राष्ट्रीय प्रौद्योगिकी संस्थान मेघालय

NATIONAL INSTITUTE OF TECHNOLOGY MEGHALAYA

UG Curriculum

with effect from

AY 2024-25

in view

of

NEP2020

Department of Computer Science & Engineering

National Institute of Technology Meghalaya

UG Curriculum with effect from AY

2024-25 In view of NEP2020

Abbreviations

SC	:	Science Core
ESA	:	Engineering Science & Arts
DSC	:	Dept. Specific Core
DSE	:	Dept. Specific Elective
OE	:	Open Elective
AECC	:	Ability Enhancement Compulsory Course
SECC	:	Skill Enhancement Compulsory Course
VAC	:	Value Added Course
L	:	Laboratory Course
A	:	Audit Course

1st Year Common Structure

Semester Wise Model Plan – First Semester							
Course Code	**Course Title**	**Course Type**	**Contact Hours**			**Credit**	**Pre-requisites**
			L	**T**	**P**	**C**	
Science Core							
MA101	Engineering Maths-I (calculus, linear algebra, & statistics)	SC	3	1	0	4	None
CB101/ PH101	Engineering Chemistry/ Engineering Physics	SC	3	0	0	3	None
CB151/ PH151	Engineering Chemistry/Engineering Physics Laboratory	SC (L)	0	0	2	1	None
CB103	Biology for Engineers	SC	2	0	0	2	None
Engineering Science and Arts							
ME101	Engineering Mechanics	ESA	3	1	0	4	None
CS101	Computer & Coding	ESA	2	0	0	2	None
CS151	Computer & Coding Lab	ESA (L)	0	0	2	1	None
CE101	Engineering Graphics	ESA (L)	0	1	3	2	None
Skill Enhancement Compulsory Course							
HS151	Communication Skills	SECC(L)	0	1	2	2	None
Value Added Course							
Total Contact Hours – Component wise			**13**	**4**	**09**		-
Total Contact Hours			**26**			**21**	-

Semester Wise Model Plan – Second Semester							
Course Code	**Course Title**	**Course Type**	**Contact Hours**			**Credit**	**Pre-requisites**
			L	**T**	**P**	**C**	
Science Core							
MA102	Engineering Maths-II	SC	3	1	0	4	None
PH101/ CB101	Engineering Physics/Engineering Chemistry	SC	3	0	0	3	None
PH151/ CB151	Engineering Physics/Engineering Chemistry Laboratory	SC (L)	0	0	2	1	None
Engineering Science and Arts							
CB102	Environmental Science	ESA	2	0	0	2	None
EE102	Basic Electrical & Electronics Engineering	ESA	3	0	0	3	None
EE152	Basic Electrical & Electronics Engineering Lab	ESA (L)	0	0	2	1	None
ME152	Workshop Practice	ESA (L)	0	0	3	1	None
Skill Enhancement Compulsory Course							
HS102	Creativity, Innovation and Entrepreneurship	SECC	2	0	0	2	None
Ability Enhancement Compulsory Course							
CS152	Python Programming	AEC C (L)	0	1	2	2	None
Value Added Course							
HS104	Ethics and Morals	VAC	2	0	0	2	None
VA102	Skill Development & Prototyping	VAC (L)	0	0	2	1	None
Total Contact Hours – Component wise			**15**	**2**	**11**		-
Total Contact Hours			**28**			**22**	-

Semester Wise Model Plan – Third Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Core							
CS201	Data Structures and Algorithms	DSC	3	0	0	3	
CS203	Digital Logic Design	DSC	3	0	0	3	
CS205	Discrete Mathematical Structures	DSC	3	0	0	3	
CS207	Computer Organization	DSC	3	0	0	3	
Department Specific Elective (any one)							
CS209	Computer Graphics	DSE	3	0	0	3	
CS211	Principles of Programming Languages	DSE	3	0	0	3	
Open Elective							
CS271	Object Oriented Paradigm	OE	2	0	0	2	
Value Added course/ Dissertation							
CS213	Web Design Using JavaScript	VAC	2	0	0	2	
Laboratory							
CS251	Data Structures and Algorithms Lab	L	0	0	2	1	
CS253	Digital Logic Design Lab	L	0	0	2	1	
CS255	Computer Organization Lab	L	0	0	2	1	
Total Contact Hours – Component wise			**19**	**0**	**6**		-
Total Contact Hours			**25**			**22**	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Fourth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Core							
CS202	Software Engineering	DSC	3	0	0	3	
CS204	Object Oriented Programming and Design	DSC	3	0	0	3	
CS206	Data Communication	DSC	3	0	0	3	
CS208	Automata and Formal Languages	DSC	3	0	0	3	
Department Specific Elective (any one)							
CS210	Augmented Reality and Virtual Reality	DSE	3	0	0	3	
CS212	Artificial Intelligence	DSE	3	0	0	3	
Open Elective							
CS272	App Design	OE	2	0	0	2	
Skill Enhancement Compulsory Course							
ME218	Indian Health, Wellness and Psychology	SECC	2	0	0	2	
Laboratory							
CS252	Software Engineering Lab	L	0	0	2	1	
CS254	Object Oriented Programming and Design Lab	L	0	0	2	1	
CS256	Data Communication Lab	L	0	0	2	1	
Total Contact Hours – Component wise			**19**	**0**	**6**		-
Total Contact Hours			**25**			**22**	-

* DP stands for 2-digit respective Department code

**Compulsory for those who are opting minor degree

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Fifth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Core							
CS301	Operating Systems	DSC	3	0	0	3	
CS303	Database Management Systems	DSC	3	0	0	3	
CS305	Computer Networks	DSC	3	0	0	3	
Department Specific Elective (any one)							
CS307	Cryptography And Network Security	DSE	3	0	0	3	
CS309	Internet of Things	DSE	3	0	0	3	
Open Elective							
CS371	Advanced Python Programming	OE	2	0	0	2	
Ability Enhancement Compulsory Course							
CS381	Internship-1	AECC	0	0	0	1	
Skill Enhancement Compulsory Course							
CS357	Seminar and Technical Report Writing	SECC	0	0	2	1	
Value Added course/ Dissertation							
CS383	Minor Project-1	VAC	0	0	4	2	
Laboratory							
CS351	Operating Systems Lab	L	0	0	2	1	
CS353	Database Management Systems Lab	L	0	0	2	1	
CS355	Computer Networks Lab	L	0	0	2	1	
Total Contact Hours – Component wise			**14**	**0**	**12**		-
Total Contact Hours			**26**			**21**	-

