studies

UNIT 2 Image Enhancement 8 hours

Gray Level Transformations, Histogram modification and equalization, Enhancement Using Arithmetic and Logic operations, Combining Spatial Enhancement Methods , Smoothening and Sharpening Spatial Filters, Smoothing and Frequency Domain Filters, Homomorphic Filtering. Examples and case studies

UNIT 3 Image Restoration and Segmentation 10 hours

Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering , Inverse filtering, Wiener filtering, Segmentation: Morphological operations in Binary and Gray Images, Point, Line and Edge segmentation. Edge linking and Boundary detection. Segmentation using thresholding, Region based segmentation, Region merging, Region splitting, Splitting and merging, Watershed segmentation, Region growing. Examples and case studies

UNIT 4 Image Compression 9 hours

Error free compression: Variable length coding, LZW, Bit-plane coding, Lossless predictive coding, Lossy compression: Lossy predictive coding, transform coding, wavelet coding. Image compression standards, CCITT, JPEG, JPEG 2000, Video compression standards. Examples and case studies

UNIT 5 Image Representation and Recognition 8 hours

Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching. Examples and case studies

This course introduces basic concepts, methodologies and algorithms of digital image processing focusing on the following three major problems concerned with digital images: (1) image enhancement and restoration for easier interpretation of images, (2) image compression techniques and (3) image analysis and object recognition. Some advanced image processing techniques (e.g., wavelet and multiresolution processing) will also be studied in this course. The primary goal of this course is to lay a solid foundation for students to study advanced image analysis topics such as computer vision systems, biomedical image analysis, and multimedia processing & retrieval.

Course Educational Objectives:

1. Introduce the scope of field of image processing and basic concepts in digital image processing
2. Demonstrate different of image enhancement techniques.
3. Describe different segmentation & compression techniques.
4. Analyze different morphological techniques.
5. Construct a model for object recognition.

Textbooks:

1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Pearson Education. III Ed.,2016

2. Jain A.K., Fundamentals of Digital Image Processing, Prentice-Hall, 2002.

References:

1. Al Bovik (ed.), “Handbook of Image and Video Processing”, Academic Press, 2000.

2. M. Petrou, P. Bosdogianni, “Image Processing, The Fundamentals“, Wiley, 1999.

3. Bernd Jähne, Digital Image Processing, Springer-Verlag Berlin Heidelberg 2005.

4. J. C. Russ. The Image Processing Handbook. CRC, Boca Raton, FL, 4^{th}edn., 2002.

Course Outcomes:

1. Describe the theory and algorithms that are widely used in digital image processing
2. Apply a proper image enhancement technique for given a set of noisy images.
3. Compare different image segmentation and compression techniques.
4. Formulate solutions using morphological concepts.
5. Develop any application using different image processing techniques.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3281	DSP PROCESSORS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	CSEN1001: Problem Solving and Programming with C						

Course Description:

Digital Signal Processors are specialized computer chips designed to perform speedy and complex operations on digitized waveforms. This course provides an exposure to the various fixed point & a floating point DSP architectures and also applications of using these processors to real-world situations.

Course Educational Objectives:

- Impart the knowledge of basic DSP concepts and number systems to be used, different types of A/D, D/A conversion errors.
- Learn the architectural differences between DSP and General-purpose processor.
- Learn about interfacing of serial & parallel communication devices to the processor.
- Implement the DSP & FFT algorithms.

UNIT 1 Introduction to Digital Signal Processing 9 hours

Introduction: Digital signal-processing system, discrete Fourier Transform (DFT) and fast Fourier transform (FFT), differences between DSP and other microprocessor architectures; Number formats: Fixed point, floating point and block floating point formats, IEEE-754 floating point, dynamic range and precision, relation between data word size and instruction word size; Sources of error in DSP implementations: A/D conversion errors, DSP computational errors, D/A conversion errors, Q-notation.

UNIT 2 Architecture of Programmable DSPS 9 hours

Multiplier and multiplier accumulator, modified bus structures and memory access in PDSPs, multiple access memory, multiport memory, SIMD, VLIW architectures, pipelining, special addressing modes in PDSPs, on-chip peripherals.

UNIT 3 Overview of Tms320c54xx Processor 9 hours

Architecture of TMS320C54XX DSPs, addressing modes, memory space of TMS320C54XX processors. Program control, instruction set and programming, on-chip peripherals, interrupts of TMS320C54XX processors, pipeline operation.

UNIT 4 Interfacing Memory And I/O Peripherals To PDSPs 9 hours

Memory space organization, external bus interfacing signals, memory interface, parallel I/O interface, programmed I/O, interrupts and I/O, direct memory access (DMA)

UNIT 5 Implementations of Basic DSP Algorithms 9 hours

The Q-notation, convolution, correlation, FIR filters, IIR filters, interpolation filters, decimation filters, an FFT algorithm for DFT filters computation of the signal spectrum. Examples and case studies

Text Books:

1. Avtar Singh and S. Srinivasan, Digital Signal Processing, Thomson Publications, 1st Edition, 2004.
2. Lapsley et al, DSP Processor Fundamentals, Architectures & Features, S. Chand & Co, 1 st Edition, 2000.
3. B. Ventakaramani, M. Bhaskar, Digital Signal Processors Architecture Programming and Applications, Tata McGraw-Hill, 1st Edition, 2006.

References:

1. Sen M. Kuo&WoonSergGan, Digital Signal Processors Architectures, Implementation and Application,Pearson Practice Hall, 1st Edition, 2013.
2. Ifeachor E. C., Jervis B. W, Digital Signal Processing: A practical approach, Pearson Education, PHI/, 2nd Edition, 2002.
3. Peter Pirsch ,Architectures for Digital Signal Processing, John Weily, 1 st Edition, 2007.

Course Outcomes:

1. Understand the basics of Digital Signal Processing and transforms.
2. Able to distinguish between the architectural features of General purpose processors and DSP processors.
3. Understand the architectures of TMS320C54xx devices.
4. Discuss about various memory and parallel I/O interfaces.
5. Analyze the concepts of interpolation and decimation filters

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE3291	BIOMEDICAL SIGNAL PROCESSING	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	MATLAB, EECE3001: Digital Signal Processing						

Course Description:

Biomedical signal processing course introduces acquisition of biological signals and analysis using signal processing techniques. The course describe the observations of physiological activities of organism and extracting significant information. This course describes the methods to analyse biological signals for filtering, removal of artifacts and classification of bio-signals

Course Educational Objectives:

1. Understand the Sources, Types & Characteristics of Different Noises and Artifacts Present in Biomedical Signals.
2. Design Time Domain and Frequency Domain Filters for Noise and Artifact Removal from Biomedical signals.
3. Understand and Apply Various Methods for Analyzing Biomedical Signal Characteristics.
4. Explore Alternative Techniques of Analyzing Biomedical Signals in Time and Frequency Domain.

UNIT 1 Biosignals and Their Characteristics 9 hours

Source of Bioelectric potential, Resting and action potential, Propagation of action potentials in nerves, Characteristics of biomedical signals, The nature of biomedical signals signal analysis, Biomedical signal acquisition and processing, Difficulties in biomedical signal acquisition and analysis, computer aided diagnosis. Examples and case studies

UNIT 2 Signal Averaging 9 hours

Basics of signal averaging, signal averaging as a digital filter, limitations of signal averaging. Removal of artifacts by averaging. Filtering for removal of artifacts: Introduction, Random noise, structured noise and physiological interference, stationary versus non stationary process. Finite time averaging :Introduction, finite time estimation of mean value, estimation of variance, correlation, synchronous averaging. Examples and case studies

UNIT 3 Frequency Domain Analysis and Adaptive Filtering 9 hours

Frequency domain analysis Introduction, Spectral analysis, linear filtering, Removal of high frequency noise (power line interference). Adaptive filtering– LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in FECG. Examples and case studies

UNIT 4 Time Series Analysis 9 hours

Time series analysis – linear prediction models, process order estimation, lattice representation, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Examples and case studies

UNIT 5 Biosignal Classification and Recognition 9 hours

Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats. Examples and case studies

Textbooks:

1. Arnon Cohen, Bio-Medical Signal Processing 2nd edition, CRC Press Inc., Boca Rato, Florida, 2000
2. Rangaraj M. Rangayyan, Biomedical Signal Analysis-A case study approach, 2ndedition, Wiley, 2015

References:

1. D.C.Reddy, Biomedical Signal Processing- principles and techniques, Tata McGraw-Hill Education, 2005
2. Tompkins, W.J. (ed.), Biomedical Signal Processing, Prentice Hall, 1993.
3. Eugene N.Bruce, Biomedical Signal Processing and Signal Modeling, Wiley Publications, 2000.

Course Outcomes:

1. Describe various bio medical signals and their characteristics
2. Apply signal averaging for different applications
3. Analyze biomedical signals using Transforms
4. Analyze biomedical signals using time series analysis
5. Classify Biomedical signals

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE3301	SPEECH PROCESSING	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	MATLAB, EECE3001: Digital Signal Processing						

Course Description:

This course introduces the student to audio engineering, its applications and perspectives in real time environment. The morphological techniques in speech processing, homomorphic speech processing, pitch estimation, Hidden Markov models of speech processing are discussed. It familiarizes the student about different filters used in speech processing for noise less transmission and uniform transmission of speech signals from source to destination.

Course Educational Objectives:

1. To explore the applications of signal processing in audio engineering.
2. To provide an understanding of hearing perception and homomorphic speech processing.
3. To familiarize speech recognition systems and voice verification
4. To introduce uniform lossless speech transmission, linear predictive coding of speech, delta modulation of speech and voice recognition systems.

UNIT 1 Introduction to Speech Processing 9 hours

Speech signal, signal processing, digital speech processing. Digital models for speech signals: Process of speech production, acoustic theory of speech production, uniform lossless tube models, digital models for speech signals, hearing and auditory perception

UNIT 2 Time-Domain Methods for Speech Processing 9 hours

Time-dependent processing of speech, short-time energy and average magnitude, short-time average zero-crossing rate, speech vs. silence discrimination, pitch period estimation using the autocorrelation function. Digital representation of the speech waveform: Instantaneous quantization, adaptive quantization, general theory of differential quantization, delta modulation.

UNIT 3 Fourier Analysis of Speech 9 hours

"Short-Time Fourier Analysis: Fourier transform interpretation, linear filtering interpretation, filter-bank summation method of short-time synthesis, spectrographic displays, analysis-synthesis systems.
Homomorphic Speech Processing: Homomorphic systems for convolution, complex spectrum of speech, pitch detection, formant estimation, homomorphic vocoder."

