CURRICULUM STRUCTURE

SECOND YEAR UG: B.E.

ARTIFICIAL INTELLIGENCE & DATA SCIENCE

REVISION: FRCRCE-1-24

Effective from Academic Year 2024-25
Board of Studies Approval:
Academic Council Approval:

Dr. DEEPAK BHOIR
Dean Academics

Dr. JAGRUTI SAVE
HOD(AI&DS)

DR. SURENDRA RATHOD
Principal

Society of St. Francis Xavier, Pilar's

Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Preamble:

Greetings and congratulations to all the education partners Fr Conceicao Rodrigues College of Engineering for getting autonomous status to the college from the year 2024-25. University Grant Commission vide letter No. F. 2-10/2023(AC-Policy) dated 23rd Nov 2023 conferred the autonomous status to Fr. Conceicao Rodrigues College of Engineering, Fr. Agnel Ashram, Bandstand, Bandra (West), Mumbai 400050 affiliated to University of Mumbai for a period of 10 years from the academic year 2024-2025 to 2033-2034 as per clause 7.5 of the UGC (Conferment of Autonomous Status Upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) Regulations,2023. We look towards autonomy as a great opportunity to design and implement curriculum sensitive to needs of Learner, Indian Society and Industries.

Government of Maharashtra has also directed Autonomous Colleges to revise their curriculum in line with National Education Policy (NEP) 2020 through Government Resolution dated 4th July 2023. We commit to ourselves to the effective implementation of UGC Regulations and NEP 2020 in its spirit.

Based on recent recommendations of the GR, we are pleased to offer our holistic curriculum for 2024-28, a "**H-Tree Model**" of Engineering Education. A unique **"H-Tree Model"** of Engineering Education Curriculum is carefully designed to systematically develop IQ (Intelligence Quotient), PQ (Physical Quotient), EQ (Emotional Quotient) and SQ (Spiritual Quotient) of a learner. This curriculum aims at the development of an **all-rounded** personality with **holistic** approach to education in which learner receives **25% teacher-led learning, 25% peer learning, 25% self-learning and 25% experiential learning**. The curriculum model is outcome based that focuses on learning by doing. Curriculum is designed to provide multiple learning opportunities for students to acquire and demonstrate competencies for rewarding careers. It ensures multiple choices to leaner acquiring skills through systematic planning. It has 7 verticals aligned to GR recommendations with strong science, and mathematics foundation and program core, sequel of electives, Multidisciplinary Minor courses, humanities & management courses and sufficient experiential learning through projects and semester-long industry / research internship along with employable skill-based courses. Learner gets an opportunity to acquire skills through NSDC aligned courses during summer vacations. Learner also gets additional option to choose the kind of degree i.e. Honors or Double Minor or Honors with Research.

Various steps are taken to transform teaching learning process to make learning a joyful experience for students. We believe that this curriculum will raise the bar of academic standards with the active involvement and cooperation from students, academic and administrative units.

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Curriculum Structure for UG Programs at Fr CRCE w.e.f. A.Y. 2024-25

Nomenclature of the courses in the curriculum	
Abbreviation	Title
BSESC	Basic Science & Engineering Science Courses
PCPEC	Program Core and Program Elective Courses
MDC	Multidisciplinary Courses
SC	Skill Courses
HSSM	Humanities, Social Sciences and Management
EL	Experiential Learning
LLC	Liberal Learning Courses
BSC	Basic Science Courses
ESC	Engineering Science Courses
PCC	Program Core Courses
PEC	Program Elective Courses
MDM	Multidisciplinary Minor
OE	Open Elective
VSEC	Vocational and Skill Enhancement Course
VSC	Vocational Skill Courses
SEC	Skill Enhancement Courses
AEC	Ability Enhancement Course
EEMC	Entrepreneurship, Economics and Management Course
IKS	Indian Knowledge System
VEC	Value Education
RM	Research Methodologies
CEFP	Community Engagement or Field Project
ELC	Experiential Learning Courses
PRJ	Project
INT	Internship
CC	Cocurricular Courses
HMM	Honors and Multidisciplinary Minor
DM	Double Minor
BC	Bridge Course

Credit Specification:
- ❖ Theory: 1 credit=13 to 15 hrs of teaching
- ❖ Lab: 1 Credit=26 to 30 hrs of lab work
- ❖ Studio Activities: 1 Credit= 26 to 30 hrs of creative activities
- ❖ Workshop Based Activities: 1 Credit=26 to 30 hrs of hands-on activities related to vocation/professional practice/skill based
- ❖ Seminar/Group Discussion: 1 Credit=13 to 15 hrs of participation
- ❖ Internship: 1 Credit=Per 2 weeks OR 36 to 40 hrs of engagement
- ❖ Field Based Learning/Practices: 1 Credit=26 to 30 hrs of learning activities
- ❖ Community Engagement Projects: 1 Credit=26 to 30 hrs of contact time along with 13 to 15 hrs of activities preparation, report writing, independent reading etc.

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Credit requirements for different options of the Degrees:

Degree/SEM	I	II	III	IV	V	VI	VII	VIII	Total
B.E	18	20	22+4#	23+5#	20	20	20	20	163+9#=172
B.E with Honors/Minors	18	20	22+4#	23+5#	20+4*	20+4*	20+6*	20+4*	163+9#+18*=190

 # Bridge courses
***Optional Credits**

1. Learners who earn a minimum of total **172 credits** will be awarded "**Bachelor of Engineering**" degree.

2. Learners will have the following options to earn **B. E. in ………(regular) Engineering with Honours/Minor in …….. (specialization)**

Sr. No.	Honors/Minor degree programs	Programs who can offer this Honours Degree Program	Programs who can offer this as Minor Degree program
1	Internet of Things	1. Computer Engineering 2. Artificial Intelligence & Data Science 3. Electronics and Computer Science 4. Mechanical Engineering	--
2	Artificial Intelligence and Machine Learning	1. Computer Engineering 2. Electronics and Computer Science	Mechanical Engineering
3	Data Science	1. Computer Engineering 2. Electronics and Computer Science 3. Mechanical Engineering	
4	Blockchain	1. Computer Engineering 2. Artificial Intelligence & Data Science 3. Electronics and Computer Science	Mechanical Engineering
5	Cyber Security	1. Computer Engineering 2. Artificial Intelligence & Data Science 3. Electronics and Computer Science	Mechanical Engineering
6	Robotics	Mechanical Engineering	1. Computer Engineering 2. Artificial Intelligence & Data Science 3. Electronics and Computer Science
7	3D Printing	Mechanical Engineering	1. Computer Engineering 2. Artificial Intelligence & Data Science 3. Electronics and Computer Science

3. **Honours and Minor Degree Eligibility Criteria for Students:**

    i. Following is the eligibility criteria for students opting the Honours/ Minor Degree program:

        a. Students with no backlog in semester I, II, and III

        b. The CGPI (based on semester I, II, and III) of the students must be 6.75 and above

        c. For direct second year (DSE) admitted students - No backlog in semester III and CGPI must be 6.75 and above

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ii) Each eligible student can opt for maximum one Honour's or one Minor Programs at any time.

iii) However, it is optional for learners to take Honours/Minor degree program.

iv) The Honours/ Minor degree program can be opted only during regular engineering studies

v) The student shall complete the Honours/ Minor degree program in stipulated four semesters only.

4. Courses offered during internship semester shall be in online mode

5. Learner can earn additional credits by enrolling to skill courses offered in summer. College shall explore feasibility to offer NSDC aligned skill based courses to the learners

6. Technical support team for registration of Academic Bank of Credits (ABC), registration of elective/optional courses, registration of online courses, registration for degree options etc. under supervision of Dean Academics.

Salient Features of Curriculum:

✓ Framed as per Government Resolution dated 4th July 2023 in line with National Education Policy (NEP) 2020.

✓ Minimum 172 choice-based credit structure with options of Degrees earning additional credits

✓ Unique 'H-Tree' Model of Curriculum: Hybrid model for holistic development with happy learning environment having bridge connecting verticals providing unique path for each learner for 3-dimensional growth, Life Long Learning, bridge courses, inclusive model indicating equal distribution of central resources

✓ More emphasis on laboratory based and experiential learning

✓ More weightage to continuous assessment to reduce examination stress

✓ Mandatory Semester-long internship, courses with emotional & spiritual learning and skill-based learning aligned with NSDC framework

✓ Well balanced curriculum to attain Program Outcomes and skills of 21st century learner

✓ Curriculum is designed to create excitement among learners for education through stories, activities, collaboration, hackathon, contest, case studies, creative art etc.

✓ Curriculum is designed to make graduates responsible citizens of country with future ready skills to handle challenges of 21st Century

SEMESTERWISE CURRICULUM STRUCTURE

SECOND YEAR Artificial Intelligence & Data Science Program:

SEM-III													
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits		
						ISE1	MSE	ISE2	ESE	Total	Points	Total	
BSC12CS05	BSESC	BSC	Discrete Maths and Statistics	TH	2	20	30	20	30	100	2	3	
				TU	1	20	-	30	-	50	1		
PCC12CS05	PCPEC	PCC	Computer Organization and Architecture	TH	2	20	30	20	30	100	2	2	
PCC12CS06	PCPEC	PCC	Data Structure	TH	2	20	30	20	30	100	2	3	
				PR	2	20	-	30	-	50	1		
PCC12CS07	PCPEC	PCC	Object Oriented Programming with JAVA	PR	2	20	-	30		50	1	1	
MDM01	MDC	MDM	Law for Engineers	TH	2	50	-	50	-	100	2	2	
OECS1X	MDC	OE	Open Elective-1	TH	1	10	15	10	15	50	1	2	
				PR	2	20	-	30	-	50	1		
OECS1X	MDC	OE	Open Elective-2	TH	1	10	15	10	15	50	1	2	
				PR	2	20	-	30	-	50	1		
EEM12CS01	HSSM	EEMC	Financial Planning, Taxation and Investment	TH	2	50	--	50	--	100	2	2	
VEC12CS01	HSSM	VEC	Human Values and Professional Ethics	TH	1	50	-	50	-	100	1	2	
				PR	2						1		
CEP12CS01	EL	CEFP	Community Engagement Project	PRJ	4	50	-	50	-	100	2	2	
LLCXX	LLC	CC	One Course from CC	PR	2	-	-	50	-	50	2	1	
PCC11CS03	BC	BC	Digital Electronics	TH	2	20	30	20	30	100	2	3*	
				PR	2	20	-	30	-	50	1		
PCC11CS01	BC	BC	Innovation and Design Thinking	PR	2	20	-	30	-	50	2	1*	
				Total	**TH:TU:PR 15:1:20=36**			-	-	1100+200*	-	22+4*	

* Introduced as Bridge Courses to fulfil Credit Requirements of University of Mumbai

SEM-IV												
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
						ISE1	MSE	ISE2	ESE	Total	Points	Total
BSC12CS06	BSESC	BSC	Linear Algebra and Business Statistics	TH	2	20	30	20	30	100	2	3
				TU	1	20	-	30	-	50	1	
PCC12CS08	PCPEC	PCC	Analysis of Algorithms	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC12CS09	PCPEC	PCC	Database Management System	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC12CS10	PCPEC	PCC	Data Analytics and Visualization	PR	2	20	-	30	-	50	1	1
MDM02	MDC	MDM	Emerging Technology and Law	TH	2	50	-	50	-	100	2	2
OECS2X	MDC	OE	Open Elective-3	TH	1	10	15	10	15	50	1	2
				PR	2	20	-	30	-	50	1	
VSE12CS03	SC	VSEC	Web Programming	PR	4	50	-	50	-	100	2	2
AEC12CS02	HSSM	AEC	Modern Indian Language	TH	2	50	-	50	-	100	2	2
EEM12CS02	HSSM	EEMC	Technology Entrepreneurship	TH	2	50	-	50	-	100	2	2
VEC12CS02	HSSM	VEC	Technology Innovation for Sustainable Development	TH	1	40	-	60	-	100	1	2
				PR	2						1	
LLCXX	LLC	CC	One Course from CC	PR	2	-	-	50	-	50	2	1
IKS11CS01	BC	BC	Indian Knowledge System	TH	2	50	-	50	-	100	2	2*
ESC11CS04	BC	BC	Human Health Systems	TH	1	20	-	30	-	50	1	1*
VSE11CS02	BC	BC	Creative Coding in Python	PR	4	50	-	50	-	100	2	2*
				Total	**TH:TU:PR 17:1:20=38**			-	-	1150+250*	-	23+5*

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					Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
SEM-V												
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	ISE1	MSE	ISE2	ESE	Total	Points	Total
PCC13CS11	PCPEC	PCC	Operating System	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC13CS12	PCPEC	PCC	Computer Network	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC13CS13	PCPEC	PCC	Cryptography and Computer Security	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC13CS14	PCPEC	PCC	Machine Learning	PR	2	20	-	30	-	50	1	1
PEC13CSXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				TU	1	20	-	30	-	50	1	
PEC13CSXX	PCPEC	PEC	Program Elective Lab	PR	2	20	-	30	-	50	1	1
MDM03	MDC	MDM	Health, Wellness and Psychology	TH	2	50	-	50	-	100	2	2
MDM04	MDC	MDM	Public Relations and Corporate Communication	TH	2	50	-	50	-	100	2	2
OECS3X	MDC	OE	Open Elective-4	TH	1	10	15	10	15	50	1	2
				PR	2	20	-	30	-	50	1	
HXXXC501	HMM/DM	HMM/DM	Honors/Minor Degree Course	TH	4	20	30	20	30	100	4	4*
			Total		TH:TU:PR 13:1:12=26 17:1:12=30*			-	-	1000+100*	-	20+4*

* Introduced as Optional Honors/Minor Degree Courses

					Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
SEM-VI												
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	ISE1	MSE	ISE2	ESE	Total	Points	Total
PCC13CS15	PCPEC	PCC	Artificial Intelligence	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC13CS16	PCPEC	PCC	Theoretical Computer Science	TH	2	20	30	20	30	100	2	3
				TU	1	20	-	30	-	50	1	
PCC13CS17	PCPEC	PCC	Data Warehousing and Mining	PR	2	20	-	30	-	50	1	1
PCC13CS18	PCPEC	PCC	Deep Learning	PR	2	20	-	30	-	50	1	1
PEC13CSXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				TU	1	20	-	30	-	50	1	
PEC13CSXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				TU	1	20	-	30	-	50	1	
PEC13CSXX	PCPEC	PEC	Program Elective Lab	PR	2	20	-	30	-	50	1	1
PEC13CSXX	PCPEC	PEC	Program Elective Lab	PR	2	20	-	30	-	50	1	1
MDM05	MDC	MDM	Emotional and Spiritual Intelligence	TH	2	50	-	50	-	100	2	2
VSE13CS04	SC	VSEC	Cloud Computing	PR	4	50	-	50	-	100	2	2
HXXXC601	HMM/DM	HMM/DM	Honors/Minor Degree Course	TH	4	20	30	20	30	100	4	4*
			Total		TH:TU:PR 10:3:14=27 14:3:14=31*			-	-	1000+100*	-	20+4*

* Introduced as Optional Honors/Minor Degree Courses

					Contact Hours	Examination Marks (1 Credit=50 Marks)					Credits	
SEM-VII												
Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	ISE1	MSE	ISE2	ESE	Total	Points	Total
PCC14CS19	PCPEC	PCC	Software Engineering	TH	2	20	30	20	30	100	2	3
				PR	2	20	-	30	-	50	1	
PCC14CS20	PCPEC	PCC	Natural Language Processing	PR	2	20	-	30	-	50	1	1
PEC14CSXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				TU	1	20	-	30	-	50	1	
PEC14CSXX	PCPEC	PEC	Program Elective Course	TH	2	20	30	20	30	100	2	3
				TU	1	20	-	30	-	50	1	
MDM06	MDC	MDM	Principles of Management	TH	2	50	-	50	-	100	2	2
RMC14CS01	EL	RM	Essentials of Research Methodology	TH	1	40	-	60	-	100	1	2
				TU	1						1	
RMC14CS02	EL	RM	Intellectual Property Rights	TH	1	40	-	60	-	100	1	2
				TU	1						1	
PRJ14CS01	EL	PR	Project	PR	8	100	-	100	-	200	4	4
HXXXC701	HMM/DM	HMM/DM	Honors/Minor Degree Course	TH	4	20	30	20	30	100	4	4*
HXXXSBL701	HMM/DM	HMM/DM	Honors/Minor Degree Course Lab	PR	4	50	-	50	-	100	2	2*
			Total		TH:TU:PR 10:4:12=26 14:4:16=34*			-	-	1000+200*	-	20+6*

* Introduced as Optional Honors/Minor Degree Courses

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Course Code	Course Vertical	Sub-Vertical	Course Name		Contact Hours	Examination Marks					Credits	
SEM-VIII												
						ISE1	MSE	ISE2	ESE	Total	Points	Total
PCC14CS21	PCPEC	PCC	Program Core Course	TH	SWAYAM	As Per SWAYAM					2	2
PCC14CS22	PCPEC	PCC	Program Core Course	TH	SWAYAM	As Per SWAYAM					2	2
PEC14CSXX	PCPEC	PEC	Program Elective Course	TH	SWAYAM	As Per SWAYAM					2	2
MDM07	MDC	MDM	One MDM Course	TH	SWAYAM	As Per SWAYAM					2	2
INT14CS01	EL	INT	Semester long Internship	PR	36-40 hrs	As Per Internship Manual					12	12
HXXXC701	HMM/DM	HMM/DM	Honors/Minor Degree Course	TH	SWAYAM	As Per SWAYAM					3	4*
				Total							-	20+4*

Online course 1 Credit=4 Week course from SWAYAM can be taken in SEM 7 or SEM VIII

Online min 8 week course from SWAYAM can be taken in SEM 7 or SEM VIII to complete 2 credit course
(Combination of two 4-week credit courses shall be allowed with prior approval)

* Online min 12 week course from SWAYAM can be taken in SEM 7 or SEM VIII to complete 3 credit course

List of Program Elective Courses:
> **Choice for Third Year:**
> **Track-A:**
>> SEM-V: Big Data Analytics, Competitive Coding Lab
>> SEM-VI: Social Media Analytics, Graph Data Science
>>> Lab: Software Testing Lab, knowledge Representation and Ontology Lab
> **Track-B:**
>> SEM-V: Blockchain, Competitive Coding Lab
>> SEM-VI: AI in Cyber Security, FinTech
>>> Lab: Explainable AI Lab, Generative AI Lab
> **Track-C:**
>> SEM-V: Image Processing, Competitive Coding Lab
>> SEM-VI: UI/UX Design, Computer Vision
>>> Lab: Soft Computing Lab, knowledge Representation and Ontology Lab

> **SEM- VII:** Any two theory courses from the other tracks

Open Electives offered to AI &DS students:
1. SEM-III Any two: Computer Graphics OR Signal Processing and Communication Fundamentals OR Verilog Programming OR Basic Manufacturing Processes OR Renewable Energy System OR Industrial Engineering
2. SEM-IV Any one: Microprocessor & Microcontrollers OR Automation and Robotics OR Optimization Techniques
3. SEM-V Any one: Embedded Systems OR IoT OR E-Vehicle OR Supply Chain Management OR Design of Experiments OR 3D Printing OR High Performance Computing

List of Multi-Disciplinary Minor Courses (MDM):
1. **SEM-III:** Law for Engineers
2. **SEM-IV:** Emerging Technology and Law
3. **SEM-V:** Public Relations and Corporate Communication
4. **SEM-V:** Health, Wellness and Psychology
5. **SEM-VI:** Emotional and Spiritual Intelligence
6. **SEM-VII:** Principles of Management
7. **SEM-VIII:** From SWAYAM (To be approved by Dean Academics)

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List of Modern Indian Language (2 credit) (AEC):

1. Sanskrit for Beginners
2. Telugu for Beginners
3. Kannada for Beginners
4. Tamil for Beginners

Indicative List of Cocurricular Courses (CC):(Min 15 to Max 20 students in each course: Except Social Activities). Will be offered based on student choice and availability of resources to conduct a course.