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Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Sixth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Core							
CS302	Design and Analysis of Algorithm	DSC	3	0	0	3	
CS304	Compiler Design	DSC	3	0	0	3	
Department Specific Elective (any two)							
CS306	Machine Learning	DSE	3	0	0	3	
CS308	Fuzzy logic and Soft Computing	DSE	3	0	0	3	
CS310	Natural Language Processing	DSE	3	0	0	3	
Open Elective							
CS372	Data Analytics using Python	OE	2	0	0	2	
Value Added course/ Dissertation							
HS302	Indian Culture and Civilization	VAC	2	0	0	2	
CS382	Minor Project-2	VAC	0	0	4	2	
Laboratory							
CS352	Design and Analysis of Algorithm Lab	L	0	0	2	1	
CS354	Compiler Design Lab	L	0	0	2	1	
CS356	Internet Web Technology lab	L	0	0	2	1	
Total Contact Hours – Component wise			**16**	**0**	**10**		-
Total Contact Hours			**26**			**21**	-

* DP stands for 2-digit respective Department code

**Compulsory for those who are opting minor degree

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Seventh Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Elective (choose any one from each group)							
Group- 1							
CS401	Distributed Computing System	DSE	3	0	0	3	
CS407	Real time Systems	DSE	3	0	0	3	
CS417	High performance computing	DSE	3	0	0	3	
Group- 2							
CS405	Social Network	DSE	3	0	0	3	
CS409	Ethical Hacking	DSE	3	0	0	3	
Group- 3							
CS403	Deep Learning						
CS411	Computer Vision and Image Processing	DSE	3	0	0	3	
CS419	Pattern Recognition and applications	DSE	3	0	0	3	
Group- 4							
CS413	Bandit Algorithm	DSE	3	0	0	3	
CS415	Blockchain and its applications	DSE	3	0	0	3	
Open Elective							
CS471	Cyber Physical System	OE	2	0	0	2	
Ability Enhancement Compulsory Course							
CS481	Internship-2	AECC	0	0	0	1	
Value Added course/ Dissertation							
CS483	Major Project-1	VAC	0	0	8	4	
Total Contact Hours – Component wise			**14**	**0**	**8**		-
Total Contact Hours			**22**			**19**	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

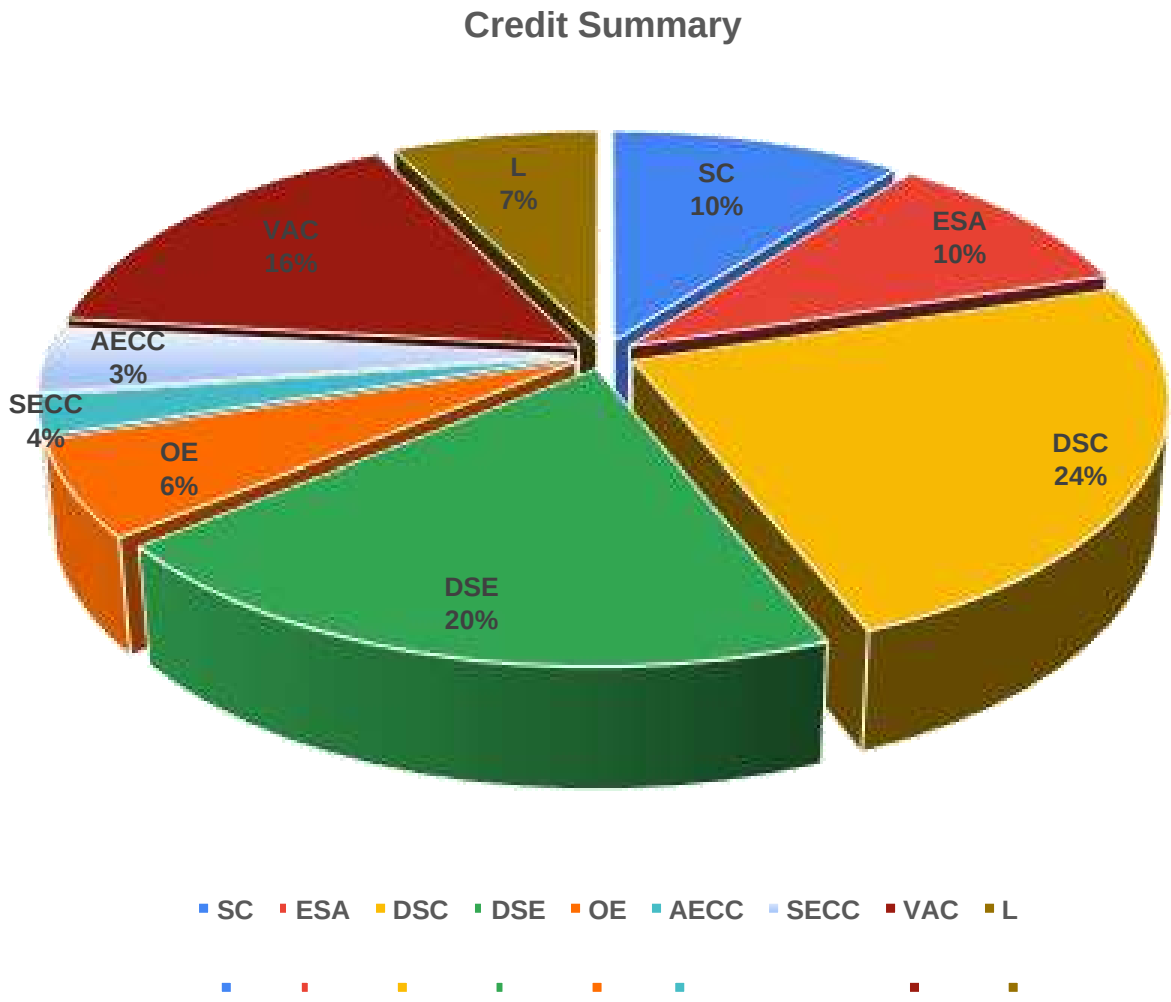
Semester Wise Model Plan – Eighth Semester							
Course Code	**Course Title**	**Course Type**	**Contact Hours**			**Credit**	**Pre-requisites**
			L	**T**	**P**	**C**	
Department Specific Elective (choose any two from each group)							
Group- 1							
CS404	Design and Implementation of Human Computer Interface	DSE	3	0	0	3	
CS406	Reinforcement Learning	DSE	3	0	0	3	
Group- 2							
CS402	Cloud Computing	DSE	3	0	0	3	
CS408	GPU Architecture and Programming	DSE	3	0	0	3	
CS410	Cyber Security and privacy	DSE	3	0	0	3	
Value Added course/ Dissertation							
CS482	Major Project-2	VAC	0	0	22	11	
Total Contact Hours – Component wise			**6**	**0**	**22**		-
Total Contact Hours			**28**			**17**	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Eighth Semester										
Sem	SC	ESA	DSC	DSE	OE	AECC	SECC	VAC	Lab	Total Credit
I	SC1 [4] SC2 [3] SC3 [2] SC-L [1]	ESA1 [4] ESA2 [2] ESA-L [1] ESA-L [2]					SECC-L [2]	VAC-A [0]		**21**
II	SC4 [4] SC5 [3] SC-L [1]	ESA3 [2] ESA4 [3] ESA-L [1] ESA-L [1]				AECC-L [2]	SECC1 [2]	VAC1 [2] VAC-L [1] VAC-A [0]		**22**
III			DSC1 [3] DSC2 [3] DSC3 [3] DSC4 [3]	DSE1 [3]	OE1 [2]			VAC2 [2]	L1 [1] L2 [1] L3 [1]	**22**
IV			DSC5 [3] DSC6 [3] DSC7 [3] DSC8 [3]	DSE2 [3]	OE2 [2]		SECC2 [2]		L4 [1] L5 [1] L6 [1]	**22**
V			DSC9 [3] DSC10 [3] DSC11 [3]	DSE3 [3]	OE3 [2]	AECC1 [1]	SECC3 [1]	VAC3 [2]	L7 [1] L8 [1] L9 [1]	**21**
VI			DSC12 [3] DSC13 [3]	DSE4 [3] DSE5 [3]	OE4 [2]			VAC4 [2] VAC5 [2]	L10 [1] L11 [1] L12 [1]	**21**
VII				DSE6 [3] DSE7 [3] DSE8 [3] DSE9 [3]	OE5 [2]	AECC2 [1]		VAC6 [4]		**19**
VIII				DSE10 [3] DSE11 [3]				VAC7 [11]		**17**
Total Credit	**18**	**16**	**39**	**33**	**10**	**4**	**7**	**26**	**12**	**165**