UNIT 4 Linear Predictive Coding of Speech 9 hours

Basic principles of linear predictive analysis, computation of the gain for the model, solution of the LPCequations, relations between the various speech parameters, synthesis of speech from linear predictive parameters, application of LPC parameters.

UNIT 5 Speaker Recognition Systems 9 hours

Speech recognition systems. Speech enhancement in noise, Single channel speech enhancement methods, beamforming with microphone array speech, distortion measurement.

Textbooks:

1. Rabiner L.R., Schafer R.W., Digital Processing of Speech Signals, 1/e, Prentice Hall of India, 1978.
2. Thomas F. Quatieri, Discrete-Time Speech Signal Processing, Principles and Practice, Pearson Education, 2002

References:

1. Ian McLaughlin, Applied Speech and Audio Processing with MATLAB examples, Cambridge University Press, 2010.
2. Lawrence Rabiner and Biing-Hwang Juang, Fundamentals of Speech Recognition, Pearson Education, 2003.
3. Daniel Jurafsky and James H Martin, Speech and Language Processing–An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Prentice Hall 2009.

Course Outcomes:

1. Model speech production system and describe the fundamentals of speech
2. Extract and compare different speech parameters.
3. Choose an appropriate speech model for a given application.
4. Analyse speech recognition, synthesis and speaker identification systems

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3311	DIGITAL SIGNAL COMPRESSION	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	MATLAB						

Course Description:

Compression of digital signals is an important aspect in computer and communications technology. This course makes the students familiar with different types of compression techniques as well as the mathematical foundation for textual, audio, image and video compression and solve the problems associated with different source coding techniques.

Course Educational Objectives:

1. To understand the concepts of data compression, and algorithms for lossy and lossless data compression.
2. To impart the knowledge of scalar and vector quantization.
3. To understand the principles of Differential Encoding techniques.
4. To develop the skill to analyze transform coding, signal modeling and its extension to compression with applications to speech, image and video processing.

UNIT 1 Mathematical Preliminaries for Lossless Compression 9 hours

"Mathematical Preliminaries for Lossless Compression: Overview, a brief introduction to information theory, derivation of average information, models, coding.
Huffman Coding: Overview, the Huffman coding algorithm.
Arithmetic Coding: overview, introduction, coding a sequence, generating a binary code, comparison of Huffman and arithmetic coding, adaptive arithmetic coding."

UNIT 2 Mathematical Preliminaries for Lossy Coding 9 hours

Mathematical Preliminaries for Lossy Coding: Overview, introduction, distortion criteria, information theory revisited, models. Scalar Quantization: Overview, introduction, the quantization problem, uniform quantizer, adaptive quantization, nonuniform quantization.

UNIT 3 Vector Quantization and Differential Encoding 9 hours

"Vector Quantization: Overview, introduction, advantages of vector quantization over scalar quantization, the Linde-Buzo-Gray algorithm Differential Encoding: Overview, introduction, the basic algorithm, prediction in DPCM, adaptive DPCM, delta modulation, speech coding."

UNIT 4 Transform and Suband Coding 9 hours

"Transform Coding: The Transform, Transforms of interest, quantization and coding of transform coefficients, application to image compression—JPEG, application to audio compression-the MDCT.
Subband Coding: Overview, introduction, filters, some filters used in subband coding, the basic subband coding algorithm."

UNIT 5 Audio, Speech and Video Compression 9 hours

"Audio compression techniques, Standards for audio compression in multimedia applications, MPEG audio encoding and decoding, Dolby AC-3 standard. Speech compression techniques, Vocoders, Speech compression - quality measures, waveform coding, source coders, Speech compression standards for personal communication systems. Video compression techniques and standards, Motion estimation and compensation techniques, H.261, Dolby AC-3. ".

Textbooks:

1. Sayood, Khalid, “Introduction to Data Compression”, Third Edition, Morgan Kaufmann, 2006.

5. David Salomon, “Data compression: the complete reference”, Third Edition, New York: Springer, 2004.

References:

1. Mark Nelson, Jean Loup Gaily, “The Data Compression book”, 2^{nd} Edition, MIS press.

2. Ida Mengyi Pu, Fundamental Data Compression, Elsevier Science, 2005

Course Outcomes:

1. Understand mathematical foundations of data compression and factual knowledge about existing compression standards.
2. Analyze coding and compression techniques.
3. Differentiate modeling and coding aspect of compression.
4. design uniform, non-uniform and adaptive quantizers for a given input data with low quantization error
5. Understand the compression formats of image, audio and video.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE3322	COMPUTER ORGANIZATION AND DESIGN	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable exposure							

Course Description:

The purpose of learning this course is to acquire knowledge about processor, memory, input / output devices interconnected by bus. It encompasses the definition of the machine's instruction set architecture. The course emphasizes instruction set design, pipelining, memory technology, memory hierarchy, virtual memory management, and I/O sub systems

Course Educational Objectives:

1. To Identify the working of various sub-modules of computer system.
2. "To understand the process of instruction execution and the interaction between CPU and memories"
3. To analyze the data transfer between the peripheral devices and CPU
4. "To interpret the design issues of RISC and CISC CPUs and the design issues of pipeline architectures."
5. To infer the functionality of parallel processing

UNIT 1 Computer architecture, Computer system and its sub modules 9 hours

State Diagram various Architectures, Moore Machine, Mealy Machine, Van Neuman architecture and hardware implementation of Arithmetic and Logic Unit, Buses Types, Specifications of a computer, Concepts of Machine level programming, Assembly level programming and High-level programming. Various addressing modes and designing of an Instruction set. Concepts of subroutine and subroutine call, use of stack for handling subroutine call and return

UNIT 2 CPU Design 9 hours

Introduction to CPU design, Instruction interpretation and execution, Micro- operation and their RTL specification, Hardwired control CPU design, Micro programmed control CPU design, Concepts of semiconductor memory, CPU-memory interaction, organization of memory modules, Cache memory and related mapping and replacement policies, Virtual memory, paging concepts, VAS to PAS and Vice-versa mapping

UNIT 3 Input / Output Devices 10 hours

Introduction to input/output processing, working with video display unit and keyboard and routine to control them, Program controlled I/O transfer, Interrupt controlled I/O transfer, DMA controller, Secondary storage and type of storage devices, Introduction to buses and connecting I/O devices to CPU and memory, TRAP and Interrupts

UNIT 4 Arithmetic and Pipelining 9 hours

Addition and subtraction of signed numbers, design of fast adders, multiplication of unsigned numbers, multiplication of signed numbers, fast multiplication, integer division, floating-point numbers and operations, Introduction to RISC and CISC paradigm. Design issues of a RISC processor and example of RISC processor

UNIT 5 Parallel Processing and Performance 8 hours

Hardware multithreading, vector (SIMD) processing, shared-memory multiprocessors, cache coherence, message-passing multicomputer

List of Laboratory Experiments

This course shall have laboratory experiments on HDL Modelling and Simulation of the below (but not limited to)

1. Basic Building Blocks of Computers including Multiplexers, Registers, Adders, Multipliers, Logical functional units
2. Read Only Memory and Random Access Memories
3. 32-bit ALU
4. Register File
5. Single Cycle Datapath and Control
6. Software Development using MIPS Instruction Set and Simulation
7. Pipelined Datapath and Control (Optional)
8. Forwarding Unit in Pipelined Systems (Optional)

Textbooks:

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky & NaraigManjikian, Computer Organization and Embedded Systems, 6/e, McGraw Hill Publications, 2010
2. "William Stallings, Computer Organization and Architecture: Designing for Performance, 8/e, Pearson Education India. 2010"
3. D. A. Patterson and J. L. Hennessy, Computer Organization and Design, 4/e, Morgan Kaufmann, 2008

References:

1. Patterson, Hennessy, Computer Organization and Design, 4/e, Elsevier Publications, 2011
2. Kai Hwang and A. Briggs, Computer Architecture and Parallel Processing, International Edition McGraw Hill, 2012
3. Sima, Terence Fountain, Peter Kacsuk, Advanced Computer Architecture, Pearson Education, 2011

Course Outcomes:

1. To Understand the functionality of CPU functional units and the interconnections among these components
2. To interpret the CPU operations, instruction interpretation and execution.
3. To analyze the different types of I/O subsystems and I/O transfer techniques
4. To understand the arithmetic operation and design issues of pipelining architecture
5. To analyze the concept of arithmetic operation and parallel processing

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3332</td><td rowspan="2">HARDWARE MODELING WITH HDLs</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7"></td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course introduces to design digital logic circuits using Verilog HDL. The various modeling styles in Verilog is explained for logic circuits. The use of Testbench and HDL synthesis in VLSI using System Verilog is provided

Course Educational Objectives:

1. To design combinational, sequential circuits using Verilog HDL
2. To understand behavioral and RTL modeling of digital circuits
3. To verify whether the design meets its timing constraint specifications
4. To analyze the program and their designs on a development board

5. To simulate, synthesize, and program their designs on a development board

UNIT 1 **Hardware Modeling basics** **9 hours**

Lexical conventions, data types, system tasks and compiler directives, Modules, ports, hierarchical names encapsulation, modeling primitives, Models of propagation delay and net delay path delays and simulation

UNIT 2 **Types of Modeling** **10 hours**

Gate-Level Modeling: Gate types, gate delays, Dataflow Modeling: Continuous assignments, delays, expressions, operators, and operands, operator types, examples, Behavioral Modeling: Structured procedures, procedural assignments, timing controls, conditional statements, multiway branching, loops, sequential and parallel blocks, generate blocks

UNIT 3 **Timing and Delays** **8 hours**

Types of delay models, path delay modeling, timing checks, delay back annotation, BCD to 7-Segment Display Decoder, BCD Adder,32-Bit Adders, Traffic Light Controller, Shift-and-Add Multiplier, Array Multiplier

***UNIT 4 Verilog Test benches* 10 hours**

What is Verification, what is a Test bench, The Importance of Verification, Convergence Model, What Is Being Verified, Functional Verification Approaches, Testing Versus Verification, Design and Verification Reuse, The Cost of Verification

UNIT 5 HDL-based synthesis 8 hours

Technology-independent design, styles for synthesis of combinational and sequential logic, synthesis of finite state machines, synthesis of gated clocks, design partitions and hierarchical structures

Simulation Assignments

This course shall involve Verilog Modelling and Simulation Assignments using Xilinx Vivado / Cadence INCISIV tools on the below topics (but not limited to)