LLC01. Culinary Arts: Foundations of Cooking
LLC02. Indian Aesthetics
LLC03. Sketching
LLC04. Personality Development and People Management
LLC05. Work Life Balance
LLC06. Art of Living
LLC07. Yoga Vidya
LLC08. First Aid and Self Defence
LLC09. Fire Safety and Electronic Security
LLC010. Sports Technology
LLC011. Athletics
LLC012. Aerobics and Fitness
LLC013. Study of Dance Forms
LLC014. Introduction to Dramatics: Exploring Theatre Arts
LLC015. Fundamentals of Photography
LLC016. Cinematography
LLC017. Music Appreciation and Composition
LLC018. Script writing
LLC019. Vehicle maintenance and traffic rules
LLC020. Garden Design and Maintenance
LLC021. Managing Social Media
LLC022. Server and Network Maintenance
LLC023. Electrical Safety
LLC024. Mentoring of School Children
LLC025. Social Club Activities
LLC026. Cultural Club Activities
LLC027. Any other course approved by Dean Academics

Honor Degree Offered to Artificial Intelligence & Data Science Students from SEM-V to SEM-VIII:
A. Name: **Internet of Things**

1. SEM-V: HIoTC501: IoT Sensor Technologies
2. SEM VI: HIoTC601:IoT System Design
3. SEM VII: HIoTC701:Dynamic Paradigm in IoT
4. SEM VIII: HIoTSBL701:Interfacing & Programming with IoTLab (SBL)
5. SEM VIII: HIoTC801: Industrial IoT

B. Name: Blockchain

1. SEM-V: HBCC501: Bit coin and Crypto currency
2. SEM VI: HBCC601: Blockchain Platform

3. SEM VII: HBCC701: Blockchain Development
4. SEM VIII: HBCSBL701: Private Blockchain Setup Lab (SBL)
5. SEM VIII: HBCC801: DeFi (Decentralized Finance)

C. Name: Cyber Security
1. SEM-V: HCSC501: Ethical Hacking
2. SEM VI: HCSC601: Digital Forensic
3. SEM VII: HCSC701: Security Information Management
4. SEM VIII: HCSSBL601: Vulnerability Assessment Penetration Testing (VAPT) Lab
5. SEM VIII: HCSC801: Application Security

Minor Degree Offered to Artificial Intelligence & Data Science Students from SEM-V to SEM-VIII:

A. Name: Robotics
1. SEM-V: HRBC501: Industrial Robotics
2. SEM VI: HRBC601: Mechatronics & IoT
3. SEM VII: HRBC701: Artificial Intelligence & Data Analysis
4. SEM VIII: HRBSBL701: Robotics and Automation Lab
5. SEM VIII: HRBC801: Autonomous Vehicle Systems

B. Name:3D Printing
1. SEM-V: H3DPC501: Introduction to CAD
2. SEM VI: H3DPC601:3D Printing: Introduction & Processes
3. SEM VII: H3DPC701:Applications of 3D Printing
4. SEM VIII: H3DPSBL701: Skill Based Lab– Digital Fabrication
5. SEM VIII: H3DPC801: 3D Printing in Medical Technology

Comparison of Credit Distribution for Four Year UG Program for Fr CRCE and GR:

UG: Artificial Intelligence & Data Science

| | Course Verticals | | | | | | | | | | | | | | | | | Total Credits |
| | BSESC | | PCPEC | | MDC | | SC | HSSM | | | | EL | | | | LLC | BC | |
SEM	BSC	ESC	PCC	PEC	MDM	OE	VSEC	AEC	EEMC	IKS	VEC	RM	CEFP	PRJ	INT	CC	BC	
I	9	9															--	18
II	9	8						3									--	20
III	3		6		2	4			2		2		2			1	6	22+4
IV	3		7		2	2	2	2	2		2					1	8	23+5
V			10	4	4	2											--	20
VI			8	8	2		2										--	20
VII			4	6	2							4		4			--	20
VIII			4	2	2										12		--	20
Total Credits as per Fr CRCE	24	17	39	20	14	8	4	5	4	-	4	4	2	4	12	2	14	163+9 =172
Total Credits as per GR	14	12	44	20	14	8	8	4	4	2	4	4	2	4	12	4	--	160

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
BSC12CS05	**Discrete Maths and Statistics**	L	T	P	L	T	P	Total
		2	1	0	2	1	--	3
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	30	20	100(30% Weightage)	100	
		Tutorial	20	--	30	--	50	

Pre-requisite Course Codes	BSC11CS01, BSC11CS03	
Course Outcomes	CO1	Apply propositional and predicate logic to solve problems and represent mathematical statements
	CO2	Analyze the implications of different types of relations and functions in various mathematical and real-world contexts
	CO3	Classify algebraic structures, Groups, Rings and solve problems using algebraic structures.
	CO4	Solve the problems on sampling and Normal probability distributions
	CO5	Develop and test a hypothesis about the population parameters to draw meaningful conclusions.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Logic**: Propositional Logic, Predicate Logic, Laws of Logic, Quantifiers, Normal Forms, Inference Theory of Predicate Calculus, Mathematical Induction.	1,2,4	5
2	2.1	**Relations**: Definition, Types of Relations, Representation of Relations, Closures of Relations, Warshall's algorithm, Equivalence relations and Equivalence Classes	1,2	6
	2.2	**Functions**: Definition, Types of functions, Composition of Functions, Invertible functions, Recursive functions, Hashing, Pigeonhole principles		
	2.3	**Lattice**: Definition, Properties of Lattice, Sub lattice, Isomorphic Lattices		
3	3.1	**Algebraic structures with one binary operation**: Semi group, Monoid, Groups, Subgroups, Abelian Group, Cyclic group, Isomorphism	1,2,3	6
	3.2	**Algebraic structures with two binary operations**: Ring		
	3.3	**Coding Theory**: Coding, binary information and error detection, decoding and error correction		
4	4.1	**Continuous Probability Distributions**: Uniform Probability Distribution, Normal Curve, Standard Normal Probability Distribution, Computing Probabilities for Any Normal Probability Distribution	5	4
	4.2	**Sampling :**Sampling Methods, Central Limit theorem, Interval Estimation		
5	5.1	**Hypothesis Tests** : Developing Null and Alternative Hypotheses,	5	5

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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		Type I and Type II Errors, Population Mean: Known, Population Mean: Unknown, Inference About Means and Proportions with Two Populations, Confidence Interval estimate		
	5.2	**Tests of Goodness of Fit and Independence** : Goodness of Fit Test: A Multinomial Population, Test of Independence		
			Total	**26**

Course Assessment:

Theory:
      ISE-1: 20 Marks
Activity: Assignments/quiz on Logic, Relations, Functions and Algebraic structures
ISE-2: 20 Marks
Activity: Assignments/quiz/ case study on Sampling, Hypothesis testing
MSE : 30 Marks written examination based on 50% syllabus
ESE : Three hours 100 marks(30% weightage) written examination based on entire syllabus

Tutorial:
      ISE-1: 20 Marks
Evaluation based on first four tutorials
ISE-2: 30 Marks
Evaluation based on next six tutorials

Topics for Tutorial
Tutorial 1: Logic
Tutorial 2: Relations, Functions
Tutorial 3: Algebraic Structures
Tutorial 4: Coding theory
Tutorial 5: Normal Probability Distribution
Tutorial 6: Sampling
Tutorial 7: Central limit theorem
Tutorial 8: Hypothesis testing(one population)
Tutorial 8: Hypothesis testing(two population)
Tutorial 9: Goodness of Fit Test
Tutorial 10: Test of Independence

Recommended Books:
1. Rosen   Kenneth: "Discrete Mathematics and its applications." McGraw Hill-New Delhi.
2. C.L.Liu, D.P.Mohapatra: "Elements of discrete mathematics: a Computer Oriented approach", 4th Edition, McGraw Hill-New Delhi.
3. B.Kolman, R.Busby, S.Ross: "Discrete Mathematical Structures",6th Edition, Pearson
4. Gary Haggard, John Schlipf, Sue Whitesides: "Discrete Mathematics for Computer Science", Thomson Brooks/Cole Publication
5. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams : "Statistics For Business And Economics"11th Edition, South-Western, Cengage Learning

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
PCC12CS05	Computer Organization and Architecture	1	-	2	1	-	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE		Total
		Theory	20	30	20	100(30% Weightage)		100
		Practical	--	--	--	--		--

Pre-requisite Course Codes	PCC11CS03,ESC11CS03
	Learners will be able to
Course Outcomes	CO1 Describe the basic structure of computer and compare architecture models.
	CO2 Implement algorithms for arithmetic operations.
	CO3 Comprehend processor architecture with various design methods of CPU.
	CO4 Classify different types of memory and implement various mapping techniques for cache and virtual memory.
	CO5 Describe I/O organization and analyze different parallel processing and pipelining concepts.
	CO6 Examine emerging trends in computer architecture.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Overview of Computer Organization and Architecture**	1	**02**
	1.1	Introduction of Computer Organization and Architecture, Basic organization of Computer and block level description of the functional units, Von Neumann model, Harvard model,Evolution of Intel processors.		
	1.2	Performance :Processor clock, basic performance equation, complier, performance measurement, Multiprocessor& Multicomputer, Multicore architecture.		
2		**Data Representation and Arithmetic Algorithms**	2,3	**03**
	2.1	Number representation: Floating point representation, floating point arithmetic,IEEE754floatingpoint number representation, Fast multiplication:Bit pair recording of multipliers		
	2.2	Booth's algorithm for signed multiplication, Restoring and Non-restoring Division		
3		**Processor Organization and Control Unit design**	1,2	**06**
	3.1	CPU Architecture, Register Organization, Instruction formats, basic instruction cycle, instruction interpretation and sequencing. Case study of 8086 architecture and Register organization		
	3.2	Control unit: Micro programmed and Hardwired Control unit design methods, Microinstruction sequencing and execution, micro		

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		operations		
	3.3	Introduction to RISC and CISC architectures and design issues.		
4		**Memory Organization**	1,2,4	06
	4.1	Memory Systems: Types of memory: RAM, ROM, Cache Memory hierarchy and its importance, Cache organization and principles, mapping techniques.		
	4.2	Virtual Memory: Paging and segmentation, Page tables and translation lookaside buffers (TLBs),Memory management unit (MMU),page replacement policies.		
5		**I/O Organization and Introduction to Parallel Processing**	1,2,4	07
	5.1	Buses: Synchronous, Asynchronous, Interface circuits: Parallel port, Serial port, Standard I/O Interfaces: PCI, SCSI,USB,CAN bus		
	5.2	Parallelism in Computer Architecture: Pipelining and its advantages, pipelining stages and pipelining hazzards Superscalar and VLIW architectures, SIMD and MIMD architectures		
6		**Emerging Trends in Computer Architecture**	5,6,7	02
	6.1	Power efficiency and low-power design, Quantum computing basics Neuro morphic computing and AI accelerators		
			Total	**26**

Course Assessment:
Theory:

ISE-1: 20 Marks
Activity: Quiz (10 Marks) and assignments (10 Marks)
ISE-2:20 Marks
Activity: Group Discussion on Benchmarking and Performance Evaluation,Influence of Computer Architecture on Software Development,Ethical Considerations in Computer Architecture,Security Implications in Computer Architecture,Parallel Processing in Real-world Applications,Impact of Cache Memory on System Performance: (10 Marks) Assignments (10 Marks)
MSE: 30 Marks written examination based on 50% syllabus
ESE: Three hours 100 marks(30% weightage) written examination based on entire syllabus

Recommended References:

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, "Computer Organization", TataMcGraw-Hill,5th Edition.
2. William Stallings, "Computer Organization and Architecture, Pearson,8th Edition.
3. Morris Mano, Computer System Architecture",Pearson, 3rdEdition.
4. John P. Hayes, "Computer Architecture and Organization", Tata McGraw-Hill, 3rd Edition.

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5. Yan Du, 'The Influence and Application of Computer Technology on Architectural Design", International conference on Network and Information systems for Computers, 2022.

6. Yoon Seok Yang, Yongtae Kim, "Recent Trend of Neuromorphic Computing hardware: Intel's Neuromorphic System Perspective", International SoC Design Conference,2020.

7. Mark Barnelli, Courtney Raymond, Lisa Loomis, DarrekIsereau, Daniel Brown, Francesca Vidal,Steven Smiley, "Advanced Ultra Low Power Deep Learning Applications with Neuromorphic Computing", High Performance Extreme Computing,2023

Society of St. Francis Xavier, Pilar's
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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
PCC12CS06	Data Structures	2	- -	2	2	--	1	3
		Examination Scheme						
			ISE	MSE	ISE	ESE		Total
		Theory	20	30	20	100 (30% Weightage)		100
		Lab	20	--	30	--		50

Pre-requisite Course Codes		ESC11CS03
Course Outcomes	CO1	Implement various operations of linear data structures.
	CO2	Implement various operations of non-linear data structures.
	CO3	Implement appropriate searching and hashing techniques on a given problem
	CO4	Apply appropriate data structure to solve different computing problems.

Module No.	Unit No.	Topics	Ref.	Hrs
1	1.1	**Introduction:** Introduction to Data Structures, Concept of ADT, Types of Data Structures: Linear and Nonlinear	1,2,3	2
2	2.1	**Stack and Queue:** **Stack:** Introduction, Stack as ADT, Operations, Implementation using array, Applications of stack: Infix to Postfix conversion, Evaluation of Postfix using stack	1,2,3	3
	2.2	**Queue:** Introduction, Queue as ADT, Operations, Implementation using array, Types of queue - Circular queue, Priority queue, Double ended queue, operations on these queues.	1,2,3	4
3	3.1	**Linked List:** Linked list as an ADT, Types of Linked List: Singly Linked List, Doubly linked list, Circular linked list concept, Operation on Singly and Doubly linked list, Applications of Linked List: Stack and Queue using Linked List. Polynomial representation and addition of two polynomials using Linked List.	1,2,3	6
4	4.1	**Tree:** Basic Terminology, Array and Linked Representation of Binary Tree ADT, Traversal of Binary Tree, Binary Search Tree and operations on it, AVL trees, Rotations, Operations on AVL Tree, Applications of these binary trees. Introduction to B tree and B+ tree.	1,2,3	6
5	5.1	**Graphs:** Basics Terminology, Adjacency List and Adjacency Matrix Representation, Graph traversals BFS and DFS.	1,2,3	3
6	6.1	**Searching Techniques and Hashing:** Linear Search and Binary Search, Hashing: Basic concepts, Hash function, Collision Resolution Techniques.	2,3	2
			Total	**26**

Society of St. Francis Xavier, Pilar's
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Course Assessment:

Theory:

ISE-1: Activity: Regular Quizzes of 20 Marks

ISE-2: Activity: Online Coding Challenge 20 Marks

Participation in online coding platforms like LeetCode, HackerRank, or Codeforces, where students can practice solving algorithmic problems related to data structures.

MSE : 30 Marks written examination based on 50% syllabus

ESE : Three hours 100 marks(30% weightage) written examination based on entire syllabus

Lab :

ISE-1: Practical Exam after completing first five experiments (20 Marks)

ISE-2: Assessment of Mini Project based on Rubrics (10 Marks)

Practical Exam based on full syllabus. (20 Marks)

Module No.	Exp. No.	Suggested List of experiments
1		**Stack ADT**
	1	a. Implement Stack ADT using array
	2	b. Convert Infix to Postfix and evaluate the postfix using Stack ADT..
2		**Queue ADT (Any Two)**
	3	a. Implement Linear Queue ADT using array.
	4	b. Implement Circular Queue ADT using array.
		c. Implement Priority Queue ADT using array.
		d. Implement Double Ended Queue using array
3		**Linked List ADT**
	5	a. Implement Circular Linked List ADT.
	6	b. Implement Doubly Linked List ADT.
	7	c. Add two polynomials using Linked list.
4		**Binary Tree, BST ADT (Any Two)**
	8	a. Implement Binary Search Tree ADT using Linked List
	9	b. Construct an expression tree from given postfix form of expression.
		c. Implement a program to represent infix, prefix and postfix form of arithmetic expressions using binary tree traversal techniques. The expression is represented as a binary tree, where each operator is a parent node, and its operands are the left and right children
5		**Graph:**
	10	a. Implement a program to represent a graph using an adjacency list or adjacency matrix data structure. And perform breadth-first search (BFS) or depth-first search (DFS) traversal algorithms.
6		**Searching and Hashing**
	11	a. Implement a hash table data structure using an array and handle collisions using chaining (linked lists) and linear probing.
		Mini Project: (Suggested list of Mini Project Topics) (Any One)
	12	a. Text Edition Application: Implement a text editor with an undo

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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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feature. Every time a change is made to the text, save the previous state. When the user performs an undo operation, last state should be reverted.

b. Develop a print job scheduler. Users submit print jobs to the printer, and they are processed in the order they were received.

c. Design and implement a music application to manage and organize playlists efficiently. The application should allow users to perform the following operations: Add song, Edit song, delete song, play song,

d. Develop a browser history manager using a doubly linked list to efficiently track and navigate through the user's browsing history. The application should facilitate the following functionalities: Navigation forward and backward, Add page, remove page, search page, display history etc.

e. Develop a word dictionary application to efficiently store and retrieve words and their definitions. The application should provide the following functionalities: Insertion, deletion, search, update etc.

f. Given a network of cities connected by roads with different weights representing distances, find the minimum spanning tree to connect all cities with minimum total distance.