Components Credit Summary - BTech Curriculum										
Course Type with Abbreviation		**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
SC	Science Core	10	8							**18**
ESA	Engineering Science & Arts	9	7							**16**
DSC	Dept. Specific Core			12	12	9	6			**39**
DSE	Dept. Specific Elective			3	3	3	6	12	6	**33**
OE	Open Elective			2	2	2	2	2		**10**
AECC	Ability Enhancement Compulsory Course		2			1		1		**4**
SECC	Skill Enhancement Compulsory Course	2	2		2	1				**7**
VAC	Value Added Course		3	2		2	4	4	11	**26**
L	Laboratory Course			3	3	3	3			**12**
Total Credits										**165**



First Semester Courses

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Mathematics**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
MA101	**Engineering Mathematics-I**	**---**	**3**	**1**	**0**	**4**	**50**	**50**	**100**	**200**

Course Objectives	To enable the students to have a good understanding of fundamental concepts of single and multivariable calculus.	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To provide the basic and important concepts of linear algebra.		MA101.1	Able to acquire **knowledge** of limit, continuity and differentiation for functions of single and multi-variables and the consequences of different mean value theorems. — **Understand, Analyze**
	To prepare the students to apply the mathematical principles of calculus and linear algebra to solve engineering problems.		MA101.2	Able to **apply** Taylor's series to approximate differentiable functions of single and multi-variables and **estimate** the error. — **Apply, Evaluate**
	To enable the students to have a good understanding of essential methods of statistical inference.		MA101.3	Able to **apply** definite integrals to **evaluate** length of plane curves, volume and surface area of solids of rotation. — **Apply, Evaluate**
			MA101.4	Able to **understand** the basic concepts of vector spaces and to solve systems of linear equations. — **Understand, Evaluate**
			MA101.5	Able to **demonstrate** and **apply** estimation of parameters, confidence interval, and testing hypotheses for normal distribution. — **Understand, Apply**
			MA101.6	Able to **formulate** relationships among random variables using regression and correlation. — **Create**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA101.1	**2**														
MA101.2	**3**														
MA101.3	**3**														
MA101.4	**3**														
MA101.5	**2**														
MA101.6	**3**														
MA101	**2.67**														

SYLLABUS

No.	Content	Hours	COs
I	**Differential Calculus:** Real valued functions of single variable: Limit; continuity; differentiation, Taylor & Maclaurin series, indeterminate forms, L'Hospital's rule. Real valued functions of two/three variables: Limit, continuity, partial differentiation; Taylor and Maclaurin series for function of two variables; Extreme values of functions of two variables.	**14**	**MA101.1 MA101.2**
II	**Integral Calculus:** Definite integral: length of a plane curve, surface area of revolution, volume of solids of revolution; Differentiation under sign of integral: Leibnitz rule; Improper integrals, convergence tests, beta and gamma functions; Multiple Integrals: double and triple integrals, volume and surface integrals.	**16**	**MA101.3**
III	**Linear Algebra:** Vector space over R, subspaces, bases and dimension; Echelon form, rank of a matrix, system of linear equations-direct & iterative methods; eigenvalues and eigenvectors; Symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal, and unitary matrices.	**14**	**MA101.4**
IV	**Statistics:** Random variables, Probability distributions, Point estimation of parameters, Confidence Intervals, Testing Hypotheses, goodness of fit: Chi-square test, Regression: fitting straight lines, correlation.	**12**	**MA101.5 MA101.6**
	Total Hours (4 Modules)	**56**	

Essential Readings

1. J. Stewart, D. K. Clegg and S. Watson, "Calculus", Cengage Learning India Pvt. Limited, 9th edition, 2023.
2. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th edition 2023.

Supplementary Readings

1. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2019.
2. N. Piskunov, "Differential Calculus and Integral Calculus – I", CBS, 1996.
3. N. Piskunov, "Differential Calculus and Integral Calculus – II", CBS, 1996.
4. D. C. Montgomery and G. C. Runger, "Applied Statistics and Probability for Engineers", John Wiley & Sons, 7th edition, 2018.