1. Modeling and Simulation of Combinational Logic Circuits at Gate Level
2. Modeling Combinational Logic Circuits at Dataflow level
3. Modelling Combinational Logic Circuits at Behavioural Level
4. Modelling Combinational Logic Circuits at Structural Level
5. Verilog Modelling of Delays in Digital Circuits
6. Verilog Modelling of Sequential Logic Circuits
7. Verilog Modelling of Finite State Machines
8. Verilog Modelling using RTL Design methodology – GCD Processor Design
9. Case Study of RTL Modelling of Data Sorter, Min-Max Computation, Serial Communication Controller
10. Modeling Testbenches for Combinational and Sequential Logic Circuits
11. Using Assertions in Verilog

Textbooks:

1. Samir Palnitkar, Verilog HDL, 2/e, Pearson Education, 2013
2. Charles Roth, Digital Systems Design using Verilog, Cengage Learning, 2014
3. M. G. Arnold, “Verilog Digital – Computer Design”, Prentice Hall (PTR), 1999

References:

1. Janick Bergeron, “Writing Test benches using System Verilog”, Springer,2014
2. J. Bhasker, System Verilog HDL Primer, B.S. Publications, 2012
3. J. Bhasker, Verilog Synthesis Primer, B. S. Publications, 2011
4. M. Ciletti, Advanced Digital Design with Verilog HDL, 2/e. Pearson Education, 2012

Course Outcomes:

1. To understand the basic concepts of verilog HDL
2. To model digital systems in verilog HDL at different levels of abstraction
3. To understand the concept of timing and delay
4. To know the simulation techniques and test bench creation
5. To analyze the process of HDL synthesis

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE3341	FPGA SYSTEM DESIGN	L	T	P	S	J	C
		2	0	2	0	0	3
Pre-requisite	EECE2021: Digital Logic Design						
Co-requisite	None						
Preferable exposure	EECE2021: Digital Logic Design						

Course Description:

This course emphasis on the various programmable logic devices. The various types of FPGA and applications. The system on chipbased design in FPGA environment. Also deals with hardware and software interations in a FPGA kit.

Course Educational Objectives:

1. To understand the issues and tools related to FPGA design and implementation
2. To interpret the optimization techniques in low power system design
3. To understand the basics of platform based design
4. To demonstrate the challenges to design FPGA board
5. To analyze the interface of hardware and software

UNIT 1 Types of ASICs 9 hours

ASICs and VLSI Design flow, Programmable ASICs, Antifuse, SRAM, EPROM, EEPROM based ASICs. Programmable ASIC logic cells and I/O cells, Programmable interconnects. Latest Version, FPGAs and CPLDs and Soft-core processor

UNIT 2 Design Specification and Resource Scoping 9 hours

Trade off issues at System Level: Optimization with regard to speed, area and power, asynchronous and low power system design. ASIC physical design issues, System Partitioning, Power Dissipation, Partitioning Methods

UNIT 3 SoC Block-Based Design 10 hours

System-On-Chip Design, SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures, On-Chip Communication Architecture Standards, Low-Power SoC Design, Performance Evaluation Methods for Multiprocessor System-on-Chip Design

UNIT 4 FPGA Design Environment 8 hours

Introduction, Scripting Environment, Interaction with Version Control Software, A Regression Test System, Common Tools in the FPGA Design Environment, Challenges that FPGAs Create for Board Design, Engineering Roles and Responsibilities, FPGA Engineers, Design Flows for Creating the FPGA Pinout, Board Design Check List for a Successful FPGA Pin-Out

UNIT 5 Hardware/Software considerations 9 hours

Introduction, Software Interface, Definition of Register Address Map, Use of the Register Address Map, Hardware/Software Co-Design and Verification, High performance algorithms for ASICS/ SoCs as case studies ,Canonic Signed Digit Arithmetic, Distributed Arithmetic.

Textbooks:

1. D. Gajski, S. Abdi, A. Gerstlauer, G. Schirner , Embedded System Design: Modeling, Synthesis and Verification, Springer,2009
2. Louis Scheffer, Luciano Lavagno, and Grant Marti , Synthesis and Optimization of Digital Circuits, McGraw-Hill, 2003
3. Luciano Lavagno, Grant Martin, EDA for IC System Design, Verification, and Testing , Taylor and Francis, 2015
4. Wayne Wolf , FPGA-Based System Design : 1st edition Prentice Hall,2004

References:

1. Wayne Wolf , Modern VLSI Design: System-on-Chip Design (3rd Edition), Pearson, 2002
2. Steve Kilts,AdvancedFpga Design: Architecture, Implementation, And Optimization, 1st edition, John Wiley,2016
5. David Pellerin, Scott Thibault, Practical FPGA Programming in C, Prentice Hall Professional Technical Reference, 2005

Course Outcomes:

1. To demonstrate VLSI tool-flow and appreciate FPGA architecture
2. To analyze the on chip communication architectures and specifications
3. To understand the basics of system on chip
4. To interpret the FPGA design environment and challenges
5. To infer hardware and software co-design

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE4042</td><td rowspan="2">VLSI DESIGN AUTOMATION</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7"></td></tr>
<tr><td>Co-requisite</td><td colspan="7"></td></tr>
<tr><td>Preferable exposure</td><td colspan="7"></td></tr>
</table>

Course Description:

This course emphasis the fundamentals principles and design processes used in the design of chips using design automation tools. Specifically the course highlights the use of synthesizable Verilog constructs for RTL design, files and algorithms used for logic synthesis and static timing analysis concepts. The course then introduces the

Course Educational Objectives:

1. To impart the synthesizable aspects of VLSI Constructs
2. To acquaint the students with timing constraints and analysis concepts
3. To elaborate different aspects of Logic Synthesis, Physical Synthesis process
4. To demonstrate the use of EDA tools for entire chip design process

UNIT 1 Introduction to Chip Design Flow and Synthesizable Verilog 9 hours

Introduction to building a Chip, Need for Design Automation, The Chip Design Flow, Synthesizable Verilog Constructs, Verilog Modeling Examples, Verilog FSM Implementation, Coding Style, Writing Synthesizeable RTL

UNIT 2 Logic Synthesis 9 hours

Logic Synthesis: HDL Compilation, Library Definition, LEF Format, Liberty (.lib), Contents of Standard Cell Libraries, Elaboration and Technology Mapping, BDDs and Boolean Minimization, Constraint Definition, Technology Mapping, Verilog for Synthesis, Timing Optimization

UNIT 3 Static Timing Analysis 9 hours

Static Timing Analysis (STA): Timing Analysis, Timing Constraints, Static Timing Analysis (STA), STA Example, Design Constraints (SDC), Understanding Timing Reports, Multi-Mode Multi-Corner (MMMC)

UNIT 4 Floorplanning, Placement and Clock Distribution 9 hours

Physical Design: Moving to the Physical Domain, Multiple Voltage Domains, Floorplanning, Hierarchical Design, Power Planning, Standard Cell Placement, Random Placement, Analytic Placement, Analytic Placement Example, Placement in Practice, Clock Tree Synthesis, Clock

Distribution, Clock Concurrent Optimization (CCOpt). Clock Tree Synthesis in EDA Tools, Clock Routing and Clock Tree Analysis, Clock Generation, Clock Domain Crossing (CDC)

UNIT 5 Routing, I/O Design and Packaging 9 hours

Global and Detailed Routing: Routing, Maze Routing, Routing in Practice, Signal Integrity (SI) and Design for Manufacturing (DFM), Input/Output Circuits and Packaging, Packaging, I/O Circuits - Digital IOs, Analog IOs, ESD Protection, Pad Configurations. Chip Finishing and Sign-Off: Sign-off Timing, Chip Finishing, including Density Fill and Antenna Fixes, Sign-off Validation, including IR Drop and EM Analysis, LEC, and DRC/LVS/ERC

Laboratory Experiments

This course shall be accompanied by laboratory experiments on the below topics (but not limited to)

5. Basic Linux Commands, Networking commands
6. TCL/Perl Scripting
7. RTL Verilog Modeling and Simulation
8. Logic Synthesis
9. Static Timing Analysis
10. DFT Insertion and Fault Simulation
11. Floorplanning, Power Planning, Placement and Routing
12. Importing Layout into Virtuoso & Physical Verification
13. Case Study/Project: Chip Synthesis of a MIPS Processor

Textbooks:

1. https://www.eng.biu.ac.il/temanad/digital-vlsi-design/
2. Sebastian Smith, Application Specific Integrated Circuits, Pearson Education, 2005.
3. Sung Kyu Lim,Practical Problems in VLSI Physical Design, Springer,2008
4. S.H. Gerez, Algorithms for VLSI Design Automation, John Wiley ,1998
5. Sabih H Gerez, Algorithms for VLSI Design Automation, Wiley,2006

References:

6. N.A.Sherwani , "Algorithms for VLSI Physical Design Automation", (3/e),Kluwer,1999
7. M. Sait , H. Youssef, "VLSI Physical Design Automation", World scientific, 1999
8. M.Sarrafzadeh, "Introduction to VLSI Physical Design", McGraw Hill (IE), 1996
9. Habib Youssef, VLSI Physical Design Automation, World Scientific,2001

Course Outcomes:

By the end of the course, the student will be able to

1. Write synthesizable RTL models in standard coding style
2. Perform logic synthesis with area/power/delay constraints using EDA tools
3. Analyze and fix digital circuits with timing violations
4. Choose appropriate floorplanning, power planning and clock distribution strategies under design constraints
5. Demonstrate the use of EDA tools for entire ASIC Design flow

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC<<01-04-22>>**

SDG No. & Statement:

SDG Justification:

EECE4052	ANALOG IC DESIGN	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite							
Co-requisite							
Preferable exposure							

Course Description:

This course introduces the fundamentals of MOS device physics and building blocks of analog integrated circuit design. This course focuses on the frequency response of the amplifiers. Nanometer design concepts and their effects have been introduced in this course

Course Educational Objectives:

1. To understand the construction, operation and mathematical models of MOSFETs.
2. To analyze and design single stage and multistage amplifiers at low frequencies.
3. To study and analyze different current mirrors used to bias IC amplifiers.
4. To understand the frequency response of amplifier designed in integrated circuits.
5. To understand the principles of operation of different feedback topologies.
6. To understand different specifications and topologies related to operational amplifiers

UNIT 1 Basic MOS Device Physics 8 hours

Basic MOS Device Physics: General considerations, MOSFET as a switch, MOSFET structure, MOS symbols, MOS I/V characteristics, threshold voltage, derivation of I/V characteristics, second-order effects, MOS device models, MOS device layout, MOS device capacitances, MOS small-signal model, MOS SPICE models, NMOS versus PMOS devices, long-channel versus short-channel devices

UNIT 2 Frequency Response of Amplifiers 9 hours

Single-Stage Amplifiers: Basic concepts, common-source stage, common-source stage with resistive load, CS stage with diode-connected load, CS stage with current-source load, CS stage with triode load, CS stage with source degeneration, source follower, common-gate stage, cascade stage, folded cascode

UNIT 3 Stability and Frequency Compensation 9 hours

Differential Amplifiers: Single-ended and differential operation, basic differential pair, qualitative analysis, quantitative analysis, common-mode response, differential pair with

MOS loads, gilbert cell. Passive and Active Current Mirrors: Basic current mirrors, cascode current mirrors, active current mirrors, large-signal analysis, small-signal analysis, common-mode properties.