Recommended Books:
1. Yedidyah Langsam, Moshe J. Augenstein, Aaron M.Tenenbaum "Data Structures using C and C++" , second edition, Pearson Publication
2. Reema Thareja, "Data Structures using C",Third Edition, Oxford University Press .
3. Robert L. Kruse, Alexander J. Ryba, "Data Structures and Program Design in C++", Prentice-HallIndia.
4. Data Structures and Algorithm Analysis in C by Mark Allen Weiss, second edition, Pearson Education India publication

Further Reading:
1. Michael H. Goldwasser, Michael T. Goodrich, Roberto Tamassia, "Data Structures and Algorithm in Java", Sixth Edition 2014,Wiley publication.
2. Richard F. Gilberg &Behrouz A.Forouzan, "Data Structures: Pseudocode approach with C", 2nd Edition, Cengage India Publication

Online Resources:
1. https://nptel.ac.in/courses/106/102/106102064/
2. https://www.coursera.org/specializations/data-structures-algorithms
3. https://visualgo.net
4. www.leetcode.com
5. www.hackerrank.com
6. www.codechef.com

Society of St. Francis Xavier, Pilar's
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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
PCC12CS07	Object Oriented Programming with Java	Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		Programming Fundamentals
Course Outcomes	CO1	Demonstrate Proficiency in Core Java Concepts
	CO2	Apply Object-Oriented Programming Principles
	CO3	Explore Java programming concepts including multithreading, File I/O, and exception handling
	CO4	Develop and Debug Java Applications

Module No.	Exp. No.	Topics
1	1	Introduction to Java Basics: Overview of Java programming language, Setting up the development environment (IDE installation), Writing and executing your first Java program, Understanding variables and data types, Basic input/output operations, Control Structures and Functions **Suggested Experiment List: (Any One)** **Coffee Shop Problem** Develop a program for a coffee shop that calculates the total cost of a customer's order, including taxes and discounts, and prints the receipt. **Temperature conversion tool** Problem Statement: Create a temperature conversion tool that converts Celsius to Fahrenheit and vice versa, based on user input. **Parking Fee Calculator** Problem Statement: Implement a parking fee calculator that calculates the parking charges based on the duration of parking and the type of vehicle.
2	2	Introduction to object-oriented programming (OOP) concepts: Classes and objects in Java, Encapsulation , Association and polymorphism **Suggested Experiment List: (Any One)** **Banking Application** Design a simple banking application that allows users to deposit, withdraw, and check their account balance. **Student Management System** Create a student management system that stores student information (name, roll number, marks) and provides functionality to add, delete, and update student records.
3	3	Inheritance: Types of Inheritance, Interface , Abstract class and methods, super and final keywords **Suggested Experiment List: (Any One)** **Shape Drawing Application** Design a shape drawing application that allows users to draw different shapes (circle, rectangle, triangle) on a canvas and perform operations like resizing and

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		rotating. **Employee Payroll Processing** Create a program for managing employee payroll information, including salary calculation, deductions, and tax withholding. Allow HR personnel to add new employees, update salary information, and generate pay stubs.
4	4	Arrays and Vector: Arrays in Java, Vector. **Suggested Experiment List: (Any One)** **Library Management App:** Develop a program for a library that manages book inventory, allowing users to search for books by title or author **Contact Management App:** Build a contact management application that stores contact information (name, phone number, email) and provides features like searching, sorting, and exporting contacts.
5	5	Strings: Introduction to strings and string manipulation **Suggested Experiment List: (Any One)** **String Encoding:** Design a Java application that efficiently compresses a given string using any encoding technique, balancing between compression ratio and computational complexity. **Word Frequency:** Create a Java application for generating word clouds from textual data. Implement algorithms for frequency analysis, word weighting, and layout optimization to produce visually appealing representations of word distributions. **NLP:** Create a Java application for natural language processing that extracts named entities from a text corpus. Implement algorithms for recognizing and categorizing entities such as persons, organizations, locations, and dates.
6	6	Exception Handling: Handling exceptions in Java (try-catch-throw- throws-finally), User defined Exceptions **Suggested Experiment List: (Any One)** **Flight Booking System** Develop a program for a flight booking system that handles exceptions such as invalid input, seat availability, and payment errors. **Transportation Management** Create a Java program for a transportation management system that handles exceptions related to route planning, vehicle breakdowns, traffic congestion, and delivery delays. Implement resilience patterns like circuit breakers and retry mechanisms."
7	7	Multithreading: Introduction to Multithreading- lifecycle, creation of threads. Synchronization and Thread Communication, Handling Thread Interruption and Thread Pools. **Suggested Experiment List: (Any One)** **Chat Application** Develop a real-time chat application that allows multiple users to communicate with each other concurrently using separate threads for sending and receiving

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		messages. **Social Media Platform** Build a simple social media platform where users can create profiles, connect with friends, and share posts. Implement features such as news feed, notifications, and privacy settings.
8	8	Introduction to JavaFx: Setting Up a JavaFX Application, Creating UI Elements, Event Handling in JavaFX **Suggested Experiment List: (Any One)** **Inventory management app** Design a simple inventory management system for a retail store that allows employees to add, update, and remove products from inventory using a graphical user interface. **Educational Game:** Create an educational game using JavaFX for teaching complex concepts in mathematics, physics, or computer science. Design engaging game play mechanics, interactive tutorials, and challenging puzzles to facilitate learning through exploration and experimentation.
9	9	Database Connection with Java: Setting Up Database Environment (MySQL/PostgreSQL), Establishing Database Connection, Executing SQL Queries, basics of Exception Handling Demonstration Program on Database Connection and Queries handling
10	10	File Handling: File Input / Output with Streams, Serialization and Deserialization, Random Access Files **Suggested Experiment List: (Any One)** **File Master App** Create a file management tool that allows users to organize and manage files and folders on their computer, including operations like creating, deleting, and renaming files. **Weather Forecasting Application** Develop a weather forecasting application that retrieves data from a file and displays current weather conditions and weather stats.
11	11	Mini Project: Defining the problem statement and objectives. Create UML diagram (Class diagram/ Usecase diagram) Implement the idea of Mini Project based on the content of the syllabus(Group of 2-3 students)

Course Assessment:
ISE-1: will be conducted for (40-50%) experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
ISE-2: will be conducted for remaining experiments. Continuous pre-defined rubrics-based evaluation for 20 marks, Mini project for 10 marks

Recommended Books:

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1. Herbert Schildt , "Java: The Complete Reference", Nineth edition, McGraw Hill Education Publication
2. E. Balaguruswamy, "Programming with JAVA", Sixth edition, McGraw Hill Education Publication
3. Kathy Sierra and Bert Bates, "Head First Java: A Brain-Friendly Guide, 2Nd Edition", O'REILLY publication
4. Joshua Bloch , "Effective Java", third edition, Addison-Wesley Professional publication
5. Brian Goetz et al., "Java Concurrency in Practice", first edition, Addison-Wesley Professional publication
6. Mark Heckler, Gerrit Grunwald, José Pereda, Sean Phillips, Carl Dea, "JavaFX 8: Introduction by Example" second edition, Apress publication

Online Repository:
1. Java Course Online for Beginners by Scaler Topics
2. Java Tutorial for Complete Beginners by Udemy
3. Object-Oriented Programming in Java by Coursera
4. Java Programming by Great Learning
5. Core Java Basics by UpGrad
6. Practice Java by Building Projects on Udemy
7. Java for Absolute Beginners by Udemy

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
MDM01	Law for Engineers	2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes	--

Course Outcomes	CO1	To demonstrate awareness of basic structure of Indian Legal System
	CO2	To demonstrate awareness of principles of contract
	CO3	To demonstrate awareness of legal aspects related to establishment of factory and various legislations related to employees, labours, and workmen's welfare
	CO4	To demonstrate awareness about right ot information, intellectual creations from infringement and laws related to energy, food and environment

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Foundation of Legal System**	1,2,3	4
	1.1	Indian Legal System: An Introduction, Human Rights, Fundamental Rights, The Supreme Court of India, Statutory Commissions– NHRC, NCW, NCM, NC-SC/ST etc.,		
	1.2	Representation of Peoples Act 1950, Prevention of Corruption Act, 1988, Understanding the Importance of Stamp Duty		
	1.3	Few Illustrated Cases of Supreme Court of India		
2		**General Principles of Contract: India Contract Act 1872**	2,3	8
	2.1	Contract Law: Agreement and Its Kinds,		
	2.2	Who Can Enter into a Contract, Contract and Its Enforceability, Offer and Acceptance in a Contract,		
	2.3	Essentials of Valid Contract- Lawful Consideration and Lawful Object, Essentials of Valid Contract- Free Consent,		
	2.4	Types of Contract, Contract of Agency, Performance of Contracts, Government Contracts, Standard Form Contracts		
3		**Industrial and Labour Laws**	2,3	8
	3.1	Labour Laws in India: An Overview, Industrial Disputes Act, 1947, Industrial Employment (Standing Orders) Act, 1946		
	3.2	Factories Act, 1948, Industries (Development and Regulation) Act, 1951		
	3.3	Contract Labour (Regulation and Abolition) Act, 1970, Bonded Labour System (Abolition) Act, 1976, Child and Adolescent Labour (Prohibition and Regulation) Act, 1986		
	3.4	Workmens Compensation Act, 1923, Equal Remuneration Act, 1976, Payment of Bonus Act, 1965, Payment of Gratuity Act, 1972, Employees' State Insurance Act, 1948, Employees' Provident Funds and [Miscellaneous Provisions] Act, 1952,		

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		Payment of Wages Act, 1936, Minimum Wages Act, 1948, Employees' Pension Scheme 1995		
	3.5	Apprentices Act, 1961, Maternity Benefit Act, 1961, Fatal Accidents Act, 1855, Trade Unions Act, 1926, Sexual Harassment of Women at Workplace Act, 2013, Collective Bargaining		
4		**Right to Information**	2,3	2
	4.1	Official Secret Act, 1923, Indian Evidence Act, 1872		
	4.2	Right to Information Act, 2005, Impact of Right to Information Act		
5		**Intellectual Property Rights**	2,3	2
	5.1	Types of Intellectual Property, Indian Copyright Act 1957, Indian Trademark Act 1999, Indian Patent Act 1970		
6		**Other Important Laws**	2,3	
	6.1	Electricity Act 2003, Atomic Energy Act 1962, Motors Vehicle Act 1988, Food Safety and Standards Act 2006, National Food Security Act 2013, Environment Protection Act 1986		2
			Total	**26**

Course Assessment:

ISE-1: Quiz: 20Marks
Activity: Debating Session: 20 Marks
Activity: Poster Making: 10 Marks

ISE-2: Quiz: 20 Marks
Activity: Client Counseling: 10 Marks
Activity: Animation Making: 20 Marks

Recommended Books:
1. N. S. Nappinai, "*Technology Laws Decoded*," LexisNexis, 2017
2. Vibha Arora and Kunwar Arora, "*Law for Engineers*" Central Law Publications, 2017
3. Vandana Bhatt and Pinky Vyas, "*Laws for Engineers*", ProCare, 2015

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OECS11	Signal Processing and Communication Fundamentals	1	--	2	1	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE		Total
		Theory	10	15	10	50(30% Weightage)		50
		Lab	20	--	30	--		50

Pre-requisite Course Codes		
Course Outcomes	CO1	Differentiate between continuous and discrete time signals and systems.
	CO2	Develop input output relationship for LTI systems
	CO3	Analyze the various elements of communication system and recognize the need of multiplexing techniques
	CO4	Analyze various Digital Modulation techniques

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Continuous and Discrete Time Signals and Systems**	1,2	3
	1.1	Mathematical Representation and Classification of Continuous Time CT) and Discrete Time (DT) Signals		
	1.2	Arithmetic Operations on Signals, Time Shifting, Time Scaling, Time Reversal of Signals, Sampling Theorem and Aliasing		
	1.3	Mathematical Representation and Classification of CT and DT systems		
2		**Time Domain Analysis of Continuous And Discrete Signals and Systems**	1,2	2
	2.1	Properties of Linear Time Invariant (LTI) systems, Impulse and Step Response		
	2.2	Use of Convolution Integral and Convolution Sum and Correlation for Analysis of LTI Systems		
	2.3	Properties of Convolution Integral/Sum		
3		**Introduction to Electronic Communication**	3,4	5
	3.1	Electromagnetic frequency spectrum, noise: types and sources of noise in brief, TDM, FDM		
	3.2	Introduction of Analog Modulation, Need for modulation, Principles of Amplitude modulation and Frequency Modulation: equation, modulation index, power and current relations, bandwidth		
4		**Introduction to Digital communication**	5,6	4
	4.1	Introduction to Digital communication system, Line codes and their desirable properties		
	4.2	Brief Concept of QAM, BFSK and M-ary PSK		
	4.3	MSK: bandwidth, Euclidean distance		
			Total	**14**

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Module No	Sr.no	Suggested List of Tutorials/experiments
1	1	Operation on Analog signals
1	2	Operations on Digital signals
2	3	Classification of Systems
2	4	Convolution of Signals
3	5	Simulation of Amplitude Modulation in Matlab
3	6	Simulation of Frequency Modulation in Matlab
3	7	Simulation of Phase Modulation in Matlab
4	8	Simulation of Amplitude Shift keying in Matlab
4	9	Simulation of Frequency Shift keying in Matlab
4	10	Simulation of Phase Shift keying in Matlab

Course Assessment:

Theory:

ISE 1: Quiz/Assignment for 10 Marks

ISE 2: Quiz/Assignment for 10 Marks

MSE : 15 Marks written examination based on 50% syllabus

ESE : Two hours 50 marks(30% weightage) written examination based on entire syllabus

Lab:

ISE-1: will be conducted based on four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks

ISE-2: conducted based on five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks, Implementation of small communication project – 10 Marks

Recommended Books:

1. Tarun Kumar Rawat, "Signals and Systems", Oxford University Press, 2016.
2. A. Nagoor Kani, "Signals and Systems", Tata McGraw-Hill Education, 2014
3. Kennedy and Davis, "Electronics Communication System", Tata McGrawHill, Fourth Edition
4. Wayne Tomasi, "Electronics Communication Systems", Pearson Education, Fifth Edition
5. Haykin Simon, *"Digital Communication Systems*," John Wiley and Sons, New Delhi, Fourth Edition, 2014.
6. Bernad Sklar,- "Digital communication", Pearson Education, 2nd Ed.

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OECS12	**Computer Graphics**	1	--	2	1	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE		Total
		Theory	10	15	10	50(30% Weightage)		50
		Lab	20	--	30	--		50

Pre-requisite Course Codes			
Course Outcomes	CO1	Compare various graphics devices	
	CO2	Analyze and implement algorithms for line drawing, circle drawing and polygon filling	
	CO3	Apply geometrical transformation on 2D and 3D objects	
	CO4	Analyze and implement algorithms for clipping	

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction**	1,3	2
	1.1	Basic concepts in Computer Graphics – Types of Graphic Devices – Interactive Graphic inputs – Raster Scan and Random Scan Displays.		
2		**Algorithms**	1,2,3	4
	2.1	Line Drawing Algorithm- DDA, Bresenham's algorithm – Circle Generation Algorithms –Mid point circle algorithm, Bresenham's algorithm- Scan Conversion-frame buffers – solid area scan conversion – polygon filling algorithms		
3		**2D transformation**	1,2,3	4
	3.1	Two dimensional transformations. Homogeneous coordinate systems – matrix formulation and concatenation of transformations. Windowing concepts –Window to Viewport Transformation- Two dimensional clipping-Line clipping – Cohen Sutherland, Midpoint Subdivision algorithm		
4		**3D transformation**	1,3	4
	4.1	Polygon clipping-Sutherland Hodgeman algorithm, Weiler Atherton algorithm, Three dimensional object representation Polygon surfaces, Quadric surfaces – Basic 3D transformations Translation, Scaling, Rotation		
			Total	**14**

Suggested List of Experiments:
1. Develop the DDA Line drawing algorithm
2. Develop the Bresenham's Line drawing algorithm
3. Develop the Bresenham's Circle drawing algorithm
4. Develop the C program for to display different types of lines

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

5. Perform the following 2D Transformation operation Translation , Rotation and Scaling
6. Perform the Line Clipping Algorithm
7. Perform the Polygone clipping algorithm
8. Perform 3D transformation of object
9. Develop small scale animation project

Course Assessment:

Theory:
        ISE 1: Quiz/Assignment for 10 Marks
        ISE 2: Quiz/Assignment for 10 Marks
        MSE : 15 Marks written examination based on 50% syllabus
        ESE : Two hours 50 marks(30% weightage) written examination based on entire
        syllabus

Lab:
        ISE-1: will be conducted based on four   experiments. Continuous pre-defined
        rubrics-based evaluation for 20 marks

        ISE-2: conducted based on five experiments. Continuous pre-defined rubrics-based
        evaluation for 20 marks, Implementation of small communication project –
        10 Marks

Recommended Books:

1. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, 2e, 1996
2. William M. Newman and Robert F. Sproull , Principles of Interactive Computer Graphics. McGraw Hill, 2e, 1979
3. Zhigang Xiang and Roy Plastock, Computer Graphics (Schaum's outline Series), McGraw Hill, 1986.