National Institute of Technology Meghalaya

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CURRICULUM

Programme	**Bachelor of Technology (All Branches)**	Year of Regulation	**2024-25**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CB 101	**Engineering Chemistry**	NIL	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the students to the concept, classifications, and industrial applications of polymers		CB101.1	The students will be apply the knowledge about polymers, polymerization processes, and their industrial applications.	**Apply**
	To gain knowledge of different types of fuels and their analysis		CB101.2	Able to describe different types of fuels and their analysis, petroleum technology	**Understand**
	To learn about metallurgy, metal extraction process, composition, and properties of alloys		CB101.3	Able to explain the process of metal extraction from ores and discuss the properties of alloys and composition	**Analyze**
	To introduce students to different types of materials, properties, and their applications.		CB101.4	Able to analyze the properties of different materials and apply the knowledge of nanotechnology for various practical applications.	**Analyse**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB101.1	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.2	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.4	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101	2	2	3												

SYLLABUS

No.	Content	Hours	COs
I	**Polymer Chemistry:** Concepts, classification, structures, and molecular weights of polymers, mechanism and kinetics of various polymerization processes, natural rubber and its properties, vulcanization of rubber, synthesis and applications of various industrial polymers, adhesives, paints, conducting polymers and their applications in electronic devices, biodegradable polymers.	**10**	CB101.1
II	**Petroleum Chemistry:** Composition, characteristics of crude oil, cracking. Solid, liquid and gaseous fuels, coal analysis; classification of coal; anti-knocking agents, octane number and cetane number, aviation fuel and biofuels, lubricants.	**08**	CB101.2
III	**Metallurgy:** Minerals, ores, and general methods of extraction and purification of metals (Fe, Al, Cu, Zn). Alloys: Definition of alloy, types of alloys (ferro, non-ferro & amalgam), composition, properties, and uses of brass, bronze, and steel.	**08**	CB101.3
IV	**Material Chemistry:** Introduction and properties of glass, ceramics and their composites, magnetic materials, and smart materials. Piezoceramic materials, electro-active materials, shape-memory materials, energy harvesting materials, self-healing materials, semiconducting materials, and liquid crystals. **Nanomaterials** Introduction, classification, properties of nanomaterials, carbon-based nanomaterials, synthesis of nanomaterials, top-down and bottom-up approaches, characterization of nanomaterials, applications of nanomaterials - materials for light emitting diodes, batteries, and fuel cells, memory devices and sensors, nanotechnology for pharmaceutical applications, nanomaterials for tissue engineering, carbon nanotubes and nanocomposites in textiles.	**16**	CB101.4
	Total Hours	**42**	

Essential Readings

1. P. C. Jain and M. Jain, "Engineering Chemistry", 17th Edition", Dhanpat Rai Publication Co., 2019.
2. S. Chawla, "A Text Book of Engineering Chemistry", 1st Edition, Dhanpat Rai & Co. (P) Limited, 2017

Supplementary Readings

1. M. G. Fontana, "Corrosion Engineering", Third Edition, McGraw-Hill Book Company, 2017
2. R. Gopalan, D. Venkappayya, S. Nagarajan, " A textbook of Engineering Chemistry" 4th Edition, Vikas Publishing House Pvt. Ltd.
3. S. Agarwal, "Engineering Chemistry: Fundamentals and Applications", 2nd edition, Cambridge University Press, 2019

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology (All branches)**	Year of Regulation	**2024-2025**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Credit Structure				Marks Distribution		
		L	T	P	C	Continuous Evaluation		Total
CB 151	**Chemistry Laboratory**	**0**	**0**	**2**	**1**	**01 Expt.**	**10**	**100**

Course Objectives		Course Outcomes	COs	Statement	Bloom's Taxonomy
	To provide the students with knowledge of various titration-based techniques for chemical analysis.		**COs**	**Statement**	**Bloom's Taxonomy**
	To teach the fundamentals of basic chemistry-related aspects for practical applications and sample analysis.		CB151.1	Able to explain the concepts of acid-base, redox, potentiometric and pH metric titration for quantitative analysis	Understand
	To develop the student's ability to use different instrumental methods for chemical analysis and testing of various samples.		CB151.2	Able to prepare standard solutions for various quantitative analysis	Apply
			CB151.3	Able to analyze water sample, alloy samples by complexometric iodometric and spectrophotometric analysis	Analyse
			CB151.4	Able to apply the concepts of partition coefficient, viscosity in analysis	Apply

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CB151.1	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
2	CB151.2	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
3	CB151.3	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
4	CB151.4	**2**	**2**													
	CB151	**2**	**2**													

SYLLABUS

No.	Content	Hours	COs
1	To determine the alkalinity of a given water sample	**2**	CB151.1 CH151.2
2	Estimation of Fe(II) in Mohr's salt solution using standard $KMnO_4$ solution via Redox titration	**2**	CB151.1 CB151.2
3	Conductometric titration of an unknown acid solution using a standard base solution	**2**	CB151.1 CB151.2
4	pH-metric titration of an unknown acid solution using a standard base solution	**2**	CB151.1 CB151.2
5	Complexometric determination of hardness of water	**2**	CB151.3
6	Iodometric determination of copper in brass alloy	**2**	CB151.3
7	Spectrophotometry on copper sulphate solution	**2**	CB151.3
8	Determination of partition coefficient of acetic acid between *n*-butanol and water	**2**	CB151.4
9	Determination of percentage composition of sugar solution from viscosity	**2**	CB151.4
10	Estimation of Fe(II) in a solution using standard $K_2Cr_2O_7$ solution via potentiometric titration	**2**	CB151.1
	Total Hours	**20**	

Essential Readings

1. J. Mendham, R. Denny, J. Barnes, M. Thomas, "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson.

Supplementary Readings

1. V. D. Athawale, P. Mathur, "Experimental Physical Chemistry", 1st Edition, New Age International (P) Limited Publishers, 2001.
2. Departmental laboratory manual