UNIT 4 Nanometer Design Studies 10 hours

Frequency Response of Amplifiers: General considerations, Miller effect, association of poles with nodes, common-source stage, source followers, common-gate stage, cascode stage, differential pair. CMOS Processing and Layout: CMOS Processing, Layout and Design Rules, Layout of Transistors, Resistors, Capacitors

UNIT 5 Layout and Packaging 9 hours

Operational Amplifiers: General considerations, performance parameters, one-stage op amps, two-stage op amps, gain boosting, comparison, common-mode feedback, input range limitations, slew rate, power supply rejection. Stability and Frequency Compensation: General considerations, multipole systems, phase margin, frequency compensation, compensation of two-stage op amps.

List of Experiments

Experiments shall be carried out using Tanner/Mentor Graphics/Cadence Tools

1. Study of MOS Characteristics and Characterization
2. Design and Simulation of Single Stage Amplifiers (Common Source, Source Follower, Common Gate Amplifier)
3. Design and Simulation of Single Stage Amplifiers (Cascode Amplifier, Folded Cascode Amplifier)
4. Design and Simulation of a Differential Amplifier (with Resistive Load, Current Source Biasing)
5. Design and Simulation of Basic Current Mirror, Cascode Current Mirror
6. Analysis of Frequency response of various amplifiers (Common Source, Source Follower, Cascode, Differential Amplifier
7. Design/Simulation/Layout of Telescopic Operational Amplifier/ Folded Cascode Operational Amplifier

Textbooks:

1. Behzad Razavi, Design of Analog CMOS Integrated Circuits, 2/e, Mc-Graw Hill Education, 2017

2. Tony Carusone, Ken Martin, Analog Integrated Circuit Design, 2/e, Wiley Publications, 2016.

References:

1. P. R. Gray & R. G. Meyer, Analysis and Design of Analog Integrated Circuits, 5/e, John Wiley, 2012
2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, 10/e, Pearson Education, 2009
3. R. Jacob Baker, CMOS Circuit Design, Layout and Simulations, 3/e, IEEE press, 2010
4. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, 7/e, Oxford University Press, 2012

Course Outcomes:

Upon successful completion of the course, the student will be able to

1. Analyze MOSFET based circuits using large signal and small signal models
2. Choose an appropriate amplifying topology and design single stage amplifiers
3. Design current sources and differential amplifiers for given specifications balancing speed, area, power tradeoffs
4. Draw efficient layouts of transistors, resistors, capacitor with awareness on mismatch and process variations
5. Choose an appropriate opamp topology and design for given specifications

EECE3351	LINEAR INTEGRATED CIRCUITS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	EECE1001: Basic Electrical and Electronics Engineering						
Co-requisite	None						
Preferable exposure	SPICE						

Course Description:

This course introduces the theoretical & circuit aspects of Opamp, which are the backbone for the basics of linear and digital integrated circuits and to understand the various linear & non-linear applications of opamp. Also to learn various digital ICs and circuits which are highly used in day to day commercial and household devices

Course Educational Objectives:

1. To understand the basic principles of integrated circuits
2. To analyze various types of operational amplifiers
3. To interpret the applications of phase lock loop
4. To illustrate the uses of special function ICs
5. To implement combinational and sequential logic using TTL logic

UNIT 1 Basics of Operational Amplifier 8 hours

Performance of an OpAmp: Introduction, input bias currents, input offset current, effect of bias current on output voltage, effect of offset current on output voltage, input offset voltage, input offset voltage for the adder circuit, nulling-out effect of offset voltage and bias currents. AC performance of an OpAmp: Introduction, frequency response of an op amp, amplifier gain and frequency response, slew rate and output voltage, noise in the output voltage, loop gain.

UNIT 2 General Applications of an Opamp 10 hours

General Applications of OpAmp: Inverting and non-inverting amplifiers, differential amplifiers, summing, scaling and averaging amplifiers,integrators, differentiators, logarithmic amplifiers, instrumentation amplifiers, voltage to current and current to voltage converters, peak detectors

UNIT 3 Comparators and Multivibrators 8 hours

Comparators and Multivibrators: Comparators, schmitt trigger, multivibrators, waveform generators (triangular and saw tooth), sample and hold circuits.

UNIT 4 Timers, PLLs and Regulators 10 hours

Integrated Circuit Timers: Introduction, operating modes of the 555 timer, terminals of the 555 timer, free running mode and applications, monostable operation and applications, timer/counter applications, switch programmable timer, phased locked loop, fixed output and adjustable output voltage regulators.

UNIT 5 Data Converters 9 hours

Data Converters: Introduction, DAC characteristics, digital to analog conversion process, voltage output DACs, multiplying DAC, 8-bit digital to analog converter DAC-08. Analog to Digital Converters: ADC characteristics, integrating ADC, successive approximation ADC, ADCs for microprocessors. Flash converters: Principle of operation, conversion time.

Textbooks:

1. D.Roy Choudhry, ShailJain,Linear Integrated Circuits,5th New Age International Pvt. Ltd., 2018
2. Floyd, Jain, Digital Fundamentals, 8th edition, Pearson Education, New Delhi,2009
3. Ramakant A. Gayakwad, OP-AMP and Linear ICs, 4th Edition, Prentice Hall / Pearson Education, 2015
4. S Salivahanan, V S Kanchana Bhaaskaran, Linear Integrated Circuits, McGraw-Hill,2012

References:

1. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 4th Edition, Tata Mc Graw-Hill, 2016
2. Robert F.Coughlin, Frederick F.Driscoll, —Operational Amplifiers and Linear Integrated Circuits‖, Sixth Edition, PHI, 2001
3. B.S.Sonde,System design using Integrated Circuits , 2nd Edition, New Age Pub, 2001
4. Gray and Meyer,Analysis and Design of Analog Integrated Circuits, Wiley International,5th Edition, 2009

Course Outcomes:

1. To introduce the basic building blocks of linear integrated circuits

2. To understand the linear and non-linear applications of operational amplifiers
3. To understand the significance of analog multipliers and PLL
4. To analyze the operation of wave form generator and special Ics
5. To implement digital circuits using Transistor Transistor Logic Ics

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE4061	MODERN VLSI DEVICES	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

This course emphasis on device physics/operation, technologies and issues in modern VLSI devices. It provides knowledge on high electron mobility transistor and high frequency resonent devices. It also illutrates the different emerging nanoscale devices

Course Educational Objectives:

1. To understand the parameters governing the performance of devices
2. To illustrate the throughput of VLSI devices based on the meterials
3. To interpret the operating principles of HEMT devices
4. To explore the types of resonant devices
5. To analyze nanowire and nano tube MOSFET

UNIT 1 Performance of devices and circuits 9 hours

Transit time of charge carriers, junction capacitances, ON-resistances and their dependence on the device geometry and size, carrier mobility, doping concentration and temperature; important parameters governing the high power performance of devices and circuits: Break down voltage, resistances, device geometries, doping concentration and temperature

UNIT 2 Metal Insulator Semiconductor and MOS devices 10 hours

Native oxides of Compound semiconductors for MOS devices and the interface state density related issues, Metal semiconductor contacts, Schottky barrier diode, Metal semiconductor Field Effect Transistors (MESFETs), Pinch off voltage and threshold voltage of MESFETs, D.C. characteristics and analysis of drain current, Velocity overshoot effects and the related advantages of GaAs, InP and GaN based devices for high speed operation, Sub threshold characteristics, short channel effects and the performance of scaled down devices

UNIT 3 High Electron Mobility Transistors (HEMT) 10 hours

Hetero-junction devices, The generic Modulation Doped FET(MODFET) structure for high electron mobility realization, Principle of operation and the unique features of HEMT, InGaAs/InP HEMT structures, Hetero junction Bipolar transistors (HBTs), Principle of operation and the benefits of hetero junction BJT for high speed applications, GaAs and InP based HBT device structure and the surface passivation for stable high gain high frequency performance, SiGe HBTs and the concept of strained layer devices

UNIT 4 High Frequency resonant devices 8 hours

Resonant-tunnelling hot electron transistors, Direct Coupled Field Effect Transistor Logic (DCFL), Schottky Diode FET Logic (SDFL), Buffered FET Logic(BFL), GaAs FET Amplifiers, Monolithic Microwave Integrated Circuits(MMICs)

UNIT 5 Emerging nanoscale devices 8 hours

Si and hetero-structure nanowire MOSFETs, carbon nanotube MOSFETs, Tunnel FET, quantum wells, quantum wires and quantum dots, Single electron transistors, resonant tunneling devices

Textbooks:

1. Yuan Taur, TakH.Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 2016
2. Sandip Kundu, Aswin Sreedhar, "Nanoscale CMOS VLSI Circuits: Design for Manufacturability" McGraw Hill, 2010
3. C.Y. Chang, F. Kai, GaAs High-Speed Devices: Physics, Technology and Circuit Applications, Wiley, 1994
4. Wong, B.P., Mittal, A., Cao Y. and Starr, G., "Nano-CMOS Circuit and Physical Design", Wiley, 2004

References:

1. G.A. Armstrong, C.K. Maiti, TCAD for Si, SiGe and GaAs Integrated Circuits, The Institution of Engineering and Technology, London, United Kingdom, 2007
2. Ruediger Quay, Gallium Nitride Electronics, Springer 2008
3. Cheng T. Wang, Ed., Introduction to Semiconductor Technology: GaAs and Related Compounds, John Wiley & Sons, 1990

Course Outcomes:

- To understand the geometry and performance of devices and circuits
- To analyze the characteristics and operation of MIS and MOS devices
- To interpret the working and structure of high mobility transistor
- To analyze the operating principle of high frequency resonant devices
- To analyze the nanoscale VLSI devices

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE4072	C-BASED VLSI DESIGN	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	CSEN1011: Problem Solving and Programming with C						
Co-requisite	None						
Preferable exposure	EECE3341: FPGA System Design						

Course Description:

This course emphasis High-level Synthesis (HLS) process of generating effecient hardware at register transfer level (RTL) from the input C-code (high-level code). HLS is an active domain of research in recent times in the domain of electronic Design Automation (EDA) of VLSI.