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		1	--	2	1	--	1	2
OECS13	Verilog Programming	**Examination Scheme**						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	10	15	10	50(30% Weightage)	50	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes			
Course Outcomes	CO1	Demonstrate understanding of basic FPGA design flow and FPGA architecture	
	CO2	Write Verilog code for a given digital design using fundamental concepts of Verilog language	
	CO3	Construct combinational and sequential circuits in different modelling styles using Verilog HDL.	
	CO4	Implement a given digital design problem using Verilog on FPGA platform	

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**FPGA Design Flow**	1,2	4
	1.1	India Semiconductor Industry and GoI policies.		
	1.2	Need of HDL, FPGA Design Flow and EDA tools		
	1.3	FPGA Architecture Fundamentals, Different FPGAs available in the market and their applications		
2		**Fundamentals of Verilog**	1,2	3
	2.1	Verilog Program Structure and concept of testbench		
	2.2	Language constructs, Verilog datatypes, Operators etc.		
3		**Design abstractions and Modeling Styles**	1,2	4
	3.1	Design Abstractions, Behavioral, Data flow, Gate level and Switch level modelling		
	3.2	Procedural Assignment and Continuous Assignment		
4		**Finite State Machines**	1,2	2
	4.1	Verilog code for both Mealy & Moore FSM		
			Total	**13**

Module No.	Sr.no	Suggested List of experiments	Ref.	Hrs.
3, 4	**1**	Design, simulate and synthesis any combinational digital design using structural modelling and carry out physical verification on given FPGA.	1,2	
	2	Design, simulate and synthesis any sequential digital design with behavioral modelling and carry out physical verification on given FPGA.	1,2	
	3	Design of greatest common divisor using both data-path and control path implementation in verilog HDL.	1,2	

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

4	Design and simulate Round Robin arbiter using behavioral modelling.	1,2	
5	Design, simulate and synthesisPulse-width modulationand carry out physical verification on given FPGA	1,2	
6	FPGA implementation of Traffic Light controller in verilog programming using Finite State machine.	1,2	
7	Design and simulate Elevator controller using Finite State machine.	1,2	
8	Mini projects as an application of Verilog programming.	1,2	

Course Assessment:

Theory:
ISE 1: MCQ: 10 Marks
ISE 2: MCQ: 10 Marks
MSE: 15 Marks written examination based on 50% syllabus
ESE: Two hours 50 marks(30% weightage) written examination based on entire syllabus

Lab:
ISE-1:
Lab exercises: 20 Marks
ISE-2:
Lab exercises: 20 Marks
Implementation of given design problem: 10 Marks

Recommended Books:
1. Samir Palnitkar "*Verilog HDL: A Guide to Digital Design and Synthesis*", Pearson Education, 2nd Ed., 2009.
2. Michel D. Ciletti "*Advanced Digital Design with Verilog HDL*" ,2nd Ed., PHI, 2009
3. Some useful websites: AMD Xilinx, EDA Playground and ASIC World

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OECS14	Basic Manufacturing Processes	1	--	2	1	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE		Total
		Theory	10	15	10	50(30% Weightage)		50
		Lab	20	--	30	--		50

Pre-requisite Course Codes		
Course Outcomes	CO1	Identify and differentiate between various manufacturing processes.
	CO2	Explain the function of the basic parts of the machine tools and its accessories.
	CO3	Analyse various machining processes and select the particular process for a specific job.
	CO4	Have the knowledge of the machining time for various manufacturing processes.

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to the various manufacturing processes.** Definition and need of various manufacturing processes.	1,2	02
	1.2	Classification of various manufacturing processes based on chip-less and chip-removal processes.		
2	2.1	**Cutting off machines** : Types of circular saws, Band saw, Power hacksaw, Friction saw, Abrasive cutting off machines.	1,4	04
	2.2	**Lathe machine :** specifications and types, Lathe operations, and Taper turning, Turning parameters like speed, feed, depth of cut, and metal removal rate. Calculation of machining time.		
3	3.1	**Drilling machine:** Drilling operations. Types of Drilling machines, Drill nomenclature. Work and tool holding devices. Calculation of machining time in drilling. Deep hole drilling and Boring machines.	1,6	04
	3.2	**Milling machine :** Types of milling operations and their difference. Milling parameters. Types of milling machines. Types of Milling cutters. Special milling attachments and accessories. Calculation of machining time in milling.		
4	4.1	**Grinding machine** Principle of grinding. Types of grinding machines and operations. Grit, grade, and structure of grinding wheels. Balancing of grinding wheels. Truing, dressing, and shaping of grinding wheels.	1,5	03
			Total	**13**

Course Assessment:

  Theory:

Society of St. Francis Xavier, Pilar's

Fr. Conceicao Rodrigues College of Engineering

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

ISE 1: Activity:A visit will be arranged for students in a Fr.CRCE workshop (other than CRCE) to get a demonstration on Lathe, Drilling, and Milling machines. Students will submit a report as part of ISE-1 based on their observation of their visit. (10 Marks)

ISE-2:
Activity: An Industrial Visit will be organized to a production facility where students will be able to gain more knowledge of the various machine tools. Students will submit a report as part of ISE-2 based on their observation of their industrial visit. (10 Marks)

MSE : 15 Marks written examination based on 50% syllabus

ESE : Two hours 50 marks(30% weightage) written examination based on entire syllabus

Lab:

	Activities to be completed during lab time	Ref.	Hrs.
A1	Visit to Fr. CRCE workshop (Demonstration of Lathe, Drilling, Milling, and Shaping machines) and report writing.	1,2	12
A2	Calculation of machining time (Lathe, Drilling and Milling operation).	1,4	6
A3	Draw and label a lathe machine.	1,5	2
A4	Draw and label any one type of drilling machine.	1,7	2
A5	Draw and label the single-point cutting tool.	1,2	2
A6	Draw and label the drill nomenclature.	1,2	2
		Total	**26**

ISE-1: will be conducted for two activities (A1 and A2) Continuous pre-defined rubrics-based evaluation for 10 marks each.

ISE-2 : will be conducted for any three activities (from A3,A4,A5,A6) Continuous pre-defined rubrics-based evaluation for 10 marks.

Recommended Books:
1. S. K. Hajra Choudhary, A. K. Hajra Choudhary, Nirjhar Roy , "Elements of Workshop Technology: Machine Tools" (Volume – 2), Media promoters 15th Edition (2023).
2. B. S. Raghuwanshi, Dhanpat Rai & Co., "A Course in Workshop Technology Vol. II (Machine Tools)" (2015).
3. W. A. J. Chapman, "Workshop Technology Part 1, 2 and 3". Taylor & Francis (2018)
4. Production Technology – HMT, Tata McGraw-Hill (2017).
5. Serope Kalpakjian, Steven R. Schmid, "Manufacturing, Engineering and Technology", 5th Edition by Pearson (2018).
6. O. P. Khanna, "A Text Book Of Production Technology Vol. II", Dhanpat Rai Publication (2012).
7. Mikell P. Groover, "Fundamentals of Modern Manufacturing- Materials, Processes and Systems", 6thEdition, Wiley India (2023).

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OECS15	**Renewable Energy Sources**	1	--	2	1	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	10	15	10	50(30% Weightage)	50	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes			
Course Outcomes	CO1	Describe the need for renewable energy and its potential for the development of a sustainable environment.	
	CO2	Analyze different solar collectors using geometrical parameters and photovoltaics for generation of solar energy.	
	CO3	Identify and analyze various wind turbine energy harnessment techniques.	
	CO4	Design biogas plant for harnessing energy from organic waste.	
	CO5	Describe significance of hydrogen energy to fulfill present and future energy needs.	
	CO6	Describe the operating principle of geothermal energy and ocean energy and their role in sustainable development.	

Module No.	Topics	Ref.	Hrs.
1	Introduction to Renewable Energy Sources. Current global and national energy scenarios. Prospects of renewable energy sources. Solar radiation terms, solar geometry, Solar radiation measurement.	1,2	02
2	Introduction and working principle of flat plate collectors, types, concentrating collectors and types. Advantages and disadvantages of flat-plate and concentrating collectors.	1,2,3	03
3	Solar Photovoltaic Energy. Introduction and working principle of solar PV systems, types of solar PV cells, solar tracking systems, controls and measurement methods of solar PV systems.	2	02
4	Wind Energy: Basic components and working principle of wind energy conversion systems, wind data and site selection considerations, various types of wind energy conversion systems, constructional features of horizontal and vertical axis wind machines	1,2	02
5	Energy from Biomass: Introduction of bioenergy, conversion technologies, types of biogas generation plants, design and construction details of biogas plant (KVIC), site selection, digester design consideration, filling a digester for starting, maintaining biogas production, utilization of biogas.Principles of fuel cells, types of fuel cells, power generation by fuel cells, applications of fuel cells.	1,2	02
6	Geothermal Energy: Introduction to geothermal technologies and methods of extracting geothermal energy. Energy from the ocean: Wave energy characteristics and wave energy conversion devices, tide energy conversion devices, Ocean Thermal Energy Conversion (OTEC) systems.	1,2	02

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

	Total	13

Course Assessment:

Theory:

ISE 1: Quiz 10 Marks
ISE 2: Quiz 10 Marks
MSE : 15 Marks written examination based on 50% syllabus
ESE : Two hours 50 marks(30% weightage) written examination based on entire syllabus

Lab:

ISE-1:

Lab activity:

  i. Case studies/discussion on the working of different renewable energy sources (Solar thermal devices, solar space heating and cooling, energy from ocean, etc).

  ii. Discussion on latest research work done in the field of renewable energy.
   Assignments: One assignment each on any 3 out of 6 modules.
   Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2:

  Presentations by students in groups of 3 on recent topics related to renewable energy sources (30 marks)

Recommended Books:

1. G.D. Rai "Non-conventional Energy Sources", 6th Edition, Khanna Publishers, ISBN: 978-81-7409-073-7

2. R. K. Rajput "Non-conventional Energy Sources and Utilisation", 2nd Edition, S. Chand. 2012

3. J W Twidell& Anthony D. Weir "Renewable Energy Sources", 3rd Edition 2015,ELBS Pub, ISBN: : 978-1-315-76641-6

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OECS16	**Industrial Engineering**	1	--	2	1	--	1	2
		Examination Scheme						
		Theory	ISE1	MSE	ISE2	ESE		Total
			10	15	10	50(30% Weightage)		50
		Lab	20	--	30	--		50

Pre-requisite Course Codes		
Course Outcomes	CO1	Learner will be able to understand evolution and revolution of Industry and basic productivity tools.
	CO2	Learner will be able to understand importance of Human factors and design consideration of Machine elements as interface.
	CO3	Learner will be able to understand and analyse method and time for productivity.
	CO4	Learner will be able to understand the importance and effect of Layout.
	CO5	Learner will be able to understand the importance of value creation and waste elimination in any product or process.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction to Industrial Engineering**	6,2	3
	1.1	Evolution of Industrial engineering; Industrial revolution 1.0 to 6.0		
	1.2	**Productivity philosophy & tools:** Productivity & Improvement tools: 5s, Poka- Yoke, Kaizen, Kanban etc.		
2		**Human Factor in Design**	3	2
	2.1	Human as a system, multi human machine dynamics		
	2.2	Locating controls and displays, health and safety of employees.		
3		**Work Study**	3	3
	3.1	Method study, motion and time study,		
	3.2	Rating factor, performance factor, allowances and standard data		
4		**Layout:**	1	2
	4.1	Significance of layout, Types of Layout,		
	4.2	Factors influencing layout choices.		
5		**Value Engineering:**	7	3
	5.1	Distinction between value engineering & value analysis.		
	5.2	Function analysis system techniques- FAST diagram (example)		
			Total	**13**

Course Assessment:

Theory:

ISE 1: Quiz (10 marks)

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

ISE-2: Quiz (10 marks)
MSE : 15 Marks written examination based on 50% syllabus
ESE : Two hours 50 marks(30% weightage) written examination based on entire syllabus

Lab:

ISE-1: Lab activity: (any three)
   i. Presentation by students on Industrial evolution/revolution 3.0, 4.0, 5.0, 6.0 in a group of three students.
   ii. Use of basic quality tools for productivity - data collection and analysis.
   iii. Understanding the human factors and its impact through experiment
   iv. Finding the performance rating of an operator and merit rating.
   v. Selection and designing the layout based on flow and demand of materials / customer / User.
   vi. Primary value and secondary value in any product / service – representation using Function Analysis System Technique (FAST) diagram

Assignments: One assignment each on any 3 out of 5 modules.
Continuous pre-defined rubrics-based evaluation for 10 marks.

ISE-2 : Presentations by students in groups of 3 on recent development and practice of Industrial Engineering (15 marks)

Recommended Books:
1. James A. Tompkins , "Facilities Planning", 4th Edition,John Wiley and Sons Inc.
2. Yasuhiro Monden, "Toyota Production System: An Integrated Approach to Just-In-Time", CRC PRESS
3. O. P. Khanna, "Work Study Motion & Time Study", Dhanpat Rai Publications (P) Ltd, ISBN: 9788189928414
4. Richard B. Chase, "Operations Management for Competitive Advantage" MGH
5. James P. Womack, "Lean Thinking: Banish Waste and Create Wealth in Your Corporation", Free Press
6. Industry 5.0 The Future of the Industrial Economy by Uthayan Elangovan, CRC Press
7. Lawrence D. Miles, "Techniques of Value Analysis and Engineering", McGraw-Hill

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
EEM12CS01	Financial Planning, Taxation and Investment	Examination Scheme						
		Theory	ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	50	--	50	--	100	

Pre-requisite Course Codes		--	
Course Outcomes	CO1	To prepare financial plan by understanding owns need	
	CO2	To demonstration awareness of taxation policies and show respect towards government norms and regulations	
	CO3	To prepare investment plan by understanding owns futuristic needs	

Financial Planning: It is possible to manage income more effectively through financial planning. Managing income helps to understand how much money is required for tax payments, other expenditures and savings. It increases cash flows by carefully monitoring the spending patterns and expenses. Knowledge of comprehensive financial planning will help students to make right financial decisions in their life. It gives guidance in helping choose the right types of investments to fit needs, personality, and goals of their life. In this activity students need to prepare the financial plan for their life.

Taxation Policies: Taxes are levied in almost every country of the world, primarily to raise revenue for government expenditures, although they serve other purposes as well. The simple fact in economics is that there are certain common public goods and public needs that require some form of government and regulation to provide or promote. Taxation is the way to pay for these common goods. In this activity student will learn various types of taxes like Income tax, Corporate tax, Capital gains, Property tax, Inheritance and Sales tax.

Investments: Investments are important because in today's world, just earning money is not enough. But that may not be adequate to lead a comfortable lifestyle or fulfil our dreams and goals. Money lying idle in the bank account is an opportunity lost. Therefore, students should have a knowledge to invest money smartly to get good returns out of it. This activity will give insight to the students about investment in the form of Stocks, Mutual Funds, Fixed Deposits, Recurring Deposit, Public Provident Fund, Employee Provident Fund and National Saving Schemes.

Methodology: Guest lectures or workshops by professionals shall be arranged on Financial Planning, Taxationand Investments. Invite guest speakers, such as tax professionals or financial advisors, shall conduct a tax planning workshop for students. The workshop can cover topics such as tax-efficient investment strategies, retirement planning, and tax-saving opportunities for individuals and businesses. Students should be engaged in assessment driven activities throughout the course.For better learning outcomes following methods of content delivery via student engagement can be adopted.
Investment Simulation Game: Divide students into groups and have them participate in a simulated investment game. Each group is given a virtual budget to invest in stocks, bonds,

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

mutual funds, or other investment vehicles. Throughout the course, they track the performance of their investments and make decisions based on real-world market trends and economic indicators.

Financial Planning Board Game: Design a board game that simulates the process of financial planning, including setting financial goals, creating budgets, managing debt, and making investment decisions. Students play the game in groups, competing or collaborating to achieve their financial objectives.

Stock Market Simulation: Use online stock market simulation platforms that allow students to buy and sell stocks in a virtual trading environment. They can experiment with different investment strategies, track the performance of their portfolios, and compete against their classmates or other teams.

Course Assessment:

ISE-1: Quiz: **20 Marks**
Activity:Presentation on Financial Instruments: **10 Marks**
Activity: Preparing Investment Portfolio (20 Marks): Assign each student or group of students to create a hypothetical investment portfolio based on specific criteria such as risk tolerance, time horizon, and financial goals. They research different investment options, analyze their potential returns and risks, and justify their portfolio allocations in a written report or presentation.

ISE-2: Quiz: **20 Marks**
Activity:Tax Return Case Studies(*Perquisite: Pan Card (if not available, student should immediately apply and get pan card))* **(10 Marks):**Consider case study of fictional individuals or families and prepare tax returns based on their financial situations. This hands-on activity allows students to apply their knowledge of taxation laws and regulations in a practical context.

Activity:Financial Literacy Podcast(10 Marks): Have students create their own podcasts or audio recordings discussing key concepts related to financial planning, taxation, and investments. They can *interview experts*, share personal finance tips, or discuss current events and trends in the financial industry.

Activity: Personal FinanceBlog (10 Marks): Students create their own personal finance blogs or websites where they share articles, tutorials, and resources related to financial planning, taxation, and investments. This activity helps them develop their writing and research skills while sharing valuable information with their peers

Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L		T	P	Total
		1	--	2	1		--	1	2
VEC12CS01	**Human Values and Professional Ethics [HVPE]**		Examination Scheme					
			ISE-I	MSE	ISE-II	ESE	Total
		Theory	50	---	50	---	100
		Lab	---	---	---	---	---

Pre-requisite Course Codes		
Course Outcomes	CO1	Adhere to the core rights and shape one's values.
	CO2	Display the role and responsibility of Engineering professionals
	CO3	Holds moral and Ethical solutions to problems through case studies.
	CO4	Apply the knowledge of human values to contemporary ethical and global issues.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Background and Approach: Fundamental Rights and Duties**		
	1.1	Fundamental Rights and Duties, Right to Compensation for being Illegally Deprived of one's Right to Life or Liberty, Right to Travel Abroad and Return to one's Country		2
	1.2	Promotion of Inter-Religious harmony and inter-faith values, Composite Culture		1
2		**Professional Ethics and Human Values**		
	2.1	Sense of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy Moral dilemmas, Moral Autonomy, Kohlberg's theory Gilligan's theory, Consensus and Controversy, Profession& Professionalism, Models of professional roles, Theories about right actionCodes of Ethics, Plagiarism		3
	2.2	Human Values. Morals, values, and Ethics – Integrity- Academic integrity- Work Ethics- Service Learning- Civic Virtue Respect for others- Living peacefully- Caring and Sharing- Honestly- Cooperation Commitment Empathy-Self Confidence -Social Expectations.		2
	2.3	Managing conflict- Respect for authority- Collective bargaining- Confidentiality, Role of confidentiality in moral integrity-Conflicts of interest		2
3		**Global Ethical Concerns**		
	3.1	Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics		2
	3.2	Engineers as Expert witnesses and advisors-Moral leadership- case studies		1
			Total	**13**

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Assessment:

ISE-1: AICTE & UNESCO's certificate course on Self-directed Emotional Learning for Empathy and Kindness (SEEK) **30 marks**
Link : https://www.framerspace.com/course/seek (Select SEEK self- directed cohort under the category of youth courses)

Activity: Quiz and assignments **20 Marks**

ISE-2: AICTE & UNESCO'S certificate course on Social Emotional Learning for Youth Waging Peace (SEL4YWP)- UNESCO **30 Marks**
Link: https://www.framerspace.com/course/ywp?cid=5eaff2c239109c2c12ef8bd3

**Participants need to register themselves in the
link https://docs.google.com/spreadsheets/d/1dECtZbAmcPhKKelSEimVv-hzPV7dA_g-Brty2rxC2vE/edit?usp=sharing, before accessing the course content.