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology (All branches)**	Year of Regulation	**2024-2025**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CB 103	**Biology for Engineers**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	COs	Statement	Bloom's Taxonomy
	To provide the basic knowledge of various biomolecules, which are essential for life, their structures, and functions.		CY103.1	Able to understand the significance of biomolecules for sustaining life, including the knowledge of the structure of the cell and the biological signal transduction process.	**Understand**
	To discuss the structure and function of cells, different cellular processes, and biological signal transduction.				
	To provide the knowledge of heredity, how genes work, the concept of the central dogma of life, genetic engineering, and genomics.		CY103.2	Able to interpret the heredity, variation, and central dogma of life followed by gene expression and their applications.	**Understand**
	To provide basic knowledge on engineering tools in disease biology, stem cell engineering, 3D printing of artificial organs and various biomaterials.		CY103.3	Able to apply the concepts of engineering tools to solve the issues related to disease aspects, diagnosis, etc.	**Apply**
			CY103.4	Able to apply the concepts of biomaterial processing and their applications.	**Apply**

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CB103.1	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
2	CB103.2	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
3	CB103.3	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
4	CB103.4	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
	CB103	2	3	3												

SYLLABUS

No.	Content	Hours	COs
I	**Molecules of life**: Chemical basis of life, protein structure and function, nucleic acids and the RNA, carbohydrates, lipids, membranes, and cells, cellular interactions, cell cycle, biological signal transduction.	**06**	CB103.1
II	**Gene structure and expression**: Mitosis, meiosis, Mendelian Genetics. DNA and the gene- Synthesis and repair, how genes work, the central dogma of life, transcription, RNA processing, translation, control of gene expression, analyzing and engineering genes, genomics.	**06**	CB103.2
III	**Trends in bioengineering**: Genetic engineering, disease biology and biopharmaceuticals, stem cell engineering, metabolic engineering, biosafety, and bioethics. Bioprinting techniques and materials, 3D printing of ear, bone, and skin. Bioimaging and Artificial Intelligence for disease diagnosis.	**08**	CB103.3
IV	**Biomaterials Processing**: Classification, concept of biocompatibility, quantification of structure-property correlation - bioglass/ glass-ceramics, biodegradable polymers, biocomposites, bioplastics, macroporous scaffolds. Self-healing bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and bioremediation via microbial surface adsorption (removal of heavy metals like lead, cadmium, mercury, arsenic).	**08**	CB103.4
	Total Hours	**28**	

Essential Readings

1. E. Engner, R. Ross, D. Bailey, "*Concepts in Biology"*, 14th Edition, McGraw Hill Education, New York, 2011.
2. R. Renneberg, V. Berkling and V. Loroch, "Biotechnology for Beginners", 2nd Edition, Academic Press, 2016.

Supplementary Readings

1. G.K. Suraishkumar, "Biology for Engineers", 1st Edition, Oxford University Press, New Delhi, 2019.
2. G. Karp, "Cell and Molecular Biology: Concepts and Experiments", 7th edition, Wiley, New York, 2013.
3. D. Floreano and C. Mattiussi, "Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies", 1st Edition, MIT Press, 2008.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2024-25**
Department	**Mechanical Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
ME101	**Engineering Mechanics**	-----	**3**	1	**0**	**4**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			COs	**Statement**	**Bloom's Taxonomy**
	This course describes the different laws of forces associated with different engineering elements.		ME101.1	Able to understand vector mechanics and classify the different laws of forces associated with engineering systems	Knowledge Identification
	This course introduces the use of force, moments and MOIs in various conditions.		ME101.2	Able to i) Illustrate the use of force and moments in various working conditions (Understanding). ii) understand the centre of gravity, centroid, centre of mass and details of MOIs.	Knowledge Identification and Application
	This course illustrates the use of subject knowledge in the fields of engineering.		ME101.3	Able to identify the equilibrium conditions of engineering structures (truss, beams, frames) under various loads.	Knowledge Identification and Analyse
	This course introduces the states of engineering elements and structures under various loading conditions.		ME101.4	Able to solve the basics of friction and its associated laws along with the related problems.	Knowledge Identification and Analyse
	This course explains how to solve the practical problems of mechanics to determine the static forces with their magnitudes and directions.		ME101.5	Able to understand the kinematics of particles and Rigid Bodies and principle of work along with the related problems.	Knowledge Identification and Analyse

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ME 101.1	3	2	2	2								2	3	2
ME 101.2	3	2	2	2								2	3	2
ME 101.3	3	2	2	2								2	2	2
ME 101.4	3	2	1	1								2	2	2
ME 101.5	3	2	1	2								2	2	2
ME 101	**3**	**2**	**1.6**	**1.8**								**2**	**2.4**	**2**

SYLLABUS

No.	Content	Hours	COs
I	Vector Mechanics with applications: Definition and representation of vectors, projection and decomposition, force vector and types, dot product, resolving force vector along and perpendicular to a given direction, cross product and scalar triple product	**06**	**ME101.1**
II	Compositions of two force system, Resolution of forces, General method of composition of forces, Equilibrium of bodies, Free body diagram. Lami's theorem, Equilibrium of connected bodies	**06**	**ME101.1**
III	Moment of force, Varignon's theorem, Couple, Resolution of a force into a force and couple, Resultant of non-concurrent force system, Equilibrium of non-concurrent system of forces.	**06**	**ME101.2**
IV	Center of gravity, Centroid, Use of axis of symmetry, Centroid of a composite section, Center of gravity of a flat plate, Difference between center of gravity and centroid, Determination of centroid from first principle.	**06**	**ME101.1 ME101.2 ME101.3**
V	Moment of inertia, Radius of gyration, Polar moment of inertia, Moment of inertia from first principles, Theorems of moment of inertia, Moment of inertia of composite sections, Moment of inertia of standard sections	**06**	**ME101.3**
VI	Frames, Truss, Assumptions in analysis of frame and Truss, Nature of forces, Methods of analysis, Method of joints, Method of sections	**06**	**ME101.3**
VII	Laws of friction, Angle of friction, angle of repose, cone of friction, Wedges, Problems involving non-concurrent force system, Rope/belt friction, pulleys, screw-jack, rolling resistance	**05**	**ME101.1 ME101.2 ME101.4**
VIII	Types of supports, Types of beam, Types of loading, finding reactions at support, shear force and bending moment, axial force and twisting moment, Concept of Stress and Strain – Stress strain, diagram, factor of safety, uniaxial loading, single and double shear, applications. Generalized Hooke's law - Poisson's ratio, Generalized Hooke's law, Relations between E, G and K	**06**	**ME101.2 ME101.4**
IX	Kinematics of Particles and Rigid Bodies: rectilinear motion, curvilinear motion, velocity and acceleration in cylindrical and path coordinate system, relative and constrained motion, rate of change of a vector in a rotating frame, three-dimensional motion of a particle relative to a rotating frame, rigid body kinematics.	**05**	**ME101.1**
X	Work, Work done by varying force, Energy, Power, Work energy equation for translation, Motion of connected bodies, work done by spring	**04**	**ME101.1**
	Total Hours	**56**	