Course Educational Objectives:

1. To acquaint the overall C to RTL synthesis flow
2. To expose the student to different scheduling, allocation and binding algorithms
3. To write a C-code for efficient hardware generation
4. To design software compiler optimizations techniques to improve the circuit performance
5. To expose the student to different optimization techniques in high level synthesis

UNIT 1 Electronic design flow and High level synthesis 6 hours

Introduction to Electronic Design Automation, Introduction to C-based VLSI Design: Background, Introduction to C-based VLSI Design: HLS Flow. HLS Design Examples, Control and Data Flow Graph, Data Dependency Graph, Sequence Graphs

UNIT 2 Scheduling Algorithms for High Level Synthesis 8 hours

Scheduling: Introduction to Scheduling, ILP Formulation of Scheduling, ILP formulation of MLRC and MRLC scheduling. Multiprocessor Scheduling, Hu’s algorithm for multiprocessor scheduling. List based scheduling of MLRC and MRLC problems, Force Directed Scheduling, Force Directed Scheduling of MLRC and MRLC problems.

UNIT 3 Allocation, Binding, Datapath and Control path generation Algorithms 9 hours

Allocation and Binding Problem Formulation, Left Edge Algorithm, ILP Formulation of Allocation and Binding, Allocation and Binding for Hierarchical Graph. Register Allocation and Binding, Multi-port Binding Problem, Datapath and Controller Synthesis

UNIT 4 HLS Directives and Optimizations 10 hours

Introduction to HLS, HLS for Arrays, HLS for Loops, HLS for Loop – pipeline, Hardware Efficient C Coding, Hardware Efficient C Coding part II, Dataflow Optimization in HLS

UNIT 5 HLS Case Studies 8 hours

Matrix Multiplication, Merge Sort, FIR Filter Design, CORDIC, DFT and FFT Designs

This course shall involve the below High-Level Synthesis assignments (but not limited to) on Vivado HLS/ Vitis HLS / Catapult HLS

1. Introduction to Vivado HLS, Interface definition, constraints, array partitioning and loop unrolling and design analysis.
2. Exporting IP and FPGA Implementation of 8-bit adder and GCD Processor designs
3. Study of Rolled Implementation, Loop Unrolling, Loop Pipelining and Array Partitioning. Of Vector Addition and Matrix-Vector Multiplication Designs
4. Use of Arbitrary Precision Data Types
5. Exploration of how function arguments like variables, pointers, arrays etc are translated into appropriate IO ports during high level synthesis. Use of different compiler directives for synthesizing block level and port level IO protocols.
6. Design Projects including FIR filter design, CORDIC, Discrete Fourier Transform and Fast Fourier Transform

Text Books:

1. G. De Micheli, Synthesis and optimization of digital circuits, McGraw Hill, India Edition, 2003
2. Ryan Kastner, Janarbek Matai and Stephen Neuendorffer, Parallel Programming for FPGAs, Kastner Research Group,2018
3. J. P. Elliot, Understanding Behavioural Synthesis: A Practical guide to high-level Synthesis, Springer, 2nd edition, 2000
4. Steve Kilts, Advanced FPGA Design, Wiley, 2007

References:

1. M. Huth and M. Ryan, Logic in Computer Science: Modelling and Reasoning about Systems, 2nd Ed, Cambridge University Press, 2004
2. K. Parhi, VLSI Digital Signal Processing Systems: Design and Implementation, Wiley,1999
3. D. D. Gajski, N. D. Dutt, A.C.-H. Wu and S.Y.-L. Lin, High-Level Synthesis: Introduction to Chip and System Design, Springer, 1st edition, 1992
4. Mike Fingeroff, High-Level Synthesis Blue Book, Mentor Graphics Corporation, 2010

Course Outcomes:

- To understand the overall C to RTL synthesis flow and how to convert to its equivalent hardware
- To design a C-Code for improving the efficiency of the VLSI design
- To understand compiler for performance optimizations
- To analyze the Machine Learning Algorithm techniques
- To implement the equivalence checking between C and RTL

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : **ACADEMIC COUNCIL:**

SDG No. & Statement:

SDG Justification:

<table>
<tr><td rowspan="2">EECE3361</td><td rowspan="2">DIGITAL SYSTEM DESIGN</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">EECE2021: Digital Logic Design</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">EECE3332: Hardware Modeling with HDLs</td></tr>
</table>

Course Description:

The emphasis of this course is on the design of digital systems and the use of a hardware description language VHDL in the design process. Modeling the combinational and sequential logic circuits using basic features of VHDL is discussed and basics of the Programmable logic devices such as SPLDs, CPLDs and FPGAs are introduced in this course. This course also deals with the hardware implementation of the digital systems using programmable logic devices.

Course Educational Objectives:

1. To provide an understanding of the basic concepts of designing combinational and sequential circuits and the possible hazards in the design.
2. To model combinational and sequential circuits using VHDL.
3. To design and model digital circuits using different modelling techniques and also design Finite State Machines.
4. To study the various programmable logic devices like SPLDs, CPLDs and FPGA.
5. To familiarize how to implement functions in FPGAs

UNIT 1 Review of Logic Design Fundamentals 8 hours

Combinational logic, Boolean algebra and algebraic simplification, Karnaugh maps, hazards in combinational circuits, flip-flops and latches, Mealy sequential circuit design, design of a Moore sequential circuit, sequential circuit timing.

UNIT 2 Introduction to VHDL 8 hours

Computer-Aided design, hardware description languages, VHDL description of combinational circuits, VHDL modules, sequential statements and VHDL processes, modeling flip-flops using VHDL processes, processes using wait statements, transport and inertial delays, VHDL data types and operators, VHDL libraries.

UNIT 3 Design Examples for Digital Circuits 8 hours

Multiplexers, BCD to 7-segmentdisplay decoder, BCD adder, 32-Bit adders, shift-and-add multiplier, array multiplier, modeling registers and counters using VHDL processes.

UNIT 4 Introduction to Programmable Logic Devices 8 hours

Brief overview of programmable logic devices, simple programmable logic devices (SPLDs), complex programmable logic devices (CPLDs), field-programmable gate arrays (FPGAs), state machine charts, derivation of SM charts.

UNIT 5 Designing with Field Programmable Gate Arrays 8 hours

Implementing functions in FPGAs, implementing functions using Shannon's decomposition, carry chains in FPGAs, cascade chains in FPGAs, FPGAs and one-hot state assignment, FPGA capacity: Maximum gates versus usable gates, design translation (Synthesis), mapping, placement, routing.

Textbooks:

1. Charles H. Roth Jr., Lizy Kurian John, Digital System Design using VHDL, 2/e, Cengage Learning, 2008.

References:

1. Stephen Brown and ZvonkoVranesic, Fundamentals of Digital Logic with VHDL Design, 3/e, McGraw-Hill Higher Education, 2008.
2. S.Trimberger, Field Programmable Gate Array Technology, 1/e, Kluwer Academic Publications, 1994.
3. J. Bhasker, A VHDL Primer, 3/e, Prentice Hall of India, 2009.

Course Outcomes:

- Design combinational and sequential logic circuits with the helpof K-maps using NAND/NOR/Universal gates (L4).
- Design Mealy and Moore state machines for the given specifications (L5).
- Explain the basics of VHDL and describe a digital circuit at different levels such as behavioural, dataflow and structural (L2).
- Develop VHDL models of combinational and sequential logic circuits (L3).
- Distinguish between different programmable logic devices and develop the state machine charts for a given digital data processing (L3).
- Implement Boolean functions in FPGA devices using cascade chains, one-hot assignment etc. (L5).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3372	DATA STRUCTURES WITH PYTHON	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The study of data structures, a fundamental component of a computer science education, serves as the foundation upon which many other computer science applications are built knowledge of data structures is a must for students who wish to work in design, implementation, testing or maintenance of any software system. Organization of data in an efficient way for application, is the major focus of the course

Course Educational Objectives:

1. Introduce object-oriented concepts.
2. Introduction to sort and search methods.
3. Familiarize with linear data structures and operations on them.
4. Demonstrate the organization of data as trees and various operations on trees.
5. Teach various graph representations.
6. Enable to perform graph traversal and find shortest path and minimal spanning tree for a graph.
7. Expose common sorting techniques and their complexities

UNIT 1 Object Oriented Programming 8 hours

Object-oriented concepts in Python: Creating a class, objects, methods, constructor, encapsulation, inheritance, polymorphism, operator overloading.

UNIT 2 Searching and Sorting 8 hours

Searching: Sequential Search,binary search. Sorting: Insertion sort, selection sort, bubble sort. Linked lists: Single linked list, double linked list, circular linked list.

UNIT 3 Stacks and Queues 8 hours

Stacks: Definition, operations: array implementation, linked implementation. queues: Definition, operations:arrayimplementation, linkedlistimplementationand applications, Priority Queue, Double-Ended Queues

UNIT 4 Trees 8 hours

Trees: Definition, Tree properties, Binary trees: properties, implementation, tree traversals, Heap tree, Heap sort, binary search tree and operations

UNIT 5 Graph Algorithms 8 hours

Graphs: ADT, data structure for graphs, properties of graphs, types of graphs, graph representations, graph traversals, directed acyclic graph, shortest path algorithms, spanning trees and min spanning tree.

List of Assignments:

1. Write a program to create

   - Student class with data members student rollno, name,address, course. Include a constructor to initialize data members. Add a method to print the student details.
   - Book class with data members book_id,name,cost and publisher. Include constructor and a method to display the book details. Create 3 objects and display their details.
   - Account class with data members acc_no,name,balance. Include a constructor and methods to perform deposit and withdraw operations on account. Create account object perform some operations and display the account details.
   - Product class with data members product_id, product_name, price, expiry_date. Include constructor to initialize data members and a method to print products details.
   - Complex_Number with data members real_part and imaginary_part. Include constructor to initialize complex number. Add a method which adds two complex numbers.
   - Employee class with data members eno,ename,sal,designation. Include constructor to initialize employee details and count the number of employee objects created.

2. Create a class called Distance. A person has to travel a certain distace and he used two cars.

   Now create two objects “cardist1” and “cardist2” for the class Distance. Add the two objects distances and put the total distance in the third object of class Distance “totaldist”. Take one data member, which will accept the distance input in km. Take two functions, for accepting the distance and the other for displaying. Display the total distance in meters.

3. Develop a program to Perform Python Multi-Level and multiple inheritances.

4. Design a program to overload “+” operator for

- Concatenating two strings
- Adding two complex numbers

5. Develop a program to overload “area” method to calculate area of different polygon shapes.

   Write a program to

   - Implement Method Overriding
   - Perform Linear Search on an array.
   - Perform Binary Search on a list stored in an array.