Activity: Article Discussion, Quiz and Assignments **20 Marks**

Recommended Books:
1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics-Concepts and cases, Wadsworth Thompson Learning, United States,2005.
4. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
5. R S Naagarazan, A textbook on professional ethics and human values, New Age International (P) limited,New Delhi,2006.
6. http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics.

Society of St. Francis Xavier, Pilar's
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(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		--	--	4	--	--	2	2
CEP12CS01	**Community Engagement Project**	**Examination Scheme**						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	50	--	50	--	100	

Pre-requisite Course Codes		--
Course Outcomes	CO1	Identify and address community needs and challenges which helplearners to develop problem-solving skills and creativity in finding innovative solutions.
	CO2	Enhance their cultural competence and ability to work effectively in multicultural settings
	CO3	Critically think on complex issues considering multiple view points
	CO4	Demonstrate collaboration, team work, civic engagement, empathy and compassion while engaging directly with community
	CO5	Develop a lifelong commitment to social justice and making a positive impact in the world

This course requires students to participate in field-based learning/projects generally under the supervision offaculty. The curricular component of 'community engagement and service'involve activities that would expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems.

At the end of the course it is expected that students will have valuable learnings in terms of enhanced communication skills, increased cultural competence, improved critical thinking, leadership skills, collaboration skills, empathy & compassion, civic engagement, problem-solving skills, self-reflection & personal growth and long-term commitment to social justice.

It is expected that 26-30 hours of contact time per credit in a semester (52 to 60 hours in a semester for 2 credits) along with 13-15 hours of activities such as preparation for community engagement and service, preparation of reports, etc., and independent reading and study.

Other Guidelines to students for successful Community Engagement:
Community engagement is the process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting the well-being of those people It is a powerful vehicle for bringing about environmental and behavioral changes that will improve the health of the community and its members. It often involves partnerships and coalitions that help mobilize resources and influence systems, change relationships among partners, and serve as catalysts for changing policies, programs, and practices.

Community engagement project is different as compared to traditional consultation. It is a regular engagement of community for achieving an identified goal or vision. It recognizes the role of community engagement in its broadest sense in the development of local democracy, while noting

that the focus of the report is on the practice of community engagement as it relates to local authority activity.

Communication, diplomacy, patience, and flexibility are essential to engage with a community. For a successful engagement conditions include: Shared and defined purpose. Willingness to collaborate. Commitment to contributing. Participation of the right people. Open and credible process. Involvement of a champion with credibility and clout. Ensure that the engagement process is complex but manageable. Initially the team will: Discuss and define the initiative and its potential impact. Set the purpose and goals for community engagement. Define the community. Know and respect the community's characteristics. Develop a relationship with the community, build trust, work with formal and informal leadership, find the community gatekeeper, identify the project champion, meet with the local organizations, and learn the assets and challenges for that community. Find the common interests.

The following four phases provide broad outline for the community engagement process:
Phase-I: Outreach
Go to the community instead of having the community come to you. Invite the stakeholders to a conversation. Create a constructive environment for dialogue allowing time to get to know the participants remembering that the community's time is valuable and must be respected. Identify the person or the organization that has convened the group and will provide initial leadership and organizational management. Outline the purpose and process for the conversation. Use a facilitator when appropriate. Define the issue and why it is important. Outline what is broken and focus on what is working. Is the issue a people problem or a situationproblem? Can the problem be solved with technical expertise or will it require something else? Determine the interest and merit in hosting future discussions.

Phase-II: Gather Facts, Brainstorm and Select
Create an environment for discussion where people are comfortable asking questions, expressing doubts, and brainstorming new ideas. Gather the facts related to the issue and its impact. Use a SWOT, appreciative inquire, asset mapping, and other tools during the factfinding stage. Clarify the issue's alignment with the community's values and ethics. Establish the common ground on which conversations will be based. Brainstorm and gather alternative solutions. Ask the "what if" questions. Spend time discussing the options and the potential impact. Allow the process to equip the participants to see the change, feel the change, and then be prepared to change. Select the best practice/solution. If required use decision-making tools to reduce the number of options.

Phase-III: Plan and Review
Write the implementation action plan. Include the evaluation procedure that will answer thequestion "What will it look like when the change has happened?". Discuss the proposal with the appropriate stakeholders searching for insight and response. Use the feedback to assess and revise the plan. Stay focused on the solution.

Phase-IV: Implement and Evaluate
Implement the plan. Remember, groups want a rapid success. Identify an action that will provide a "meaningful win" within the "immediate reach." Evaluate the impact. Report the status to the community and gather feedback. Revise the plan and evaluate again.

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Keep the participants informed through discussion agendas, written summaries of previous discussions, goals/assignments for the next discussion, and progress reports providing accountability for delivering what was promised.

Course Assessment:

ISE-1:
Activity: Report Submission: 20 Marks
Activity: Report Presentation: 30 Marks

ISE-2:
Activity: Report Submission: 20 Marks
Activity: Report Presentation: 30 Marks

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	2	2	--	1	3
PCC11CS03	**Digital Electronics**	**Examination Scheme**						
			ISE1	MSE	ISE2	ESE		Total
		Theory	20	30	20	100(30% Weightage)		100
		Lab	20	–	30	–		50

Pre-requisite Course Codes		**Binary number system and codes, binary arithmetic**
Course Outcomes		After the successful completion students should be able to
	CO1	Compare TTL and CMOS families w.r.t. their characteristic parameters
	CO2	Construct combinational circuits using given MSI devices.
	CO3	Apply the knowledge of flip-flops and MSI devices to design sequential circuits.
	CO4	Analyze the given sequential circuits to identify the state transitions and race conditions.
	CO5	Implement the given logic function using programmable logic devices.

Module No.	Unit No.	Topics	Ref	Hrs.
1		**Implementation of Logic functions**		
	1.1	Logic gates, Implementation of functions using basic gates and using Universal gates	1,2,3,4	4
	1.2	Formulating a logic function, Sum of Products (SOP), Product of Sums (POS), Minimization using Boolean Algebra, De Morgan's Theorems, Minimization using Karnaugh map (upto 4 variables), Quine-McClusky Technique	1,2,3,4	
2		**Logic Families**		
	2.1	Characteristic parameters of logic families: Voltage and Current parameters, Fan in, Fan out, Noise margin, Power Dissipation, Propagation Delay	1,2,3,4	3
	2.2	TTL NAND gate and its transfer characteristics, CMOS inverter and transfer characteristics, comparison of TTL and CMOS logic families		
3.		**Combinational Circuit Design**		
	3.1	Full adders, ripple carry adders, Carry Look ahead Adders, Binary Subtractors	1,2,3,4	5
	3.2	Multiplexer/ Demultiplexer, Encoders, Priority Encoders, Parity Generators, Code Converters, comparator, ALU		
	3.3	Static and dynamic hazards in combinational circuits		
4		**Elements of Sequential Circuit**		
	4.1	Storage elements: Latches and Flip-flops (S-R, J-K, D, T Flip-flop), Master Slave Flip-flop	1,2,3,4	5
	4.2	Synchronous and Asynchronous counters, Shift registers and their applications	1,2,3,4	

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Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

5.		**Analysis of Sequential circuits**		
	5.1	Analysis of Moore and Mealy type Finite State Machines (FSM), State Reduction	1,2, 3,4	5
	5.2	Introduction to Asynchronous Sequential circuits, Essential hazards in asynchronous sequential circuits	1,2, 3,4	
6.		**Programmable devices**		
	6.1	Structure of Programmable Logic Devices (PLDs), Function implementation with PAL and PLAs, Introduction to CPLD and FPGA	1,2, 3,4	4
			Total	**26**

Laboratory Experiments:

Sr. No.	Title of experiment	Module	Ref
1.	To implement the combinational logic for a given function using basic gates and Universal gates.	1	1,2
2.	To simulate a CMOS inverter and to plot the transfer characteristics (using SPICE)	2	1,2
3.	a. To verify the function of 8 bit binary adder IC7483 b. To implement a BCD adder using IC7483	3	1,2
4.	a. To implement the function of 8 bit Multiplexer using IC74151 b. To implement a given 4 variable Boolean function using Multiplexer IC 74151	3	1,2
5.	To implement an 8 bit binary comparator using IC 7485	3	1,2
6.	a. To implement a Mod n asynchronous counter using flip-flops b. To implement a Mod n counter using IC 74163	4	1,2
7.	Implementation of a combinational circuit using reconfigurable devices a. To write an HDL code for the parity generator and simulate verify the operation by simulation. b. To implement the HDL code on FPGA and verify the operation.	6	7,8
8.	Implementation of a sequential circuit using reconfigurable devices a. To write an HDL code for a 4 bit shift register and verify the operation by simulation. b. To implement the HDL code on FPGA and verify the operation.	6	7.8

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Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Assessment:

Theory:

  ISE-1: 20 marks

  1. Quiz/ crossword …10 Marks

  2. Open book test ….10 marks

  ISE-2: 20 Marks

  1. Case study …10 Marks

  2. Oral examination….10 marks
  MSE:30 Marks written examination based on 50% syllabus

  ESE: Three hours 100 marks(30% weightage) written examination based on entire syllabus

Laboratory Assessment:

40 Marks (08 experiments of 05 marks each) + 10 Marks (activity based) = 50 Marks

  ISE:
  1. ISE-1 will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
  2. ISE-2
    a. Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.
    b. Activity based: Testing and debugging activity for 10 marks

Recommended Books:
  1. John F. Wakerly, "Digital Design Principles and Practice"- Pearson Publications, 4th edition
  2. Morris Mano, Michael D. Ciletti, " Digital Design with introduction to Verilog HDL" Pearson, 5th edition
  3. John M. Yarbrough, "Digital Logic Applications and Design" – Thomson Publications
  4. Stephen Brown and ZvonkoVranesic, "Fundamentals of digital logic design with Verilog design", McGraw Hill, 3rd Edition
  5. Roth and Kinney, "Fundamentals of Logic Design", Cengage learning,7th edition
  6. William I.Fletcher, "An Engineering Approach to Digital Design", PrenticeHall of India
  7. J. Bhaskar, A Verilog HDL Primer, Third Edition, Star Galaxy Publishing
  8. Sameer Palnitkar, "Verilog HDL: A guide to digital design and synthesis"

Online References:
https://archive.nptel.ac.in/content/storage2/courses/106108099//Digital%20Systems.pdf

Society of St. Francis Xavier, Pilar's
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(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
PCC11CS01	**Innovation and Design Thinking**	L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		
Course Outcomes		At the end of the course the students will be able
	CO1	To discuss case studies of innovative products and services.
	CO2	To identify the market needs and customer demand analysis.
	CO3	To generate ideas through brainstorming and frame product/service idea
	CO4	To empathize with the customer.
	CO5	To design and develop a prototype.
	CO6	To pitch their idea.

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Innovation and Creativity:** **(Takeaway)** Innovation, Invention and Creativity. Mindset. Convergent and Divergent Thinking. Case Studies – levels and types of Innovations. Market Impact. Linear and Non-Linear Innovations. **(Key Exercises)** 1. Exercises/Games/Activities to boost creativity and Inspiration 2. Article/Case Studies Discussion 3. Digital Market Survey Report and Customer Demand Analysis,Preparing competenciesreport to identify desired level of innovation & domain definition.		04
2		**Introduction of Design Thinking:** **(Takeaway)** Five stage model of design thinking. Empathize, Define, Ideate, Prototype, Testing. Non-linearity of the Model. **(Key Exercises)** 1. Live examples and videos 2. Design Thinking Activity for given problem 3. Find the impact and value of Innovation		04
3	3.1	**Empathize:** **(Takeaway)** Empathize with users. Step into the customer's shoes. Ask right questions.What? Why? Empathy Map. Draw inference from research. **(Key Exercises)** 1. Immersion Activity-Body Storming.		04

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Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		2. Finding the user needs in the market by using Social, Physical, Identity, Communication, Emotional (SPICE) Framework 3. Creation of Empathy Map, Affinity Map, Mind Map, Journey Map 4. Story Telling, K-Scripts for case study, Role Playing		
4	4.1	**Definition and Ideation:** **(Takeaway)** Idea Generation, Themes, Thinking for refinement, Storytelling and Tools for Innovation **(Key Exercises)** 1. Brainstorming, Sketch 2. Situation, Constraints, Objectives, People, Estimates and Scope (SCOPES) tool 3. Social. Technology, Economy, Environment and Political (STEEP) trend analysis for opportunity framing by using steep matrix template. 4. Defining the strategic priorities of customer demand and stakeholder mapping 5. Generating new ideas with Substitute, Combine, Adapt, Magnify/Minify, Reverse, Eliminate, put to other use (SCAMPER) tool.		04
5	5.1	**Prototyping:** Prototyping, Testing for Desirable, Feasible and viable solution, Product Market Fit, Business Model validation **(Takeaway)** **(Key Exercises)** 1. Value Proposition Canvas 2. Business Model canvas		06
6		**The Design Challenge:** **(Takeaway)** Define Design Challenge, PrototypingIteration, Pitching, Media **(Key Exercises)** 1. Demo day		04
			Total	**26**

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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Assessment:
Lab:

    ISE:
1. **ISE-1** will be conducted for first three experiments. (Article discussion, Design thinking workshop for a sample idea, Empathy Map)
   Continuous pre-defined rubrics-based evaluation for 20 marks.
2. **ISE-2**
   a. Idea Competition. Continuous pre-defined rubrics-based evaluation for 10 marks.
   b. Business Model Canvas for identified Idea for 10 marks
   c. Demo Day – Prototype for 10 marks

Recommended Books:
1. Prof.BalaRamadurai, "*Karmic Design Thinking*", ISBN-13 January 2020.
2. Idris Mootee, "*Design Thinking For Strategic Innovation: What They Can't Teach You at Business or Design School*", 2013, Wiley Publications.
3. Christoph Meinel, Larry Leifer, Hasso Plattner, "*Design Thinking: Understand – Improve – Apply*", Springer, 2011.
4. Roger Martin, "*The Design of Businesses: Why Design Thinking is the next Competitive Advantage*", Harward Business Press, 2009

Referenced Books:

1. Peter F. Drucker, "*Innovation and Entrepreneurship*", Routledge.
2. Tim Brown, "*Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*", 2009 HarperBusiness.
3. Blake Masters, Peter Thiel, "*Zero to One: Notes on Start Ups, or How to Build the Future*"
4. Eric Ries, "*The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*" 2011 Penguin
5. Andrew King, Jeanne Liedtka, Kevin Bennett, *"Solving Problems with Design Thinking: Ten Stories of What Works"*, Columbia Business School Publishing, 2013.
6. MaurícioVianna, YsmarVianna, Isabel K. Adler, Brenda Lucena, Beatriz Russo, *"Design Thinking: Business Innovation Kindle Edition*", MJV Press 2011
7. Robert A. Burgelman, Clayton M. Christensen, Steven C Wheelwright, *"Strategic Management of Technology and Innovation",* McGraw-Hill, 2017, 5th Edition.

Online Courses:

    https://www.classcentral.com/course/youtube-design-thinking-transforming-teams-110078
    https://www.coursera.org/learn/uva-darden-design-thinking-innovation
    https://www.coursera.org/learn/creative-thinking-techniques-and-tools-for-success
    https://www.coursera.org/specializations/uva-darden-design-thinking
    learning.edx.org: Design Thinking and Creativity for Innovation

Course Code	Course Name	TeachingScheme (Hrs/week)			CreditsAssigned			
BSC12CS06	**Linear Algebra and Business Statistics**	L	T	P	L	T	P	Total
		2	1	0	2	1	0	3
		ExaminationScheme						
			ISE1	MSE	ISE2	ESE		Total
		Theory	20	30	20	100(30% Weightage)	100	
		Tutorial	20	--	30	--	50	

Pre-requisite Course Codes	BSC11CS01, BSC11CS03	
Course Outcomes	CO1	Demonstrate basic knowledge about the vector spaces as an algebraic structure.
	CO2	Able to optimize the given function using linear programming problems
	CO3	Able to optimize the given function using non-linear programming problems
	CO4	Apply the concept of Correlation and Regression to engineering problems in data science, machine learning, and AI.

Theory:

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Linear Algebra - Vector Spaces**	1,2	**06**
	1.1	Vector spaces		02
	1.2	Subspaces of vector spaces		02
	1.3	Basis and dimension		01
	1.4	The Gram-Schmidt orthogonalization process		01
2	Title	**Linear programming Problems (LPP)**	3,4	**07**
	2.1	Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions,slack variables,surplus variables, Simplex method.		03
	2.2	Artificial variables, Big-Mmethod(Method of penalty)		02
	2.3	Duality,Dual of LPP and Dual Simplex Method		02
3	Title	**Non-linear Programming Problems (NLPP)**	3,4	**06**
	3.1	NLPP with one equality constraint(two or three variables) Using the method of Lagrange's multipliers		02
	3.2	NLPP with two equality constraints		02
	3.3	NLPP within equality constraint:Kuhn-Tucker conditions		02
4	Title	**Correlation and Regression**	5,6,7	**07**
	4.1	Karl Pearson's Coefficient of correlation(r) and related concepts With problems.		02
	4.2	Spearman's Rank correlation coefficient(R)(Repeated &non		01

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

		Repeate dranks problems)		
	4.3	Lines of regression		02
	4.4	Introduction to multiple linear regression		02
			Total	26

Tutorial:

Exp.No.	Tutorial Details	Marks
1	Vector spaces and subspaces	**06**
2	Basis and dimension of a vector space	**06**
3	LPP: Simplex method and Big M method	**08**
4	LPP: Dual of LPP and dual simplex method	**06**
5	NLPP: Optimization with equality constraints	**06**
6	NLPP: Optimization with inequality constraints	**06**
7	Correlation	**06**
8	Regression	**06**
	Total Marks	**50**

Course Assessment:
Theory:
> **ISE-1:**MCQ: 20 Marks
> **ISE-2:**MCQ: 20 Marks
> **MSE:**30 Marks written examination based on 50% syllabus
> **ESE:** Three hours 100 marks(30% weightage) written examination based on entire syllabus

Tutorial:
> **1. ISE-1** will be conducted for threetutorials. Continuous pre-defined rubrics-based evaluation for 20 marks.
> **2. ISE-2**will be conducted for fivetutorials. Continuous pre-defined rubrics-based evaluation for 30 marks.