Essential Readings

1. F.P. Bear, E. R. Johnston, Vector Mechanics for Engineers, Tata McGraw Hill, 12th Edition 2019,
2. S. Timoshenko, D.H., Young, JV Rao, S. Pati, Engineering Mechanics, McGraw Hill Education, 5th Edition, 2017

Supplementary Readings

1. H. J. Shah, S. B. Junarkar, Applied Mechanics, Charotar Publication, 19th Edition 2015
2. S. S. Bhavikatti, K. G. Rajashekarappa, Engineering Mechanics, Wiley Eastern Ltd., 2018
3. R. C. Hibbeler, Engineering Mechanics –Statics & Dynamics, Macmillan Publication Co., 11th Edition, 2006

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS101	**Computer and Coding**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the basic architecture of a computer, the concept of algorithm, the basic concepts and terminology of programming in general and concept of functional hierarchical code organization.		CS101.1	**Able to explain the basic architecture of a computer, the concept of algorithm, and the basic concepts and terminology of programming in general.**	Understand
	To inculcate the ability to do algorithmic thinking to analyse real-world problems and develop algorithms to solve those.		CS101.2	**Able to develop the ability to do algorithmic thinking to analyse a problem and develop an algorithm to solve it.**	Create
	To introduce programming using C language and writing programs in C on a computer, and edit, compile, debug, correct, recompile and run those.		CS101.3	**Able to apply the C programming language to implement various algorithms.**	Apply
	To train the students in choosing right data representation formats based on a problem specification.		CS101.4	**Able to choose the right data representation formats based on the requirements of the problem.**	Apply
			CS101.5	**Able to develop programs on a computer, edit, compile, debug, correct, recompile and run those.**	Create
			CS101.6	**Able to understand the concept of functional hierarchical code organization.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS101.1	3		1		1					1	1	1			
CS101.2	2	3	3	2	1	1			1				1	1	1
CS101.3	3	3	3	2	1				1					1	1
CS101.4	3	1	1	2										2	3
CS101.5	3		3	1	3				1					1	1
CS101.6	3	2	2	2					2						1
CS101	2.83	2.25	2.17	1.80	1.50	1.00			1.25	1.00	1.00	1.00	1.00	1.25	1.40

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** **Organization of a Computer: Von Neumann architecture; CPU; Memory; RAM; ROM; Hardware; Software; Application Programs; System Programs; Operating Systems; Number Systems.** **Concept of Programming and Programming Languages: Machine Language; Assembly Language; High-Level Programming language; Compiler; Assembler; Interpreter; Linker; Loader; Compiling a C program in command line and in an IDE** **Concept of Algorithm, Flowchart, Pseudo code, Illustrative Problem Solving Examples.**	**5**	**CS101.1** **CS101.2**
II	**Introduction to C programming language** **Features of a Programming Language: Character Set; Constants; Escape Sequences; Identifiers; Keywords; Data Types; Data Type Qualifiers; Variables; Declarations; enum; typedef; Operators & Expressions - Binary operators :- Arithmetic Operators, Logical Operators, Relational Operators, Bitwise Operators; Assignment Operator; Shorthand Assignment Operators; Unary Operators; Ternary Operators; Special Operators; sizeof(); Operator Precedence and Associativity in expressions; Data type conversion: coercion (implicit type conversion), type casting (explicit type conversion); Statements: Assignment statements, Input/ Output statements for standard input/ output devices.** **Flow Control - Conditionals and Branching:- Simple if Statement, if-else Statement, Nested if-else Statement, Ladder structure of if-else, switch-case statement, goto statement;** **Iteration - while Statement, do-while Statement, for Statement, break and continue.** **Functions; Function Types - standard library functions, user defined functions; syntax of functions; Arguments and Parameters; Call by Value; Call by Reference; parameterized main function; Storage Classes - auto, register, static, extern; Scope Rule: Variable scope - local, global; Recursion.** **Arrays - Single Dimensional Arrays, Multi-Dimensional Arrays, Introduction to strings :- Definition of a string, character arrays and strings, pointers and strings, standard library string functions, arrays of strings; Pointers - different types of pointers, pointer arithmetic, pointers and arrays.** **Structures - creating structures using struct, Arrays in Structures, Array of Structures, Difference between arrays and structures; Unions - creating structures using union, difference between structures and unions.** **Preprocessor directives and Files - Preprocessor directives :- File inclusion by macro, macros, macros and functions; Basic Input/ Output operations on Files :- Text files and binary files, file opening modes, opening, closing, reading, writing and appending to a file.** **(A programming language like C/ C++ shall be used as a basis language. The same language is to be used for the laboratory).**	**23**	**CS101.3** **CS101.4** **CS101.5** **CS101.6**
	Total Hours	**28**	

Essential Readings

1. E. Balagurusamy, "Programming in ANSI C", McGraw-Hill Education, 8th edition, 2019.
2. V. Rajaraman, "Fundamentals of Computers", PHI Learning, 6th revised edition, 2014.

3. Yashavant Kanetkar, “Let Us C”, BPB Publications, 19th edition, 2022.

Supplementary Readings

1. Byron S. Gottfried, “Programming with C”, McGraw-Hill Education, 4th edition, 2018.

2. Brian W. Kernighan, Dennis M. Ritchie, “The C Programming Language: ANSI C Version”, Pearson Education India, 2nd edition, 2015.