6. Develop a program to implement various sorting techniques
   - Insertion sort
   - Selection Sort
   - Bubble Sort
7. Design a program to create a singly linked list for the following operations
   - Insert a Node at Beginning, at Ending and at a given Position
   - Delete a Node at Beginning, at Ending and at a given Position
   - Search, Count the Number of Nodes and Display
8. Design a program to create a doubly linked list for the following operations
   - Insert a Node at Beginning, at Ending and at a given Position
   - Delete a Node at Beginning, at Ending and at a given Position
   - Search, Count the Number of Nodes and Display
9. Create a Circular singly linked list for adding and deleting a Node.
10. Create a stack and perform various operations on it.
11. Convert the infix expression into postfix form.
12. Perform String reversal using stack
13. Create a queue and perform various operations on it.
14. Construct a binary tree and perform various traversals.
15. Construct a binary search tree and perform search operation.

16. Implement Depth First Search, Breadth First Search traversals on a graph.

17. Implement Dijkstra's Shortest Path Algorithm

Textbooks:

1. Michel T.Goodrich ,Roberto Tamassia, Michel H.Goldwasser, Data Structures and Algorithms in Python, Willey March, 2013. ISBN:978-1-118-29027-9.

2. RanceD.Necaise, Data Structures and Algorithms using Python, John Willey & Sons, India. 2011, ISBN 9788126562169.

References:

1. Wesly J. Chun, Core Python Programming, 2/e, Prenctice Hall, 2006

Course Outcomes:

- After Completion of this course, the student will be able to:
- Explain various ways of representing data in a computer (L2)
- Demonstrate operations on linear data structures (L2)
- Illustrate the mechanisms for creating, altering and traversing various types of trees (L2)
- Explain the representations, traversals and applications of graphs (L2)
- Analyze common sorting algorithms (L4)
- Choose a data structure that gives the best performance for a given application(L6)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3381: MACHINE LEARNING

L	T	P	C
3	0	0	3

Machine Learning is the science of making machines think intelligently without being explicitly programmed. Machine learning is pervasive in everyday life today. This course is designed to enable students get in-depth understanding of different machine learning techniques including deep learning and reinforcement learning and apply them on real-life data.

Course Objectives

- Understand the fundamental concepts of Supervised learning.
- Explore descriptive problem solving through unsupervised learning strategies.
- Acquire skills in developing as well as evaluating different machine learning models.
- Demonstrate the application of different deep learning methodologies.
- Gain an understanding of concepts like Reinforcement Learning and Active Learning.

Course Outcomes:

After successful completion of the course, the student will be able to

- relate knowledge about application of machine learning techniques to real world problems. (L3)
- apply deep learning methodologies to applications such as image recognition, video tagging etc.(L3)
- generate suitable unsupervised learning approaches to descriptive machine learning models. (L4)
- utilize supervised learning approaches to perform predictive modeling of data. (L3)
- assess different machine learning algorithms based on performance evaluation measures. (L5)

Unit I **10L**

Supervised Learning (Regression/Classification): Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes, Linear models: Linear Regression, Logistic Regression, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class

Unit II **7L**

Unsupervised Learning: Clustering: K-means, Dimensionality Reduction: PCA and kernel PCA, Generative Models (Gaussian Mixture Models and Hidden Markov Models)

Unit III **6L**

Evaluating Machine Learning algorithms, Model Selection, Ensemble Methods (Boosting, Bagging, Random Forests)

Unit IV **9L**

Modeling Sequence/Time-Series Data, Deep Learning (Deep generative models, Deep Boltzmann Machines, Deep auto-encoders, Applications of Deep Networks) and Feature Representation Learning

Unit V **9L**

Scalable Machine Learning (Online and Distributed Learning) Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

Text Book(s):

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer, 2017.
3. Jiawei Han, Micheline Kamber, Jian Pei , Data Mining: Concepts and Techniques, 3/e, Morgan Kaufmann, 2016.
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2016.

EECE4081	MACHINE LEARNING FOR SPEECH AUDIO AND VIDEO ANALYSIS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	CSEN1021: Programming with Python, EECE3381: Machine Learning, EECE3001: Digital Signal Processing						

UNIT 1 Audio Acquisition, Representation and Storage 8 hours

Sound Physics, Production and Perception, Audio Acquisition, Audio Encoding and Storage Formats, Time-Domain Audio

UNIT 2 Image and Video Acquisition, Representation and Storage 8 hours

Human Eye Physiology, Image Acquisition Devices, Color Representation, Image Formats, Video Principles, MPEG Standard.

UNIT 3 Speech and Handwriting Recognition 8 hours

Introduction, General , The Front , HMM Training, Recognition and Performance Measures , Recognition Experiments, Speech Recognition Results, Applications

UNIT 4 Automatic Face Recognition 8 hours

Face Recognition: General Approach, Face Detection and Localization, Lighting Normalization, Feature Extraction, Classification, Performance Assessment, Experiments.

UNIT 5 Video Segmentation and Keyframe Extraction 8 hours

Applications of Video Segmentation, Shot Boundary Detection, Shot Boundary Detection with Torchvision, Keyframe Extraction, Keyframe Extraction with Torchvision and Torch

Text Books:

1. Francesco Camastra, Alessandro Vinciarelli, Machine Learning for Audio, Image and Video Analysis: Theory and Applications, Springer Publications, 2008.

References:

1. A.V. Oppenheim and R.W. Schafer. Discrete-Time Signal Processing. Prentice- Hall, 1989.
2. T. Painter and A. Spanias. Perceptual coding of digital audio. Proceedings of IEEE, 88(4):451–513, 2000.
3. T. Acharaya and A. K. Ray. Image Processing: Principles and Applications. John Wiley and Sons, 2005.
4. D. Le Gall. MPEG: a video compression standard for multimedia applications. Communications of the ACM, 34(4):46–58, 1991.

Course Outcomes:

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE4091	MACHINE LEARNING FOR ANTENNA ARRAY APPLICATIONS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	CSEN1021: Programming with Python, EECE3381: Machine Learning, EECE3021: Antenna Analysis and Synthesis						

UNIT 1 **Review of Linear Support Vector Machines** **8 hours**

Review of Linear Support Vector Machines, Linear Gaussian Processes, Kernels for Signal and Array Processing

UNIT 2 **Fundamental Concepts of Deep Learning** **8 hours**

Fundamental Concepts of Deep Learning, Deep Learning Structures

UNIT 3 **Direction of Arrival Estimation** **8 hours**

Fundamentals of DOA Estimation, Conventional DOA Estimation, Statistical Learning Methods, Neural Networks for Direction of Arrival

UNIT 4 **Beamforming** **8 hours**

Fundamentals of Beamforming, Conventional Beamforming, Support Vector Machine Beamformer, Beamforming with Kernels, RBF NN Beamformer

UNIT 5 **Reconfigurable Antennas and Cognitive Radio** **8 hours**

Introduction, Basic Cognitive Radio Architecture, Reconfiguration Mechanisms in Reconfigurable Antennas, Examples, Machine Learning Implementation on Hardware

Textbooks:

1. Manel Martínez-Ramón, Arjun Gupta, José Luis Rojo-Álvarez, Christos Christodoulou, Machine Learning Applications in Electromagnetics and Antenna Array Processing, Artech House, 2021

References:

1. VanTrees, H. L., Optimum Array Processing: Part IV of Detection, Estimation, and Modulation Theory. Detection, Estimation, and Modulation Theory, New York:Wiley, 2004.

2. Bkassiny, M., Y. Li, and S. K. Jayaweera, “A survey on machine-learning techniques in cognitive radios,” IEEE Communications Surveys & Tutorials, Vol. 15, No. 3, 2012, pp. 1136–1159.

Course Outcomes:

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE4082	BIG DATA ANALYTICS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

The course is designed which largely involves collecting data from different sources, manage it in a way that it becomes available to be consumed by analysts and finally deliver data products useful to the organization business.The process of converting large amounts of unstructured raw data, retrieved from different sources to a data product useful for organizations forms the core of Big Data Analytics

Course Educational Objectives:

1. Optimize business decisions and create competitive advantage with Big Data analytics.
2. Introducing Java concepts required for developing map reduce programs.
3. Derive business benefit from unstructured data.
4. Imparting the architectural concepts of Hadoop and introducing map reduce paradigm.
5. To introduce programming tools Hbase& HIVE in Hadoop echo system.

UNIT 1 Big data 8 hours

What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics

UNIT 2 Introduction to NoSQL 8 hours

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations

UNIT 3 Data format 8 hours

Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures.

UNIT 4 MapReduce workflows 8 hours

MapReduce workflows, Unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats.

UNIT 5 HBASE 8 hours

Hbase, data model and implementations, Hbase clients, Hbaseexamples,praxis.Cassandra, Cassandra data model, Cassandra examples Cassandra clients,Hadoop integration. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation,HiveQL queries.

Textbooks:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. P. J. Sadalage, M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2014.

References:

1. Tom White, "Hadoop: The Definitive Guide", 3/e,4/e O'Reilly, 2015.

Course Outcomes:

After completing this Course, the student should be able to:

- Demonstrate the big data concepts for real world data analysis(L1).
- Develop Map Reduce concepts through Java (L2).
- Analyze the configuring of Hadoop clusters effectively (L3).
- Illustrate Hadoop API for Map reduce framework (L4).
- Develop basic programs of map reduce framework particularly driver code, mapper code, reducer code (L5).
- Building a complete business data analytic solution and apply structure of Hadoop data with Hive (L6).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE2101	OPTICAL ENGINEERING	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite							
Co-requisite							
Preferable exposure							

UNIT 1 **8 hours**

Introduction to Geometrical Optics: Introduction, Rays, Snell's Laws**,**
Optical System Design in Optic Studio: Introduction to Optic studio, Lenses in Optic stud Configurations & Optimization,Design a Lens with Optic Studio

UNIT 2 **8 hours**

First Order Ray Tracing: Graphical Ray Tracing, Lens Equation: Mirrors and Lenses, **Thick Optics and Mirrors:** Lens Maker's Equation, Thick Lenses, **First Order Ray Tracing of Multi-Element Systems:** Tabular First-Order Ray Tracing, ABCD Matrices

UNIT 3 **8 hours**

Geometrical Optics for Gaussian Beams: Introduction to Optical Efficiency and Resolution, Introduction to Gaussian Beams, Imaging with Gaussian Beams, Lagrange Invariant, **Maxwell's equations:** Mathematical Background, Waves, **Impulse Responses and Transfer Functions:** Fourier transforms and Lenses, Impulse Responses, Transfer Functions, **Finite Aperture Optics:** Stops, Effects of stops on imaging, Optical Invariant**, Radiometry:** Introduction to Radiometry and Sources, Applying Radiometry

UNIT 4 **8 hours**

Chromatic Aberrations: Introduction to Design of High-Performance Optical systems, Abbe Number and its uses, Achromatic Doublet, **Ray Aberrations:** Non-Paraxial Optics, Introduction to Aberrations, Defocus, Magnification & Spherical Aberration, Coma & Astigmatism, **Field Curvature and Distortion:** Petzal or Field Curvature, Distortion, Summary of 3rd Order Ray Aberrations, Seidel Aberration Coefficients

UNIT 5 **HBASE** **8 hours**

Techniques for Reduction of Aberrations: Field Curvature and Field Lenses, Conic Mirrors
Optical Components: Prisms, Gradient Index Lenses, Diffraction Gratings, Fresnel Lenses, Introduction to the Eye, Optical Design for the Eye

References:

1) Coursera Course: First Order Optical System Design, University of Colorado Boulder

2) Coursera Course: Optical Efficiency and Resolution, University of Colorado Boulder
3) Coursera Course: Design of High Performance Optical Systems, University of Colorado Boulder

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE2091	EMBEDDED SENSORS AND MOTORS-1	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Introduction: Embedded systems incorporate different types of sensors (for monitoring) and motors (for actuation). This course introduces the different types of sensors and their working principles used in embedded processing systems.