Recommended Books:
1. Robert M. Thrall, Leonard Tornheim, "*Vector Spaces and Matrices*", Dover Publications, Inc.
2. Gilbert Strang, "*Linear Algebra for Everyone*", Wellesley Publisher.
3. Prem Kumar Gupta, D. S. Hira, "*Operations Research*", S. Chand and Company Limited, Reprint edition (2017).
4. Hamdy A. Taha, "*Operations Research: An Introduction*", Pearson/Prentice Hall Publisher, 6th edition.
5. DrB.S.Grewal,"*HigherEngineeringMathematics*",KhannaPublications,4nd Edition.
6. H.K.Dass,"*AdvancedEngineeringMathematics*",S.Chand,28th Edition.
7. ErwinKreysizg,"*AdvancedEngineeringMathematics*",JohnWiley&Sons,10th Edition.

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	**T**	**P**	**L**	**T**	**P**	**Total**
PCC12CS08	Analysis of Algorithms	2	- -	2	2	--	1	3
		Examination Scheme						
			ISE	MSE	ISE	ESE		Total
		Theory	20	30	20	100(30% Weightage)		100
		Lab	20	--	30	--		50

Pre-requisite Course Codes		PCC12CS05
Course Outcomes	CO1	Analyze the time and space complexity of algorithms.
	CO2	Apply divide and conquer strategy to solve a problem.
	CO3	Apply greedy strategy to solve optimization problem.
	CO4	Apply dynamic programming strategy to solve optimization problem.
	CO5	Apply backtracking and branch and bound strategies to solve a problem.
	CO6	Apply various string-matching algorithms to solve pattern matching problems

Module No.	Unit No.	Topics	Ref.	Hrs
1	1.1	**Introduction:** Performance analysis, space and time complexity calculations, Asymptotic notations. **Complexity class**: Solving Recurrence equations using Substitution, Recursion tree and Masters theorem	1,2	7
	1.2	**Divide and Conquer strategy:** General Concept, Quick sort, Merge sort, multiplying long Integers OR Finding minimum and maximum element of an array		
2	2.1	**Greedy Strategy:** General concept, Minimum Coin Change problem, Activity Selection problem. Fractional Knapsack Problem, Minimum Spanning Tree (Prim's and Kruskal's Algorithm), Dijkstra's Algorithm	1,2	4
3	3.1	**Dynamic Programming:** General Method, 0/1 knapsack problem, longest common subsequence, Bellman ford algorithm, Floyd Warshall algorithm, Multistage Graph, Assembly line scheduling	1,2	6
4	4.1	**Backtracking and Branch and bound:** Backtracking: General Method, N-queen problem, Graph coloring Problem, Sum of subsets Branch and Bound: Travelling Salesperson Problem, 15 Puzzle problem	1,2	6
5	5.1	**String Matching Algorithms:** The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm	1,2	3
			Total	26

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Course Assessment:
Theory:

    ISE-1 & ISE-2: Activities
- Quiz
- Problem solving score of hacker rank / code chef/leetcode
- Assignments
- Internal Coding Competition
- Certification course of 10-12hr duration on platform like coursera/udemy/NPTEL
- Design of an experiment

    MSE : 30 Marks written examination based on 50% syllabus

    ESE : Three hours 100 marks(30% weightage) written examination based on entire syllabus

Lab :

    ISE-1: will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks

    ISE-2: Rest five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks. Practical Exam on full syllabus for 10 marks

Module No.	Exp. No.	Suggested List of experiments
1	1	**Sorting:** Implement and analyze time and space complexity of Modified bubble, Insertion and Selection sort to display exam result of students based on their total marks scored.
	2	**Divide and Conquer:** Implement and analyze time and space complexity of Quick and Merge sort to display records of an employee working in any organization based on their work experience.
	3	**Divide and Conquer: (Any one)** I. Implement and Analyze time and space complexity of multiplying long Integers using divide and conquer strategy. II. Implement and Analyze time and space complexity of finding minimum and maximum element of an array using divide and conquer strategy
2	4	**Greedy Strategy: (Any 2)** I. Identify and implement an algorithm to be used to solve the challenge faced by airline and shipping companies of maximizing revenue while adhering to weight and space constraints when loading cargo onto airplanes or ships. determine the optimal selection and allocation of cargo items based on their values (revenue) and weights, ensuring efficient use of cargo space.
	5	II. Identify and implement an algorithm to be used in the construction of communication networks (telephone or internet

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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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		networks) where a telecommunication company needs to lay down cables to connect several cities to establish a reliable network infrastructure. The company wants to minimize the cost of laying down cables while ensuring that all cities are connected and there is no redundancy in the network.
		III. Identify and implement an algorithm to be used by vending machines to determine the optimal combination of coins to give as change to customers.
3	6	**Dynamic Programming: (Any 2)** I. Identify and implement an algorithm to be used in disaster management and emergency response systems to find the shortest path for emergency vehicles, such as ambulances or fire trucks, to reach affected areas or victims.
	7	II. Identify and implement an algorithm to be used to compare DNA /RNA sequences to identify similarities and evolutionary relationships between organisms.
		III. Identify and implement an algorithm to be used by city planners and urban developers to determine the shortest paths between all pairs of locations, such as residential areas, commercial centers, and public facilities, to improve accessibility, reduce traffic congestion, and enhance urban mobility.
4	8	**Backtracking: (Any 1)** I. Implement N queen problem II. Identify and implement an algorithm to be used for coloring regions on a map such that adjacent regions do not have same color.
5	9	**String Matching:** Identify and implement an algorithm to be used by search engines to quickly locate documents containing specific keywords or phrases, improving search efficiency and response time.

Recommended Books:
1. T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", 2nd Edition, PHI Publication 2005.
2. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms" University Press
3. Steven S. Skiena , "Algorithm Design Manual", Springer Publication
4. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw Hill Edition
5. S. K. Basu, "Design Methods and Analysis of Algorithm", PHI

Online Resources:
1. https://nptel.ac.in/courses/106/106/106106131/
2. https://www.coursera.org/specializations/algorithms
3. https://www.mooc-list.com/tags/algorithms
4. https://www.youtube.com/watch?v=aGjL7YXI31Q&list=PLEbnTDJUr_IeHYw_sfBOJ6gk5pie0yP-0
5. https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

6. Algorithm visualization tool https://visualgo.net/
7. LeetCode/ HackerRank platform to solve challenging problems

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	**T**	**P**	**L**	**T**	**P**	**Total**
PCC12CS09	**Database Management System**	**2**	**- -**	**2**	**2**	**--**	**1**	**3**
		Examination Scheme						
			ISE	**MSE**	**ISE**	**ESE**		**Total**
		Theory	20	30	20	100(30% Weightage)		100
		Lab	20	--	30	--		50

Pre-requisite Course Codes		PCC12CS05
Course Outcomes	CO1	Identify the need and describe various components of DBMS
	CO2	Design ER/EER Model for real life applications and convert it into relational model
	CO3	Identify Relational Algebra operation to perform operation on database
	CO4	Implement SQL commands for given task
	CO5	Apply normalization to database design to remove redundancies
	CO6	Describe concurrency control mechanism to achieve serializability and deadlock Handling

Module No.	Unit No.	Topics	Ref.	Hrs
1		**Introduction Database Concepts**	1,2	2
	1.1	Introduction, Characteristics of databases, File system v/s Database system,		
	1.2	Data abstraction and data Independence, DBMS system architecture, Database Administrator		
2		**Entity–Relationship Data Model**	1,2	4
	2.1	The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation,		
	2.2	Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation		
	2.3	Introduction to the Relational Model, ER to relational model rules and problems, Case studies and practice problems		
3		**Relational Algebra**	1,2	4
	3.1	Introduction to relational query language, Role of Relational Algebra in DBMS, Relational Algebra operators and Queries, Conversion of Relational Algebra into SQL		
4		**Structured Query Language (SQL)**	1,2	4
	4.1	Overview of SQL, Data Definition Language Commands, key constraints, Domain Constraints		
	4.2	Data Manipulation commands ,DQL, Aggregate function-group by, having, Views in SQL, joins, Nested and complex queries, Data Control commands, Set and string operations, Triggers, PLSQL		

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Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

5		**Relational-Database Design**	1,2	6
	5.1	Pitfalls in Relational-Database designs, Concept of normalization, Function Dependencies, First Normal Form, 2NF, 3NF, BCNF. Converting Relational Schema to higher normal form, Problems based on Normalization		
6		**Transactions Management, Concurrency and Recovery**	1	6
	6.1	Transaction concept, Transaction states, ACID properties, Transaction Control Commands, Concurrent Executions, Serializability-Conflict and View, Problems based on Conflict and View Serializability, Concurrency Control: Lock-based, Timestamp-based protocols, Recovery System: Log based recovery, Deadlock handling		
		Total		**26**

Course Assessment:

Theory:

      ISE-1 : Activity: Quiz / assignments on first three modules for 20 marks

      ISE-2: Activity: Quiz/Assignments/ Article discussion on next three modules for 20 marks

      MSE : 30 Marks written examination based on 50% syllabus

      ESE : Three hours 100 marks(30% weightage) written examination based on entire syllabus

Lab :

      ISE-1: will be conducted for five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks

      ISE-2: Rest five experiments. Continuous pre-defined rubrics-based evaluation for 20 marks. Implementation of Mini project for 10 marks

Module No.	Exp. No.	Suggested List of experiments
1,2	1	Identify the case study and detail statement of problem. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model
1,2	2	Convert ER/EER model to relational model
4	3	Create and populate database using Data Definition Language (DDL) and DML Commands for the specified System without integrity constraint.
4	4	Create and populate database using Data Definition Language (DDL) and DML Commands for the specified System with integrity constraint
4	5	Perform Simple queries and Date operations
4	6	Perform Join operations and Complex queries
4	7	Perform nested sub-queries in SQL
4	8	To implement PL/SQL and Procedures and Functions
4	9	To implement Triggers and Cursors
6	10	To implement Transaction and Concurrency control
	11	Exposure to MongoDB
	12	Mini project for Real life Scenario

Recommended Books:

    1. Korth, Slberchatz, Sudarshan, Database System Concepts, 6thEdition, McGraw Hill

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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

2. Elmasri and Navathe, Fundamentals of Database Systems, 5thEdition, Pearson Education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH
4. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management‖, Thomson Learning, 5thEdition.
5. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
6. G. K. Gupta, Database Management Systems, McGraw Hill, 2012

Online Resources:

1. https://www.db-book.com/db6/slide-dir/index.html-Korth, Slberchatz,Sudarshan, 6th Edition
2. http://www.tutorialspoint.com/sql/
3. https://www.w3schools.com/sql/default.asp
4. http://www.mysqltutorial.org/ or https://www.tutorialspoint.com/postgresql/
5. https://academy.vertabelo.com/course/standard-sql-functions#
6. www.postgresqltutorial.com/postgresql-grouping-sets/
7. www.postgresqltutorial.com
8. https://www.freeprojectz.com/entity-relationship-diagram
9. https://www.w3schools.com/sql/sql_any_all.asp
10. https://www.geeksforgeeks.org/sql-all-and-any/

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
PCC12CS10	Data Analytics and Visualization	--	--	2	--	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes		
Course Outcomes	CO1	Explore various data analytics Libraries in R and Python.
	CO2	Build various time series models on a given data set.
	CO3	Perform various prediction techniques
	CO4	Implement visualization techniques to given data sets using R .
	CO5	Implement visualization techniques to given data sets using Python.

Sr. No.	Suggested List of Experiment
1	Study the introduction of R and R studio and implement some basic commands
2	Implement statistical models in R
3	Introduction of data analytics libraries in Python and R
4	Implement Statistical analysis in python
5	Implement Statistical analysis in R
6	Implement time series analysis in python
7	Implement TF-IDF in python/R
8	Perform stock market prediction in python and R
9	Perform climate prediction in python/R
10	Implement data visualization in R
11	Implement data visualization in Python

Course Assessment:

ISE-1:
Evaluation of first four experiments for 10 marks and quiz / Assignment for 10 marks.

ISE-2:
Evaluation of next experiments for 20 marks and quiz / Assignment/ Oral exam/ Case study presentation for 10 marks

Recommended Books:
1. Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems, Jan 2018, By: Dr. Ossama Embarak, Publisher: Apress
2. The Big Book of Dashboards: Visualizing Your Data Using Real-World Business Scenarios, 2017 by Steve Wexler ,Jeffrey Shaffer, Andy Cotgreave , Wiley publication

Society of St. Francis Xavier, Pilar's
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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
MDM02	Emerging Technology and Law	2	--	--	2	--	--	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		--
Course Outcomes	CO1	To recognize the importance of legal technology domain
	CO2	To demonstrate awareness of the laws related to emerging technologies and legal implications of their work
	CO3	To demonstrate understanding of the impact of emerging/contemporary technologies on the legal ecosystem
	CO4	To demonstrate awareness about company laws, FEMA and few other important acts related to engineering design and consumer protection

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Tech Legal Market**	1	4
	1.1	Legal Marketplace, Impact of Technology on Legal Profession		
	1.2	How technologists can help reshape legal system		
	1.3	Career Development in Legal Tech Domain		
2		**Emerging Technologies and Legal Implications-1**	1	8
	2.1	Cyber Crimes, Cyber Threats and Issues: Information Technology Act 2000		
	2.2	Blockchain and Legal Issues		
	2.3	Legal Implications of Artificial Intelligence		
	2.4	Electronic and Digital Signatures		
	2.5	Implications of Social Media Laws		
3		**Emerging Technologies and Legal Implications-2**	1	6
	3.1	Legal Ecosystem for Autonomous Vehicles and Unmanned Aerial Vehicles (UAV)		
	3.2	Privacy and Data Protection with a Trillion Connected & Cognitive Devices		
	3.3	Legal Ecosystem for 5G		
4		**Company Laws**	2,3	4
	4.1	Companies Act, 1956- Nature and Meaning, Classification of Companies, Incorporation of Companies		
	4.2	Sources of Capital, Board of Directors, Company Meetings	2,3	
5		**Regulation and Management of Foreign Exchange**		2
	5.1	Foreign Exchange Management Act FEMA 1999		
6		**Other Important Laws**	2,3	2
	6.1	Consumer Protection Act, Competition Act 2002, Semiconductor Integrated Circuits Layout-Design Act 2000, Designs Act 2000, Bureau of Indian Standards Act 2016,		

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

	Total	**26**

Course Assessment:

ISE-1: Quiz: 20 Marks
Activity: Negotiation: 30 Marks

ISE-2: Quiz: 20 Marks
Activity: Moot Court: 30 Marks

Recommended Books:
1. N. S. Nappinai, "*Technology Laws Decoded*," LexisNexis, 2017
2. Vibha Arora and Kunwar Arora, "*Law for Engineers*" Central Law Publications, 2017
3. Vandana Bhatt and Pinky Vyas, "*Laws for Engineers*", ProCare, 2015

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		1	--	2	1	--	1	2
OECS21	Microprocessors and Microcontrollers	Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	10	15	10	50(30% Weightage)	50	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes			
Course Outcomes	CO1	Describe the core concepts of the 8086 microprocessor like Pipelining and Memory Segmentation	
	CO2	Describe the architecture and memory organization of the 8051 Microcontroller	
	CO3	Program the 8086 and 8051 in assembly language for a given application	
	CO4	Design 8051 Microcontroller systems for a given application	
	CO5	Analyze the internal architecture of Pentium Processor and ARM cores	

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction to Microcontrollers and Microprocessors**	1	1
	1.1	Basic Microprocessor architecture, Harvard and VonNeumann architectures with examples, Microprocessor versus Microcontroller, CISC and RISC architectures,8-bit & 16-bit Microprocessor and Microcontroller, Overview of Embedded systems.		
2		**8086 Architecture**	1	3
	2.1	8086 Architecture, Memory Segmentation, Pin description, Register Organization, Memory addressing, 8086 Interrupt structure and Interrupt Servicing		
	2.2	Addressing modes, Instruction Set and Assembler Directives, Minimum mode and Maximum mode operation		
3		**8051 Microcontroller**	2	2
	3.1	8051 Architecture, I/O Ports, Memory Organization		
	3.2	Addressing Modes, Instruction set of 8051, Assembly language programming.		
4		**8051 Microcontroller hardware**	2	3
	4.1	I/O port structure		
	4.2	Timer/Counter section and modes		
	4.3	Serial Port structure and modes		
	4.4	Interrupt structure and Priority		
5	5.1	**8051 Interfacing**	2	2
	5.2	LCD & Keyboard Interfacing		

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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

	5.3	ADC, DAC & Sensor Interfacing		
6		**High-Performance Architectures**	3,4,5	2
	6.1	Pentium Processor: Pentium Architecture, Superscalar Operation, Integer &Floating-Point Pipeline Stages		
	6.2	ARM Architecture: ARM Processor fundamentals, Introduction to CORTEX Processor cores		
			Total	**13**

Course Assessment:

    Theory:

        ISE-1: 10 Marks

            Activity: Quiz (05 Marks) and Assignment (05 Marks)

        ISE-2:10 Marks

            Activity: Implement a mini-project based on the 8051 Microcontroller

        MSE : 15 Marks written examination based on 50% syllabus

        ESE : Two hours 50 marks(30% weightage) written examination based on entire syllabus

    Lab:

Sr. No	Suggested list of experiments
1	Arithmetic operations using 8086 [Assembly language programming]
2	Block transfer using 8086 (using string instructions)
3	To find the minimum/ maximum number from a given data bytes stored in internal/external data memory location
4	I/O port programming using 8051
5	Serial port programming using 8051
6	Timer programming using 8051
7	Stepper Motor/DC motor interfacing using 8051
8	Arduino programming (any application)
Digital Material:	
1	Virtual Lab simulator for Microcontroller http://vlabs.iitkgp.ernet.in/rtes/index.html

ISE-1 : will be conducted for first five experiments. (20marks)

ISE-2 : Remaining three experiments. (30 marks).