3. Darrel L. Graham, “C Programming Language”, Createspace Independent Publishing, 1st edition, 2016.

National Institute of Technology Meghalaya

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS151	**Computer & Coding Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives

- **To introduce programming using C language and to write programs in C on a computer, and to edit, compile, debug, correct, recompile and run those.**
- **To inculcate the ability to do algorithmic thinking to analyse real-world problems and develop algorithms to solve those.**
- **To train the students in choosing right data representation formats based on a problem specification.**

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CS151.1	**Able to explain the basic concepts and terminology of programming in general.**	Understand)
CS151.2	**Able to do algorithmic thinking to analyse a problem and develop an algorithm to solve it.**	Create
CS151.3	**Able to use the C programming language to implement various algorithms.**	Apply
CS151.4	**Able to choose the right data representation formats based on the requirements of the problem.**	Apply
CS151.5	**Able to develop programs on a computer, edit, compile, debug, correct, recompile and run those.**	Create
CS151.6	**Able to understand the concept of functional hierarchical code organization.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS151.1	3		1		1					1	1	1			
CS151.2	2	3	3	2	1	1			1					1	
CS151.3	3	3	3	2	1				1					3	
CS151.4	3	2	1	2										1	
CS151.5	3		3	2	3	1			1					2	
CS151.6	3	2	2	2					2					1	
CS151	**2.83**	**2.50**	**2.17**	**2.00**	**1.50**	**1.00**			**1.25**	**1**	**1**	**1**		**1.60**	

SYLLABUS

No.	Content	Hours	COs
I	1. C program to print the paragraph as shown below: " Hello World " % Hello World % \\ Hello World \\ 2. C program to print the result of the following arithmetic expression where a=4, b= 5. $\frac{5a + ab^2}{\sqrt{a^2+9}}$	**02**	**CS101.1** **CS101.2** **CS101.3** **CS101.4** **CS101.5** **CS101.6**
II	3. C program to check a given number is odd or even and positive or negative. 4. C program to read three numbers and find the greatest one.	**02**	
III	5. C program to read five numbers and find the second smallest number. 6. C program to find GCD and LCM of two numbers.	**02**	
IV	7. C program to store ten numbers in an array and find the largest and smallest. 8. C program to store N numbers in an array and count the total positive, negative, odd and even numbers [0 < N < 11].	**02**	
V	9. C program to check whether a given number is prime or not. 10. C program to print first N numbers of Fibonacci series.	**02**	
VI	11. C program to find a key from n numbers using sequential search (Linear search), and if found, show the position. 12. Implementation of an algorithm to insert an element at any arbitrary position in an array of integer numbers and also the implementation of an algorithm to display the condition of the array before and after insertion.	**04**	
VII	13. Implementation of an algorithm to delete an element in an array of integer numbers and also the implementation of an algorithm to display the condition of the array before and after deletion. 14. Implementation of an algorithm to reverse the elements of an array of integer numbers and also the implementation of an algorithm to display the condition of the array before and after reversal.	**04**	
VIII	15. C program to solve Tower of Hanoi problem for n disks. 16. C program to generate n Fibonacci numbers using both recursive and non-recursive methods.	**04**	
IX	17. C program to implement a swap function to swap the values of two variables. 18. C program to store the name, roll number, marks and grades of 5 students using array of structure.	**04**	
X	19. C program to create a file named "StudentDatabase" and storing the name, roll number, phone number and average marks of N students, where N is a natural number between 2 to 10.	**02**	
	Total Hours	**28**	

Essential Readings

1. E. Balagurusamy, "Programming in ANSI C", McGraw-Hill Education, 8th edition, 2019.

2. V. Rajaraman, “Fundamentals of Computers”, PHI Learning, 6th revised edition, 2014.
3. Yashavant Kanetkar, “Let Us C”, BPB Publications, 19th edition, 2022.

Supplementary Readings

1. Byron S. Gottfried, “Programming with C”, McGraw-Hill Education, 4th edition, 2018.
2. Brian W. Kernighan, Dennis M. Ritchie, “The C Programming Language: ANSI C Version”, Pearson Education India, 2nd edition, 2015.
3. Darrel L. Graham, “C Programming Language”, Createspace Independent Publishing, 1st edition, 2016.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE 101	**Engineering Graphics**	**-----**	**0**	**1**	**3**	**2**	**50**	**50**	**100**	**200**

Course Objectives

- To develop the student's ability to understand the role and importance of technical drawings in engineering drawing process, and application of BIS and ISO conventions.
- To develop the student's ability to understand the proper representation and practice of Lines, Lettering, and dimensioning.
- To develop student's ability to understand the importance of types of scales.
- To develop the student's ability to construct plane geometry.
- To develop the student's ability to understand the concepts of projection and their application in technical drawing.
- To develop the student's ability to apply projection technique to draw Multi-view, pictorial view (Isometric View) drawings.
- To develop the student's ability to understand development process of surfaces of various objects.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CE101.1	Able to acquire knowledge about BIS conventions and it's application to draw letters, lines and dimensions.	Knowledge Application
CE101.2	Able to acquire knowledge about developing various types of scales associated with engineering drawing and it's application.	Knowledge Application
CE101.3	Able to acquire knowledge about constructing points, lines, curves, polygons, planes, solids etc. and it's application.	Knowledge Application
CE101.4	Able to acquire knowledge about the system of projection with respect to the observer, object, the reference planes and it's application.	Knowledge Application
CE101.5	Able to acquire knowledge about creating orthographic, isometric, multi-view drawing, and sectional views of objects and it's application.	Knowledge Application
CE101.6	Able to acquire knowledge about the development process of surfaces of various objects and it's application.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE101.1	2	2	2		2				1	3		1	3		
CE101.2	2	2	2		2				1	3		1	3		
CE101.3	2	2	2		2				1	3		1	3		
CE101.4	2	2	2		2				1	3		1	3		
CE101.5	2	2	2		2				1	3		1	3		
CE101.6	2	2	2		2				1	3		1	3		
CE101	**2**	**2**	**2**		**2**				**1**	**3**		**1**	**3**		

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Importance of Engineering Drawing, drawing Instruments and materials, B.I.S. and ISO conventions, Lines, Lettering, and Dimensioning	**02**	**CE101.1**
II	**Scales:** Construction of scales – plane scale, diagonal scale, Vernier scale, functional scale; concept of conversion scale and nomogram	**02**	**CE101.2**
III	**Plane Geometry:** Geometrical Construction: line, arc, and angle, divisions of straight line and circumference, construction of polygon	**02**	**CE101.3**
IV	**Conic Sections and other Curves:** Construction of Ellipse, Parabola, Hyperbola, Rectangular Hyperbola, Cycloidal Curves: Cycloid, Involute	**02**	**CE101.3**
V	**Projection:** Principle of Projection and Orthographic Projection, Projection of points and lines, Projection of Planes.	**03**	**CE101.4**
VI	**Solid Geometry:** Types of Solids: polyhedral, prisms, pyramids, cylinder, cone, sphere, auxiliary projection method, Orthographic projection of solids: one view, two view and three view drawings, Missing view, rules for selection of views.	**03**	**CE101.4**
VII	Sectional view, section plane perpendicular to the HP & VP and other Various positions, true shape of sections.	**03**	**CE101.4**