Course Objectives

- To introduce the role of sensors and their characteristics and impart the selection criteria
- To impart the working principles of mechanical and electromechanical sensors
- To acquaint the knowledge of interfacing different types of sensors with embedded processors
- To impart the working principles of DC motor and stepper motors
- To expose the use of smart sensors in electric vehicles and medical appliances

UNIT 1 **8 hours**

Sensors Fundamentals and Applications: Basic sensor technology, sensor systems, sensor classification, sensor characteristics, system characteristics, instrument selection, data acquisition and readout.

UNIT 2 **8 hours**

Mechanical and Electromechanical Sensors: Potentiometer, strain gauges, inductive sensors- ferromagnetic type, transformer type, electromagnetic, capacitive sensors, parallel plate, variable permittivity, electrostatic, piezoelectric.

UNIT 3 **8 hours**

Sensor Interfacing: Introduction to microcontrollers, microprocessors and SOCs, and their Interfacing, Introduction to Sensor Interfacing using TinkerCAD.

UNIT 4 **8 hours**

DC Motor Control and Stepper Motors: Basic principles of DC motor, tepper motor control, stepper motor specs, operation and commercial driver chips and packages.

UNIT 5 **8 hours**

Advanced Smart Sensors: Radar level transmitters work, components and design issues for LIDAR systems used in self driving vehicles, sensors for medical applications, mini project

Textbook(s)

1. Jon S. Wilson, Sensor Technology Handbook, 1/e, Elsevier Publications, 2005.
2. E.O. Doeblin, Measurement Systems, Application and Design, 1/e, Tata McGraw Hill Publishers, 2004.

References:

1. A. K. Sawhney, Puneet Sawhney, A Course in Mechanical Measurements and Instrumentation, 1/e, Dhanpat Rai and Company, 2001.
2. D. V. S. Murthy, Transducers and Instrumentation, 1/e, Prentice Hall of India, 1995.
3. D. Patranabis, Sensors and Transducers, 1/e, Prentice Hall of India, 2004.
4. D. Patranabis, Principles of Industrial Instrumentation, 1/e, Tata McGraw Hill Education, 2010.

Course Outcomes

Upon Successful completion of the course, students will be able to

- Classify sensors based on their characteristics and choose a sensor for a specific application (L3)
- list the design criteria involved in design of mechanical sensors and elaborate the design aspects (L4)
- choose the appropriate method for interfacing sensors with embedded processors (L3)
- list the basic principles of dc/stepper motor and elaborate the design issues (L4)
- describe the role of smart sensors and describe design issues for applications like self-driving vehicles, medical appliances

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22nd AC 01-04-22**

SDG No. & Statement:

SDG Justification:

EECE3661	NEURAL NETWORKS	L	T	P	S	J	C
		3	0	0	0	0	3
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	CSEN1021: Programming with Python						

Course Description:

Neural Networks can assist in the analysis, interpretation, and utilization of large amounts of highly complex structured and unstructured data. Neural Network based decision support systems have been deployed in agricultural, biomedical, biometric, economic, and legal applications. Neural Networks can be utilized as components of advanced robots and control systems for industrial automation. Neural Networks can also be utilized in engineering design.

Course Educational Objectives:

1. Introduce a variety of Neural Network architectures
2. Evaluate merits and demerits of learning models used by Artificial Neural Networks
3. Describe the algorithms for training of Neural Networks
4. Explain the effect of choice of parameters on training efficiency

UNIT 1 Introduction to Neural Networks 8 hours

Architecture based classification of Neural Networks. Classification of Neural Networks based on learning methods. Activation functions and Loss functions. Factors to be considered for choice of type of Neural Network. Introduction to hardware requirements for implementation of Neural Networks.

UNIT 2 Rosenblatt's perceptron model 8 hours

Rosenblatt's perceptron convergence theorem. Back Propagation Method. Back propagation learning algorithm for multilayer feed forward Neural Network. Factors affecting back propagation-based training of a Neural Network.

UNIT 3 Radial basis function networks 8 hours

Generalized regularization theory. Neural Network models with Hebbian learning. Introduction to Hopfield networks. Recurrent Neural Network models. Universal approximation theorem. Backpropagation through time. Real time recurrent learning. Long short-term memory.

UNIT 4 Convolutional Neural Networks 8 hours

Variants of the basic convolution function. Convolution algorithms. Recursive Neural Networks. Greedy layer-wise pretraining. Transfer learning. Structured probabilistic models for deep learning. Convolutional Boltzmann machines.

UNIT 5 Model based calculation of reward in Reinforcement learning 8 hours

Markov decision process. Bellman's optimality criteria. Policy iteration. Value iteration. Q-learning. Model free Reinforcement learning. Deep reinforcement learning. Generative adversarial networks.

Textbooks:

1. S.O.Haykin. Neural Networks & Learning Machines. 3rd Ed. Pearson. 2019

References:

1. S.J.Russell and P. Norvig. Artificial Intelligence: A Modern Approach. 3rd Ed. Pearson. 2016.
2. Charu C. Aggarwal. Neural Networks and Deep Learning: A Textbook. Springer. 2018.
3. I.Goodfellow, Y.Bengio, A.Courville, F.Bach. Deep Learning (Adaptive Computation and Machine Learning series). MIT Press. 2016
4. S.O.Haykin. Neural Networks: A comprehensive foundation. 2nd Ed. Pearson. 1997

Course Outcomes:

At the end of this course the student should be able to:

- Describe major types of Neural Networks (L1)
- Classify Neural Networks based on type of architecture and learning method (L2)
- Apply Neural Networks to solve simple problems (L3)
- Analyze a problem and identify optimal Neural Network type for its solution (L4)
- Evaluate a problem description and predict optimal training algorithm and training parameters for its solution (L5)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS :24-12-21 **ACADEMIC COUNCIL: 22ndAC 01-04-22**

SDG No. & Statement:

SDG Justification:

CSEN3011	ARTIFICIAL NEURAL NETWORKS	L	T	P	S	J	C
		3	0	2	0	0	4
Pre-requisite	None						
Co-requisite	None						
Preferable exposure	None						

Course Description:

Artificial Neural Networks to be more precise, represent a technology that is rooted in many disciplines: neurosciences, mathematics, statistics, physics, computer science and engineering. ANN find applications in such diverse fields as modelling, time series analysis, pattern recognition, signal processing and control by virtue of an important property: the ability to learn from input data with or without a teacher.

Course Educational Objectives:

- To understand the architecture, learning algorithm and issues of various neural networks.
- Analyse ANN learning, Error correction learning, Memory-based learning, Competitive learning and Boltzmann learning
- To adopt gradient - descent techniques in real time applications
- Provide knowledge on Generalization and function approximation and various architectures of building an ANN
- Implement and learn the applications of Self-organization Map

UNIT 1 Introduction to Neural Networks 9 hours, P - 6 hours

Introduction, The Basic Architecture of Neural Networks, Training a Neural Network with Backpropagation, Practical Issues in Neural Network Training, Common Neural Architectures.

UNIT 2 Shallow Neural Networks 9 hours, P - 6 hours

Neural Architectures for Binary Classification Models, Neural Architectures for Multiclass Models, **Autoencoder**: Basic Principles, Neural embedding with continuous bag of words, Simple neural architectures for graph embeddings

UNIT 3 Deep Neural Networks 9 hours, P - 6 hours

Introduction, Backpropagation, Setup and Initialization Issues, Gradient-Descent strategies, the bias-variance trade-off, Generalization Issues in Model Tuning and Evaluation, Ensemble Methods

UNIT 4 Attractor Neural Networks 9 hours, P - 6 hours

Associative Learning, Attractor Associative Memory, Linear Associative memory, Hopfield Network, application of Hopfield Network, Brain State in a Box neural Network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory.

UNIT 5 Self-organization Feature Map 9 hours, P - 6 hours

Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Vector Quantization, Self-organization Feature Maps, Application of SOM.

List of Lab experiments:

1. Write a program to construct a Neural network with hidden layers
2. Write a program to train the Neural Network on labeled training data
3. Write a program to train a Neural Network with Back propagation method
4. Write a program to understand Neural network architecture for Multiclass Models (such as 3 class, 4 class and so on..)
5. Write a program to implement Neural network embedding with continuous bag of words
6. Write a program to implement Gradient-Descent strategies to train Neural Networks (like Batch, Stochastic Gradient Descent, Mini-Batch Gradient Descent)
7. Write a program to design generalized Brain State in a Box of Neural Network
8. Write a program to implement Simulated Annealing for neural network
9. Write a program to implement Maximal Eigenvector Filtering
10. Write a program to implement Principal Components extraction to represent a multivariate data table as smaller set of variables
11. Write a program to implement Vector Quantization
12. Write a program to implement Self-organization Feature Maps to mimic the actions of a small class of biological neural networks

Lab Infrastructure:

1. Python or PROLOG on Windows or Linux
2. Python packages such as neural net, TensorFlow, PyTorch.

Textbooks:

1. Neural Networks and Deep Learning - Charu C. Aggarwal, Springer International Publishing AG, part of Springer Nature 2018 (Chapters 1, 2, 3)

2. Neural Networks A Classroom Approach– Satish Kumar, McGraw Hill Education (India) Pvt. Ltd, Second Edition. (Chapters 4, 5)

References:

1. Neural Networks: A Comprehensive Foundation - Simon Haykin PHI, 2nd Edition 2005.
2. Introduction to Artificial Neural Systems-J.M. Zurada, Jaico Publications 1994.
3. Artificial Neural Networks-B. Yegnanarayana, PHI, New Delhi 1998.