Recommended Books:

1. John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", PHI.
2. Muhammad Ali Mazidi and Janice Gillispie Mazidi, "The 8051 – Microcontroller and Embedded Systems",7th Edition, Pearson Education
3. Andrew N. Sloss, Dominic Symes, Chris Wright and John Rayfield, "ARM System Developer's Guide, Designing and Optimizing System Software", Elsevier, 2004.
4. Tom Shanley and Don Anderson, "Pentium Processor System Architecture", Addison Wesley.
5. Joseph Yiu, "The Definitive guide to ARM CORTEX-M3 & CORTEX-M4 Processors", Elsevier, 3rd Edition
6. https://www.arduino.cc

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Fr. Conceicao Rodrigues College of Engineering

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OECS22	**Automation and Robotics**	1	--	2	1	--	1	2
		Examination Scheme						
		Theory	**ISE1**	**MSE**	**ISE2**	**ESE**		**Total**
		Theory	10	15	10	50(30% Weightage)		50
		Lab	20	--	30	--		50

Pre-requisite Course Codes			
Course Outcomes	CO1	Describe the various components of Automation	
	CO2	Design various single cylinder pneumatic circuits	
	CO3	Design various single cylinder Electro-pneumatic & PLC circuits	
	CO4	Classify and describe a robotic system	
	CO5	Solve a direct and inverse kinematic problem	

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Automation** Definition; Automation in production systems; Automation principles and strategies; Architecture of Industrial Automation Systems, Basic elements of an automated system, Concept of Low cost Automation	1	3
	1.2	Levels of automation; Types of automation – Applications, Advantages and Disadvantages		
	1.3	Benefits and Impact of Automation in Manufacturing and Process Industries.		
2	2.1	**Pneumatic Systems** Overview of different types of valves and Actuators in Pneumatics, their applications and their ISO symbols.	2	3
	2.2	Design of Pneumatic circuits for 1 cylinder only.		
	2.3	Valves working : DCV, Shuttle valve, Two Pressure Valve, one way Flow control Valve , quick exhaust valve, Time delay , pressure sequence valve.		
3	3.1	Electro-Pneumatics Design of Electro-Pneumatic Circuits for single acting and Double acting Cylinders using single solenoid and double solenoid valves, Timers and Counters, Concept of Latching, Dominant on and Off,	2	2
	3.2	**PLC controls** Design of Pneumatic circuits using PLC Control		
4	4.1	**Introduction to Robotics :** Robotic system & Anatomy, Classification and Future Prospects	3	2
	4.2	**Manipulator Peripherals :** Robot & its Peripherals End Effecters: Type mechanical and other grippers, Tool as end effecter.		

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

5	5.1	**Robot Kinematics and Dynamics :** Homogeneous Transformations Matrix, Direct and Inverse Kinematics	4	3
	5.2	**Sensors:** Sensors in Robotics, Specifications		
	5.3	**Robot Kinematics and Dynamics :** Homogeneous Transformations Matrix, Direct and Inverse Kinematics of a 2doF Planar Robotic arm		
			Total	**13**

Course Assessment:

Theory:
> **ISE 1**: 10 Marks
> > Activity: Quiz and Assignments
> **ISE-2:** 10 Marks
> > Activity: Quiz and assignments
> **MSE :** 15 Marks written examination based on 50% syllabus
> **ESE :** Two hours 50 marks(30% weightage) written examination based on entire syllabus

Lab:
ISE-1 : will be conducted for four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks.

ISE-2 : Next Four experiments. Continuous pre-defined rubrics-based evaluation for 20 marks. Activity/mini project/case study presentation for 10 marks

Exp. No.	Topics
1	Design of Pneumatic Circuits – Basic Single Cylinder
2	Design of Pneumatic Circuits – Flow control Valve , Time Delay and Pressure sequence
3	Design of Electro- Pneumatic Circuits – Basic Single Cylinder
4	Design of Electro- Pneumatic Circuits – Timer and Counter
5	Introduction to Matlab
6	Simulation of Direct Kinematics (matlab)
7	Simulation of Inverse Kinematics (matlab)

Recommended Books:
1. Mikell P. Groover , "Automation, Production Systems, and Computer-integrated Manufacturing" (3rd Edition), PHI Learning Private Limited, New Delhi.
2. Joji P, "Pneumatic Controls", Wiley India Pvt. Ltd.
3. Grover, Weiss, Nagel, Ordey, "Industrial Robotics, Technology, Programming & Applications", Mc Graw Hill.
4. R. K. Mittal and I J Nagarath, "Robotics and Control"

Society of St. Francis Xavier, Pilar's
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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
OECS23	Optimization Techniques	1	--	2	1	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	10	15	10	50(30% Weightage)	50	
		Lab	20	--	30	--	50	

Pre-requisite Course Codes			
Course Outcomes	CO1	Identify types of optimization problems and apply calculus based methods to single variable problems	
	CO2	Formulate the problem as a linear programming problem and analyze the sensitivity of a decision variable	
	CO3	Apply various linear and non-linear techniques for problem solving in various domains	
	CO4	Apply multi-objective decision making methods for problems in manufacturing environment and other domains	
	CO5	Apply multi criteria decisions for problems in manufacturing environment and other domains	

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Basic Concepts: Statement of the Optimization Problem, Basic Definitions. Optimality Criteria for Unconstrained and Constrained Optimization, Engineering Application of Optimization		2
	1.2	Classification of Optimization Problems. Classical Optimization Techniques: Single variable optimization		
2	2.1	Linear Programming Problem: Formulation, Simplex method, Big M and Two Phase methods.(No numerical)		3
	2.2	Duality in L.P. Models. Dual Simplex method.		
	2.3	Applications of LP: Transportation and Assignment Models; Integer Programming Model: Gomory's cutting plane method, Branch & Bound Technique.		
3	3.1	Non L.P. Model: Lagrangian method & Kuhn tucker Method, Newton's method.		2
	3.2	Discrete Event Simulation: Generation of Random Variable, Simulation Processes, Monte-Carlo Technique		
4	4.1	Traditional Techniques such as, quadratic programming, geometric programming, goal programming and dynamic programming.		2
	4.2	Introduction to Non-traditional optimization Techniques such as Genetic Algorithm, particle swarm, simulated annealing and Techniques based on Neural network & Fuzziness		
5	5.1	Simple Additive Weighting (SAW) Method Weighted Product		2

Society of St. Francis Xavier, Pilar's
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Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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		Method (WPM) Analytic Network Process (ANP)		
	5.2	Analytic Hierarchy Process (AHP) Method TOPSIS Method PROMETHEE		
6	**6.1**	Multi Objective Decision making (MODM) Methods: Introduction to Multi objective optimization		2
	6.2	Multi Criterion Decision-making (MCDM) Methods: Introduction to multi criterion optimization		
			Total	**13**

Course Assessment:

Theory:
ISE 1: 10 marks
Activity: Assignments , viva voce on each topic
ISE2: 10 marks
Activity: Assignments, viva voce on each topic
MSE : 15 Marks written examination based on 50% syllabus
ESE : Two hours 50 marks(30% weightage) written examination based on entire syllabus

Lab: Suggested list of Experiment

1. Identifying given case study as a constrained or unconstrained optimization problem.
2. Formulation of a given case study as a Linear programming model and solving using simplex method.
3. Case study on Transportation model and assignment model and solution to case study using software.
4. Case study to simulate and analyse the solution so obtained. (any simulation software may be used which may be branch specific)
5. Solution to case study discussed above using Genetic Algorithms/ Particle swarm Method/Simulated annealing.
6. Analysis of a case study as regards MODM/ MCDM.

ISE-1: Evaluation of first two case studies (15 marks) followed by viva (5 marks)
ISE-2 : Evaluation of other four case studies (20marks) followed by viva (10 marks)

Recommended Books:
1. S.S. Rao, "Engineering Optimization - Theory and Practice", John Wiley and Sons Inc.
2. Ranjan Ganguli, "Engineering Optimization - A Modern Approach" Universities Press
3. Pablo Pedregal, "Introduction to Optimization", Springer
4. L.C. Jhamb, "Quantitative Techniques Vol. 1 and 2", Everest Pub. House
5. Pierre D.A., "Optimization, Theory with Application", John Wiley & sons.
6. R V Rao, "Decision Making in the Manufacturing Environment Using Graph Theory and Fuzzy Multiple Attribute Decision Making" (Springer Publication).

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
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7. Ritter, H., Martinetz, T., &Schulten, K., Addison,"Neural Computation and Self-Organizing Maps"-Wesley Publishing Company
8. Douglas C.Montgomery,"Design and analysis of experiments"(John Wiley & Sons Inc.)
9. Saravanan R,"Manufacturing Optimization through Intelligent Techniques", Taylor & Francis (CRC Press)-2006.

Society of St. Francis Xavier, Pilar's
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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
VSE12CS03	Web Programming	--	--	4	--	--	2	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	50	--	50	--	100	

Pre-requisite Course Codes			
Course Outcomes	CO1	Apply JavaScript, HTML5 and CSS3 effectively to create interactive and dynamic websites.	
	CO2	Construct responsive websites using Bootstrap.	
	CO3	Implement client side scripting using JavaScript.	
	CO4	Construct website using React as front end and node.js/express.js as back end.	
	CO5	Construct web site using Java Server Pages and Java Beans.	
	CO6	Implement Model View Controller architecture using Struts/Spring/FLUX	

Sr. No.	Suggested List of Experiment
1	**Web Programming Fundamentals:** Web application architectures. New elements of HTML5- Image, Links, table, Form, List, Semantic Elements, audio, video, drag-drop, geo location, canvas. Develop static web page using HTML5 tags.
2	**Cascading Style Sheets:** CSS3 Syntax, Inclusion, Color, Background, Fonts, Tables, Lists, CSS3 selectors, Pseudo classes and Pseudo elements. Apply the Cascading Style Sheet to the html web page
3	**Bootstrap:** Bootstrap Grid System, Forms, Button, Navbar, Dropdowns and Responsive Tabs, Breadcrumb, Jumbotron. Construct responsive website using Bootstrap.
4	**JavaScript:** Variables, Operators, Conditions, Loops, Functions, Events, , Error handling, Validations, Built-in Objects Arrays, String , Date, Document Object Model(DOM) Objects, ECMAEcripts-ES5,ES6,ES7,ES8, Iterators, Classes and Objects, Arrow Function, Promises Apply JavaScript to make the webpage interactive.
5	**React:** JSX, Components, Props, State, Forms, Events, Routers, Refs, Keys, Effects, Hooks, Flow Architecture

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

	Design a web page React JS.
6	**Node.js and Express.js:** Asynchronous Programming, Callback concept, Callbacks, Event Loops, Event Emitter, Networking module, Express Router, REST API, Authentication, Integrating with React Create website with Node.JS/Express.
7	**Java EE application:** Introduction to JSP-Servlet-Enterprise Java Beans,Stateful and stateless Session beans, JNDI, Message-driven beans, JDBC Database Connectivity Implement Server-side programming using JSP and JavaBeans.
8	**MVC Framework:** Model View Controller-FLUX, Struts or Spring, Bundling the application, Web Pack Mini web application with MVC architecture Spring/Struts/FLUX

Course Assessment:

ISE-1:
Evaluation of first four experiments for 20 marks. Quiz/Assignment for 30 marks.
ISE-2:
Evaluation of next experiments for 20 marks and Project Competition/Hackathon (with at least one innovative feature): 30 marks

Recommended Books:
1. Christopher Schmitt, Kyle Simpson, "HTML5 Cookbook", O'Reilly Media
2. Eric Meyer, "CSS Pocket Reference, 5th Edition", O'Reilly Media, Inc., 2018
3. Venkat Subramaniam, "Rediscovering JavaScript, Master ES6, ES7, and ES8", 2018
4. Alex Banks and Eve Porcello, "Learning React Functional Web Development with React and Redux", O'Reilly
5. Andrew Mead, "Learning Node.js Development", Packt Publishing
6. Juha Hinkula, "Full Stack Development with Spring Boot and React -Third Edition", Packt Publishing
7. "Beginning JSP 2.0, Build Web Applications using JSP, Java, Struts", Wrox Publications
8. Ed Roman, Rima Patel Sriganesh, Gerald Brose, "Mastering Enterprise JavaBeans", Wiley Publications

Online Courses:
1. https://www.coursera.org/learn/html-css-javascript-for-web-developers?action=enroll
2. https://onlinecourses.swayam2.ac.in/ugc19_lb05/preview
3. https://reactjs.org/tutorial/tutorial.html
4. https://react-redux.js.org/introduction/quick-start
5. https://webpack.js.org/
6. https://www.oracle.com/java/technologies/jee-tutorials.html
7. https://getbootstrap.com/docs/5.2/getting-started/introduction/

Society of St. Francis Xavier, Pilar's

Fr. Conceicao Rodrigues College of Engineering

Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
AEC12CS021	**Sanskrit for Beginners**	**Examination Scheme**						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50		50		100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		Basic Language skills
Course Outcomes	CO1	Demonstrate understanding of the Fundamentals of Sansrkit Language
	CO2	Apply Vocabulary and grammar skills for day to day conversation
	CO3	Developing Speaking and Learning skills

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	Introduction: Some Unique characteristics of Sanskrit The Sounds of Sanskrit: Its Alphabet Sentence Construction and Its underlying logic Introduction of Self and Others Basic verbs and some conjugations	1-8	6
2	2.1	Introduction to Genitive (6th Case) Counting and Reading the Time Plural of Pronouns and Nouns Conjugation of Basic Verbs in the Plural Introduction to the Locative (7th Case)	1-8	6
3	3.1	Days of the week, Months, Future Tense Past Tense and More Verbs Introduction to the Accusative (2nd Case) Introduction to the Instrumental (3rd Case)	1-8	6
4	4.1	Introduction to the Ablative (5th Case) Introduction to the Dative (4th Case) Introduction to the Vocative (8th Case)	1-8	6
	4.2	Stories and Motivational Shlok with word by word meaning	1-8	2
			Total	**26**

Course Assessment:

ISE-1: Activities and Assignments: 20 Marks
Oral Examination : 30 Marks
ISE-2: Activities and Assignments: 20 Marks
Oral Examination : 30 Marks

Recommended Books:

1. Kumari, S. "*SanskritaChitrapadakoshah*," Mysuru: BharatiyaBhashaSansthanam, 1993
2. *Samkrita-vyavahaara-sahasri* (Samskrit-English), New Delhi: Sanskrita Bharati
3. Sampad, & Vijay, "*The Wonder that is Sanskrit*" Pondicherry: Sri Aurobindo Society, 2005.

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

4. Satvlekar, S. D. "*Sanskrit Swayam Shikshak,*" Delhi: Rajpal & Sons, 2013
5. Shastri, V K. "*Teach Yourself Samskrit: Prathama Diksha*" Delhi: RashtryiaSanskritaSamsthana, 2012
6. Vishwasa "*Abhyāsa-pustakam*", New Delhi: Samskrita Bharati, 2014
7. https://onlinecourses.nptel.ac.in/
8. https://www.learnsanskrit.org/

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
AEC12CS022	**Tamil for Beginners**	**Examination Scheme**						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50		50		100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes	Basic Language skills	
Course Outcomes	CO1	Demonstrate understanding of the Fundamentals of Tamil Language
	CO2	Apply Vocabulary and grammar skills for day to day conversation
	CO3	Developing Speaking and Learning skills

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Tamil Alphabets and Pronunciation** History of Tamil language		1
	1.2	Learning Tamil Alphabets		1
	1.3	Basic Pronunciation and Oral drills with visual learning		2
	1.4	Greetings and common expressions		2
2	2.1	**Basic Grammar and Sentence Structure** Sentence Construction : Subject, Verb, Object (SVO)		2
	2.2	Present tense,Past tense and Future tense		2
	2.3	Common Nouns, Pronouns with negative imperatives		2
3	3.1	**Building Vocabulary for Everyday Conversation** Learning Numerals (Cardinal numbers) 1-20, 100. 200…1000		2
	3.2	Forming Simple sentences with interactive lessons		3
	3.3	Learning Days of week, Months of the year, Fruit, Food grains, Parts of the Body, Names of Common places like Hospitals, Market place, shops, Saloons..etc.		3
4	4.1	**Daily life and Survival Phrases** Day to day usage of language for daily routines in conversation with Student to Teacher, Vegetable shop vendor, Railway Station, conversation with Auto Drivers , Hospitals …etc.		3
	4.2	Role Play exercises in common situations		3
			Total	**26**

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Assessment:

ISE-1: Activities and Assignments: 20 Marks
Oral Examination : 30 Marks
ISE-2: Activities and Assignments: 20 Marks
Oral Examination : 30 Marks

Recommended Books:

1. Kesav.,"A practical course to learn tamil for Absolute beginners(Standard and Colloquial), Notion Press, 2020
2. Dr.R.Kalidasan, Dr.S.Velayuthan, " English Grammar-An easy way to learn with Tamil Explanation and key, Shanlax publisher, 2019
3. Oxford English-English Tamil Dictionary, Oxford.

Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
AEC12CS023	**Kannada for Beginners**	**Examination Scheme**						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		Basic Language skills
Course Outcomes	CO1	Demonstrate understanding of the Fundamentals of Kannada Language
	CO2	Apply Vocabulary and Grammar skills for day to day conversation
	CO3	Developing Speaking and listening skills

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Kannada Alphabets and Pronunciation** History of Kannada Language		1
	1.2	Learning Kannada Alphabets		1
	1.3	Pronunciation and visual learning		2
	1.4	Greetings and Common expressions		2
2	2.1	**Basic Grammar and Sentence Structure with Subject, Verb, Objective (SVO)** Basics of Sentence Formation		2
	2.2	Present tense, Past tense, Future tense,and Introduction to Adjectives		2
	2.3	Common Nouns, Pronouns with negative imperatives		2
3	3.1	**Conversation Phrases and Language Vocabulary** Learning Numerals (Cardinal Numbers) 1-20 / 100 -1000		2
	3.2	Classified Sentences and Useful expressions		3
	3.3	Learning Days of week, Months of the year, Fruits, Food grains, Parts of the body, Names of common places like Hospitals, markets, shops, saloons, gender, weather , etc.		3
4	4.1	**Developing Language fluency and Proficiency.** Day to day usage of Language for daily routine in conversation with Student to Teacher, vegetable vendor, in Railway station, with Auto driver , in Hospitals, etc.		3
	4.2	Role play exercises in common situations		3
			Total	**26**

Course Assessment:

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

ISE-1: Activities and Assignments : 20 Marks
          Oral Examination   :30 Marks
ISE-2: Activities and Assignments : 20 Marks
          Oral Examination   :30 Marks

Recommended Books:

1. Upadhaya,U.P&N.K.Krishnamurthy, "Conversational Kannada"Prism Books, 2018
2. Thomas Hodson, "Grammar of the Kannada or Canarese language", Gyan publishing house, 2020
3. Ramanja Reddy Merugu , "Learn kannada through English" 2021
4. Dr.Prabhusankara&B.V.Sridhar," Oxford English-English-Kannada dictionary", Oxford Publications.

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
AEC12CS024	**Telugu for Beginners**	Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes	Basic Language Skills	
Course Outcomes	CO1	Demonstrate understanding of the fundamentals of Telugu Language
	CO2	Apply vocabulary and grammar skills for day to day conversation
	CO3	Developing Speaking and Listening skills

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Telugu Alphabets and Pronunciation** History of Telugu language		1
	1.2	Learning Telugu Alphabets and Symbols		1
	1.3	Basic Pronunciation		2
	1.4	Greetings and Common expressions		2
2	2.1	**Basic Grammar and Sentence Structure** Sentence Structure : Subject , verb, Object (SVO)		2
	2.2	Present tense, Past tense and Future tense		2
	2.3	Common nouns, Pronouns, Adjectives		2
3	3.1	**Conversation Phrases for Daily Situations** Learning numerals (Cardinal Numbers) 1- 20, 100 -1000		2
	3.2	Forming Simple sentences / Listening and Speaking skills		3
	3.3	Days of week, Months of the year, Gender, Fruits, Parts of the body, Names of common places like hospitals, markets, shops, saloons etc.		3
4	4.1	**Common Phrases and Developing Language Fluency and Proficiency** Day to day usage of Telugu language for daily routines in conversation with Student to teacher, Vegetable Shop vendor, Railway passengers, Auto drivers, in Hospitals., etc..		3
	4.2	Role Play Exercises in Common situations, presentation on Telugu culture, Telugu scripts, Telugu classical music, Telugu festivals.		3
			Total	**26**

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Assessment:

ISE-1: Activities and Assignments: 20 Marks
Oral Examination : 30 Marks
ISE-2: Activities and Assignments: 20 Marks
Oral Examination :30 Marks

Recommended Books:

1. Sanjay,D, " Spoken Telugu for Absolute Beginners", Notion Press, 2019.
2. Praveen Ragi, "Learn Telugu Through English .V1" Evincepub Publications, 2020
3. Oxford compact English-English Telugu Dictionary
4. English- Telugu Conversation guide / AarthiJanyavula , 2018

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
EEM12CS02	**Technology Entrepreneurship**	**Examination Scheme**						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		--
Course Outcomes	CO1	Identify problems worth solving
	CO2	Craft value proposition
	CO3	Prepare B-Plan
	CO4	Register virtual company

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Opportunity Discovery**	1	6
	1.1	Self-discovery		
	1.2	Effectuation Principle		
	1.3	Identification of problem worth solving		
	1.4	Looking for solutions		
	1.5	Present the problem		
2		**Value Proposition Canvas and Business Model**	2,3	7
	2.1	Craft your value proposition		
	2.2	Presentation of Value Proposition Canvas		
	2.3	Business Model and Lean Approach(Finance, Marketing, Operations)		
	2.4	Presentation of Lean Canvas		
3		**Business Plan**	4	6
	3.1	Creation of Business Plan		
4		**Company Formation**	5	7
	4.1	Promoters, Capital, Shareholders		
	4.2	Directors, DIN		
	4.3	Company Name, Registrations		
	4.4	Branding		
			Total	**26**

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Assessment:

ISE-1:
Quiz: 10 Marks
Assignment: Effectuation case study: 10Marks
Activity: Presentation of Value Proposition Canvas: 30 Marks Rubric Based assessment

ISE-2:
Quiz: 10 Marks
Assignment: Presentation of Lean Canvas: 10Marks
Activity: Virtual Company registration: 30 Marks Rubric Based assessment

Recommended Books:
1. Sarasvathym "*Elements of Entrepreneurial Expertise (New Horizons in Entrepreneurship Series)*" Edward Elgar Publishing.
2. Alexander Osterwalder "*Business Model Generation :A Handbook for Visionaries, Game Changers, and Challengers*"
3. Alex Osterwalder, Yves Pigneur, Greg Bernarda, Alan Smith, Trish Papadakos "*Value Proposition Design: How to create Products and Services Customers Want*"
4. Garrett Sutton "*Writing Winning Business Plans*"
5. M.C. Bhandari "*Company Law Procedures*" LexiNexis, 2018

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
VEC12CS02	Technology Innovation for Sustainable Development	1	--	2	1	--	1	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	--	--	--	--	--	
		Lab	40	--	60	--	100	

Pre-requisite Course Codes	--	
Course Outcomes	CO1	Demonstrate a broad and coherent knowledge of United Nations Sustainable Development Goals (SDGs)
	CO2	Build the vocabulary and develop a nuanced understanding of the SDG themes: people, planet, prosperity, peace and partnership
	CO3	Identify technological solutions to address challenges of SDGs
	CO4	Build the vision to explain how to create a technological solution for sustainability

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**What are SDGs**	1,2,3	3
	1.1	Concept of Sustainability. The Role of UN and the Need for SDGs. Why SDGs are important.		
	1.2	Introduction to 17 SDGs		
2		**People Theme**	4,5	4
	2.1	Sustainable development goals 1-5		
	2.2	Technological Solutions to advance people theme		
3		**Planet Theme**		6
	3.1	Sustainable development goals 6, 12-15	4,5	
	3.2	Technological Solutions to advance planet theme		
4		**Prosperity Theme**		7
	4.1	Sustainable development goals 7-11		
	4.2	Technological Solutions to advance prosperity theme		
5		**Peace Theme**	4,5	3
	5.1	Sustainable development goal 16		
	5.2	Technological Solutions to advance peace theme		
6		**Partnership Theme**	4,5	3
	4.1	Sustainable development goals 17		
	4.2	Technological Solutions to advance partnership theme		
			Total	**26**

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Assessment:

ISE-1: Quiz: 20 Marks
Activity: Case Study Presentation: 20 Marks

ISE-2: Quiz: 20 Marks
Activity: Short Film Creation and Presentation: 30 Marks

Recommended Books:
1. https://sdgs.un.org/goals

2. https://sdgs.un.org/tfm

3. Himanshu Sharma, Tina Sobti "*An Introduction to Sustainable Development Goals*" 2018

4. Henrik SkaugSætra "*Technology and Sustainable Development*" Routledge, 2023

5. Sinan Kufeoglu "*Emerging Technologies: Value Creation for Sustainable Development*", Springer International Publishing, 2022

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
IKS11CS01	**Indian Knowledge System**	**Examination Scheme**						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	50	--	50	--	100	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes	--	
Course Outcomes	CO1	Enumerate the main characteristics of education system in Vedic and post Vedic period to enrich the intellectual imagination
	CO2	Review the ancient discovery and research in Indian number system and ancient Indian mathematics
	CO3	Review the contribution from Ancient Indian system to astronomy and metallurgy
	CO4	Tracethe significant developments in Indian engineering and technology in Irrigation, painting, surgical techniques and shipbuilding
	CO5	Cultivate a deep sense of identity and pride in enriched scientific Indian heritage

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**1.1**	What is Indian Knowledge System (IKS)? Why do we need it? Salient aspects of IKS.	1	2
	1.2	The Vedic Corpus: Introduction to Vedas, Sub-classification of Vedas, Messages in Vedas, Vedic Life: A Distinctive Features	1	3
2	**2.1**	Number systems in India, Measurements for time, distance, and weight, Bhūta-Saṃkhyā system, Kaṭapayādi system, Piṅgala and the Binary system	1	4
	2.2	Unique aspects of Indian Mathematics, Indian Mathematicians and their Contributions, Algebra, Geometry and Trigonometry	1	4
3	**3.1**	Indian contributions in astronomy, The celestial coordinate system, Elements of the Indian calendar, Notion of years and months, Indian Astronomical Instruments	1	4
	3.2	Wootz Steel, Mining and ore extraction, Metals and Metalworking Technology, Iron and steel in India, Lost wax casting of idols and artefacts, Apparatuses used for extraction of metallic components	1	4
4	**4.1**	Irrigation systems and practices in South India, Dyes and painting technology, Surgical techniques, Shipbuilding	1	3
	4.2	Temple architecture in India, Perspective of Arthaśāstra on town planning.	1	2
			Total	**26**

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Assessment:

ISE-1: Quiz: 20Marks (Two 10 marks each)
Activity: Group Discussion on Indian Knowledge System: 10 Marks
Activity: Creative Activity: 20 Marks

ISE-2: Quiz: 20 Marks (Two 10 marks each)
Activity: Reflection discussion on Indian Knowledge System: 10 Marks
Activity: Creative Activity: 20 Marks

Recommended Books:

1. B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R. N.,"*Introduction to Indian Knowledge System: Concepts and Applications*" PHI, 2022
2. Kapil Kapoor, Avadhesh K. Singh,"*Indian Knowledge Systems, Volume 1*", Indian Institute of Advanced Study, 2005
3. R. P. Kulkarni, "*Glimpses of India Engineering and Technology: Ancient and Medieval Period*," MunshiramManoharlal Publishers Pvt. Ltd., 2018

Society of St. Francis Xavier, Pilar's
Fr. Conceicao Rodrigues College of Engineering
Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai – 400 050
(Autonomous College affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
ESC11CS04	**Human Health Systems**	L	T	P	L	T	P	Total
		1	--	--	1	--	--	1
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Theory	20	--	30	--	50	
		Lab	--	--	--	--	--	

Pre-requisite Course Codes		Basic Science
Course Outcomes	CO1	Familiarize the students with the basic biological concepts and their engineering applications.
	CO2	Understand bio-design principles to create novel devices and structures in the future
	CO3	Develop the interdisciplinary vision of biological engineering

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Topic**	**Significance of Biology in Engineering**		2
	1.1	Introduction, Aspects of Biology as an Independent scientific discipline		
	1.2	Biological observations ofthe 18[th]Centurythat led to major discoveries, Brownian motion, Origin of Thermodynamics concerning original observations of Robert Brown and Julius Mayor		
	1.3	Fundamental importance of observation in any scientific inquiry		
2	**Topic**	**Human Organ Systems and BioDesigns–1**		4
	2.1	Brain as a CPU System, Architecture of the human brain as a CPU system-Comparison between Brains Computing System with Conventional Von Neumann Computing System		
	2.2	Central Nervous System(CNS)and Peripheral Nervous System (PNS)-2 types: Somatic and Autonomic, Signal Transmission		
		EEG (Electroencephalography- Applications, EEG Signals and Types of Brain Activity)		
	2.3	Robotic Arms for Prosthetics-Robotic Arm Prosthetic Direct Control through Muscle Signals (myoelectric control), Robotic Arm Prosthetic by Brain-Machine Interfaces		
	2.4	Parkinson's disease Engineering Solutions for Parkinson's Disease		
	2.5	Artificial Brain		
	2.6	Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye)		
	2.7	Heart as a pump system (architecture, electrical signaling- ECG monitoring and heart-related issues, reasons for blockages of blood vessels, design of stents, pacemakers, defibrillators)		
3	Topic	**Human Organ Systems and BioDesigns–2**		3

	3.1	Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology – COPD(Chronic obstructive pulmonary disease), Ventilators, Heart-lung machine)		
	3.2	Kidney as a filtration system (architecture, mechanism of filtration, Chronic Kidney Disease, dialysis systems)		
	3.3	Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis)		
4		**Nature-Bio inspired Materials And Mechanisms**		2
	4.1	Echolocation (ultrasonography, sonars),		
	4.2	Photosynthesis (photovoltaic cells, bionic leaf).		
	4.3	Lotus leaf effect(Super hydrophobic and self-cleaning surfaces),		
	4.4	Plant burrs (Velcro)		
	4.5	Kingfisher beak(Bullet train)		
	4.6	Sharkskin (Friction reducing swimsuits)		
	4.7	Human Blood substitutes-hemoglobin-basedoxygen carriers(HBOCs)and Perfluoro carbons (PFCs)		
5		**Trends in Bioengineering**		2
	5.1	Bio printing techniques and materials,		
	5.2	3D printing of ear,bone,andskin.3D printed foods,		
		Electrical tongue, and electrical nose in food science,		
	5.3	DNA origami and Bio computing,		
	5.4	Bio imaging and Artificial Intelligence for disease diagnosis.		
	5.5	Self-healing Bio concrete(based on bacillus spores, calcium lactate nutrients, and bio mineralization processes)		
	5.6	Bio remediation and Bio mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, and Arsenic)		
			Total	**13**

ISE Marks

1. ISE1-1 Quiz/ Assignment   = 20 Marks
2. ISE2-1 Quiz/ Assignment   = 10 Marks
3. Presentation /Poster Making   = 20 Marks

Suggested Learning Resources:
1. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-HilleBook.16thEdition,2022
2. Biology for Engineers, ThyagarajanS., SelvamuruganN., RajeshM.P., NazeerR.A., Thilagaraj W., BarathiS., and JaganthanM.K., Tata McGraw-Hill, NewDelhi, 2012.
3. Biology for Engineers, Arthur T.Johnson,CRCPress,TaylorandFrancis,2011
4. Biomedical Instrumentation, LeslieCromwell,PrenticeHall2011.
5. Biology for Engineers, Sohini Singhand Tanu Allen,Vayu Education of India,NewDelhi,2014.
6. Biomimetics: Nature-BasedInnovation, YosephBar-Cohen,1stedition,2012,CRCPress.
7. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D.Floreano and C.Mattiussi, MITPress,2008.

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8. Bio remediation of heavy metals: bacterial participation, by CR Sunilkumar, N Geetha A C Udaya shankar Lambert Academic Publishing,2019.
9. 3DBioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
10. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, AcademicPress, 2016
11. Blood Substitutes, Robert Winslow, Elsevier,2005

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/121106008
2. https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
3. https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
4. https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
5. https://www.coursera.org/courses?query=biology
6. https://www.classcentral.com/subject/biology
7. https://www.futurelearn.com/courses/biology-basic-concepts

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Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
VSE11CS02	Creative Coding in Python	--	--	4	--	--	2	2
		Examination Scheme						
			ISE1	MSE	ISE2	ESE	Total	
		Lab	50	--	50	--	100	

Pre-requisite Course Codes		
Course Outcomes	CO1	Demonstrate awareness of skills of 21st century engineer
	CO2	Demonstrate basic concepts ofpython programming.
	CO3	Identify, install and utilize python packages.
	CO4	Illustration of data analytics and data visualization using Python libraries
	CO5	Create GUI Applications using Python.
	CO6	Demonstrate creativity while implementing solution for a given problem using python

Module No.	Unit No.	Topics
1		**21st century skills**
		Introduction and Importance of 21st Century skills, case studies of creativity in engineering, Creator Tool Picto Blox, Github
2		**Python Fundamentals:**
	2.1	*Basic Data Types:* Letter Counter App, Right Triangle Solver App, Multiplication Exponent Table Program
	2.2	*Lists:* Grade Sorter App, Grocery List App, Basketball Roster Program
	2.3	*Dictionaries:* Thesaurus App, Code Breakers App
3		**Decision Flow Control Statements**
	3.1	*For Loops:* Binary Hexadecimal Conversion App, Grade Point Average Calculator App
	3.2	*Conditionals:* Voter Registration App, Rock, Paper, Scissors App
	3.3	*While Loops:* Guess the Word App, PowerBall Simulation App
4		*Functions*
	4.1	*Functions:* Head to Head Tic-Tac-Toe App, Bank Deposit and Withdrawal Program
	4.2	*Classes:* Casino Blackjack App
5		*Graphics and GUI*
	5.1	*Turtle* - Hirst Painting
	5.2	*Tkinter*- Building a Password Manager GUI App.
6		*Python in Data Sciences for Beginner*
	6.1	*NumPy, Pandas, Matplotlib:* Data Analysis and visualization of any data set (Stock market/healthcare/weather/Agriculture)
7		**Project Development using Python for various engineering domains like electronics, mechanical etc.**

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Course Assessment:
Lab:

ISE:
1. ISE-1
Experiments: 20 Marks
Quiz: 10 Marks
Design contest: 20 Marks
2. ISE-2
Experiments: 20 Marks
Quiz: 10 Marks
Mini Project: 20 Marks

Recommended Books:

1. Yashvant Kanetkar, "Let us Python: Python is Future, Embrace it fast", BPB Publications;1stedition (8 July2019).
2. Dusty Phillips, "Python 3 object-oriented Programming", Second Edition PACKT Publisher, August2015.
3. John Grayson, "Python and Tkinter Programming", Manning Publications (1 March1999).
4. Core Python Programming, Dr. R. Nageswara Rao, DreamtechPress
5. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wroxpublication
6. Introduction to computing and problem solving using python, E Balagurusamy, McGrawHill Education

Online Resources:

1. Python 3 Documentation: https://docs.python.org/3/
2. "The Python Tutorial", http://docs.python.org/release/3.0.1/tutorial/
3. http://spoken-tutorial.org
4. Python 3 Tkinter library Documentation: https://docs.python.org/3/library/tk.html
5. Numpy Documentation: https://numpy.org/doc/
6. Pandas Documentation: https://pandas.pydata.org/docs/
7. Matplotlib Documentation: https://matplotlib.org/3.2.1/contents.html
8. ScipyDocumentation : https://www.scipy.org/docs.html
9. Machine Learning Algorithm Documentation: https://scikit-learn.org/stable/
10. https://nptel.ac.in/courses/106/106/106106182/
11. NPTEL course: "The Joy of Computing using Python"