Course Outcomes:

After successful completion of the course the student will be able to:

1. Understand the origin, ideological basics, Learning process and various Neural Architectures of ANN.
2. Understand the concepts and techniques of Shallow neural networks through the study of important neural network models.
3. Training Deep Neural Networks and Teaching Deep Learners to Generalize.
4. Apply Attractor neural networks to particular application.
5. Design a self-organizing system that are capable of extracting useful information from the environment within which they operate.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDGs: 3, 9

SDG:3 Good Health and Well-being

SDG Justification:

Statement: Artificial Neural Networks can be applied across all levels of health care organizational decision-making. Influenced by advancements in the field, decision-makers are taking advantage of hybrid models of neural networks in efforts to tailor solutions to a given problem and well-being.

SDG:9 Industry, Innovation and Infrastructure

Statement: The holistic understanding of Artificial Neural Networks has lead to develop various new models like CNN, RNN, RCNN, and GANs for achieving outstanding results on several complex cognitive tasks, matching or even beating those provided by human performance

<table>
<tr><td rowspan="2">CSEN3081</td><td rowspan="2">DEEP LEARNING</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Linear Algebra, Artificial Neural Networks</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

This course is designed to introduce modern techniques of neural networks and deep learning, which have revolutionized machine learning and artificial intelligence practice to graduate students. Deep Learning continues to fascinate us with its endless possibilities in self-driving cars and virtual assistants like Alexa, Siri, and Google Assistant. This course aims to cover the basics of Deep Learning and some of the underlying theory with a particular focus on supervised Deep Learning along with a good coverage of unsupervised methods.

Course Educational Objectives:

- To summarize neural networks and regularization techniques.
- To familiarize Convolution Neural Networks and its architecture.
- To learn Recurrent Neural network architecture and its effectiveness
- To illustrate deep unsupervised learning techniques
- To inspect Deep neural network architecture in real time applications

UNIT 1 — Deep Feed Forward Networks, Gradient descent, Back propagation, Regularization techniques — 9 hours

Parameter Norm Penalties, Norm penalties as constrained optimization.

UNIT 2 — Convolution Network — 9 hours

Architectures, Convolution operations, Pooling layer, Variants of the basic Convolution Function, Efficient Convolution algorithms, Random and unsupervised features, Neuro Scientific Basis for Convolutional Networks

UNIT 3 — Sequence Modelling — 9 hours

RNN, Encoder and decoder archerites, DRN, Recursive Neural Networks, LSTM and other Gated RNN, GRU

UNIT 4 Auto encoders and Deep generative models 9 hours

Auto encoders: Under complete auto encoders, regularized encoders, stochastic encoders and decoders

Deep generative models: Boltzmann Machines, restricted Boltzmann machines, Deep Belief networks, Deep Boltzmann machines for real world data

UNIT 5 Applications of Deep Learning 9 hours

Large scale Deep learning, Computer vision, speech recognition, NLP, other applications. Introduction to Generative Adversarial Networks(GANs) and its applications

Textbooks:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press,2015.

Additional Reading

Reference Books:

1. Amlan Chakrabarti Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra, Deep Learning, First Edition, Pearson
2. Sandro Skansi, Introduction to Deep Learning, Springer

Coursera Courses:

1. https://www.coursera.org/learn/neural-networks-deep-learning/home/welcome
2. https://www.coursera.org/learn/introduction-to-deep-learning-with-keras
3. https://www.coursera.org/learn/convolutional-neural-networks
4. https://www.coursera.org/learn/nlp-sequence-models?specialization=deep-learning (Week-1)

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

1. Illustrate the role of neural networks and its various applications.

2. Design the architecture of CNN

3. Apply the RNN architecture and its effectiveness for a real world applications

4. Investigate auto encoders techniques in deep learning.

5. Analyse the applications of Deep Learning

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDGs: 3, 9

SDG Justification:

SDG:3 Good Health and Well-being

Statement: The potential of Deep Learning for better equity, access, and the development of real-time public health solutions. It allow everyone and everywhere access to personalized medicine which is effective, respects the biological, cultural and behavioral differences between people, respects privacy & other ethical requirements and affordable

SDG:9 Industry, Innovation and Infrastructure

Statement: The holistic understanding of Deep Learning has led to develop various new models like CNN, RNN, RCNN, and GANs for achieving outstanding results on several complex cognitive tasks, matching or even beating those provided by human performance

<table>
<tr><td rowspan="2">CSEN3261</td><td rowspan="2">MACHINE LEARNING AND ITS APPLICATIONS</td><td>L</td><td>T</td><td>P</td><td>S</td><td>J</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">None</td></tr>
<tr><td>Co-requisite</td><td colspan="7">None</td></tr>
<tr><td>Preferable exposure</td><td colspan="7">None</td></tr>
</table>

Course Description:

Machine Learning is a flourishing subject in Computer Science which devises models that can automatically learn from data and detect patterns from data. The applications of machine learning are diverse ranging from self- driven cars to disaster management systems. With easy availability of data from different devices and measurements, machine learning techniques become imperative in analysing trends hidden in the data. This course focuses on the major tasks of machine learning that can robustly address data that is non-linear, noisy as well as high-dimensional in nature.

Course Educational Objectives:

- To introduce various key paradigms of machine learning approaches
- To familiarize with mathematical relationships across various machine learning algorithms
- To understand various key approaches in supervised learning
- To understand various key approaches in unsupervised learning
- To illustrate the concept of the neural network

UNIT 1 Machine Learning Fundamentals 9 hours, P - 6 hours

Machine Learning Fundamentals: Use of Machine Learning, Types of machine learning systems, Machine learning challenges, Testing and validating, working with real data, Obtaining the data, Visualizing the data, Data preparation, Training and fine tuning the model.

UNIT 2 Supervised Learning 9 hours, P - 6 hours

Supervised Learning: Classification, training a binary classifier, performance measures, multiclass classification, error analysis, multi label classification, multi output classification. Linear Regression, Gradient Descent, Polynomial Regression, learning curves, regularized linear models, logistic regression.

UNIT 3 Unsupervised Learning 9 hours, P - 6 hours

Unsupervised Learning: Clustering, K-Means, using clustering for image segmentation, Semi-supervised learning, DBSCAN, other clustering algorithms.

Gaussian Mixtures, anomaly detection, selecting number of clusters, Bayesian Gaussian Mixture Models, anomaly and novelty detection algorithms.

UNIT 4 Dimensionality Reduction& Ensemble Learning 9 hours, P - 6 hours

Dimensionality Reduction: The curse of dimensionality, main approaches for dimensionality

reduction, PCA, Non Negative Matrix Factorization.

Ensemble Learning: voting classifiers, bagging, random patches and random spaces, random forests, boosting, stacking.

UNIT 5 Neural Networks & Deep Neural Networks 9 hours,P - 6 hours

Neural Networks: From biological to artificial neurons, implementing MLPs with Keras, fine tuning neural network hyper parameters.

Deep Neural Networks: Vanishing/Exploding Gradients Problem, avoiding overfitting through regularization, Dropout Regularization.

List of Experiments:

1. Write a python program to characterize the density functions

2. Write a python program to model statistically the feature space using distribution functions

3. Write a python program to understand the distribution functions (Normal, Binomial, Poissonetc)

4. Write a python program to estimate co variance matrix and its properties

5. Write a python program to visualize the changes of distribution as changes in parameters

(mean vector, covariance matrix)

6. Write a python program for perceptron learning and test the linear separability

7. Write a python program for Bayesian classification and analyze the decision boundaries by

varying the means and covariance matrices

8. Write a python program to classify the given data using maximum likelihood Estimation. Write a program to solve Robot traversal problem (Understanding Means End Analysis)

9. Write a phyton program to understand Morkov Chians and Monto Calro methods. Write a program to implement Hangman game

10. Write a python program to Decision trees

11. Write a python program to build a Bayesian network for given data set

12. Write a python program to understand Kernel methods.

13. Write a program to implement a linear regression problem

14. Write a program to implement kNN neighbour problem

15. Write a program to implement logistic regression

TextBooks:

1. Aurelion Geron, Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow: Concepts, Tools and Techniques to build Intelligent Systems, 2/e, O'Reilly Media, 2019.(Chapters 1,3,4,5)

2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep learning, MIT press, 2016 (Chapter2)

References:

1. Tom M. Mitchell, "Machine Learning" First Edition by Tata McGraw- Hill Education.
2. Ethem Alpaydin,"Introduction to Machine Learning " 2nd Edition, The MIT Press, 2009
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning" By Springer, 2007.
4. Mevi P. Murphy, "Machine Learning: A Probabilistic Perspective" by The MIT Press, 2012.
5. https://www.coursera.org/learn/uol-machine-learning-for-all
6. https://www.coursera.org/learn/introduction-to-machine-learning-supervised-learning
7. https://www.coursera.org/learn/machine-learning-with-python? (Clustering Week -4))
8. coursera.org/learn/mixture-models?specialization=bayesian-statistics (GMM & Bayesian GMM)
9. 5.https://www.coursera.org/learn/ibm-unsupervised-machine-learning(Curse Dimensionality, PCA)
10. https://www.coursera.org/learn/supervised-machine-learning-classification
11. https://www.coursera.org/learn/introduction-to-deep-learning-with-keras(Week1 &Week 2Part-1)
12. https://www.coursera.org/learn/deep-neural-network(Week 1- part 2)

Course Outcomes:

After successful completion of the course the student will be able to:

1. To formulate the different machine learning problems
2. Apply various learning approaches on real time problems using Classification
3. Apply various learning approaches on real time problems using Regression
4. Apply various learning approaches on real time problems using Clustering
5. Construct the neural networks for classification problems

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

APPROVED IN:

BOS : 06-09-2021 **ACADEMIC COUNCIL: 01-04-2022**

SDG No. & Statement:

SDGs: 3, 6, 11

SDG:3 Good Health and Well-being

SDG Justification:

Statement: Machine Learning has the potential to personalize healthcare monitoring, diagnosis and treatment for the individual in the community and at home. It puts consumers in control of health and well-being.

SDG:6 Clean Water and Sanitation

Statement: Machine Learning will help to resolve challenges related to clean water and sanitation. It is helping utilities and municipalities to better manage their water and wastewater systems to ensure a clean and sanitized water supply.

SDG:11 Sustainable Cities and Communities

Statement:Machine Learning enable smart urban solutions brings multiple benefits, including more efficient energy, water and waste management, reduced pollution, noise and traffic congestions

GITAM School of Technology

GITAM (Deemed to be Universtiy)

Visakhapatnam | Hyderabad | Bengaluru