VIII	Classification, line of intersection, line/generator method and section plane method: intersection of two prisms, two cylinders, intersection of cone and cylinder	**03**	**CE101.4**
IX	Terminology, isometric scale, isometric view and isometric projection, isometric axes, and lines, missing view	**02**	**CE101.5**
X	Method of development, parallel line development, radial line development, developments of cylinder, cone, prism, pyramid, true length of edges – oblique surface.	**02**	**CE101.6**
XI	Introduction to CAD software	**04**	**All COs**
Total Hours		**28**	

Essential Readings

1. N.D. Bhatt, Engineering Drawing, Chrotar Publishing House, 2011.
2. Dhananjay A Jolhe, Engineering drawing, TMH, 2008
3. M.B. Shah and B.C. Rana, Engineering Drawing, Pearson, 2009.

Supplementary Readings

1. T E French, C J Vierck and R J Foster, Graphic Science and Design, 4th edition, McGraw Hill, 1984
2. W J Luzadder and J M Duff, Fundamentals of Engineering Drawing, 11th edition, Prentice-Hall of India, 1995.
3. K Venugpoal, Engineering Drawing and Graphics, 3nd edition, New Age International, 1998.
4. Gary R. Bertoline, Eric N. Wiebe, Nathan W. Hartman, William A. Ross, Technical graphics Communication, 4th Edition, McGraw Hill Higher Education, 2009
5. Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, Cindy M. Johnson Technical Drawing With Engineering Graphics, 15th Edition, Prentice Hall, 2016
6. SP 46: 2003, Engineering Drawing Practice for schools and colleges.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-25**
Department	**Humanities and Social Sciences**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
HS151	**Communication Skills**	**Nil**	**0**	**1**	**2**	**2**	**01 Experiment X 10**	**100**

Course Objectives		Course Outcomes	COs	Statement	Bloom's Taxonomy
	To introduce the basic concepts of communication		HS151.1	Describe and apply the skill of listening in Communicative English	Apply
	To improve English communication skills of students which are essential to succeed in today's business environment.		HS151.2	Demonstrate good reading skills in English	Apply
	To improve oratory skills and body language		HS151.3	Demonstrate good writing skills in English	Apply
	To develop the ability to critically analyze topics and contexts independently or in groups		HS151.4	Demonstrate good oratory skills in English	Apply

	Mapping with Program Outcomes (POs)													Mapping with PSOs	
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS151.1	-	-	-	-	-	-	-	-	1	3	-	3			
HS151.2	-	-	-	-	-	-	-	-	1	3	-	3			
HS151.3	-	-	-	-	-	-	-	-	1	3	-	3			
HS151.4	-	-	-	-	-	-	-	-	1	3	-	3			
HS151	-	-	-	-	-	-	-	-	1.0	3.0	-	3.0			

SYLLABUS

No.	Activities/Experiments	Hours	COs
I	Short speeches or other audio files: Listening; Conversing with the teacher or other students; Writing a summary; Speaking and recording of important points	6	HS151.1
II	Short movies or other video files: Watching; Conversing with the teacher or other students; Writing a summary; Speaking and recording of important points	6	HS151.1
III	Unseen comprehension: Reading passages or essays; Conversing with the teacher or other students; Writing a summary or answering questions	6	HS151.2
IV	Written composition: Writing paragraphs and argumentative and narrative essays; Letter writing–official, personal, job application; Notice writing; Reports	12	HS151.3
V	Oratory: Greetings & introductions; Extempore; Debate; Group discussion; Individual/group seminar presentations; Vocabulary building; Taking and giving interviews; pronunciation skills exercises	12	HS151.4
	Total Hours	**42**	

Essential Readings

1. C. Muralikrishna and Sunita Mishra, *Communication Skills for Engineers*, Pearson, 2nd Edition, 2011.
2. Nitin Bhatnagar and Mamta Bhatnagar, *Communicative English for Engineers and Professionals*, Pearson, 2010.

Supplementary Readings

1. J. K. Gangal, *A Practical Course for Developing Writing Skills in English*, PHI, 2011.
2. John Seely, *Oxford Guide to Effective Writing and Speaking*, Oxford University Press, 3rd Edition, 2013.
3. Sanjay Kumar and Pushp Lata, *Communication Skills*, Oxford University Press, 2nd Edition, 2015.

Second Semester Courses

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Mathematics**	Semester	**II**

Course Code	Course Name	Pre-requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
MA 102	**Engineering Mathematics-II**	**NIL**	**3**	**1**	**0**	**4**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	1. To introduce the fundamental concepts of various engineering mathematics tools involving integral transforms, differential equations and complex variables.		MA102.1	Able to **describe** the basic concepts of Fourier series, Fourier transform, Laplace transform and their applications.	**Understand**
			MA102.2	Able to **solve** ordinary differential equations analytically and **implement** the ODEs to model real world problems.	**Apply**
	2. To develop problem-solving and critical thinking skills in engineering mathematics.		MA102.3	Able to **compare** second order PDEs and **solve** Laplace, heat and wave equations using Fourier series.	**Analyze** **Apply**
			MA102.4	Able to **recognize** analytic functions, **solve** contour integrals and **determine** the Taylor and Laurent series expansions.	**Understand** **Apply**
			MA102.5	Able to **use** the basic knowledge of engineering Mathematics in solving real-world problems .	**Apply**
			MA102.6	Able to **apply** Gauss' divergence theorem, Stokes' theorem and Green's theorem to evaluate double and triple integrals	**Apply**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA102.1	**3**														
MA102.2	**3**														
MA102.3	**3**														
MA102.4	**3**														
MA102.5	**3**														
MA102.6	**3**														
MA102	**3**														

SYLLABUS

No.	Content	Hours	COs
I	**Integral Transforms:** Fourier series of a function with arbitrary period, Fourier series of even and odd functions, half-range Fourier series, Fourier Transform: Fourier integral theorem, Fourier sine and cosine integrals, complex form of Fourier integral, Fourier transform of derivative of a function, applications of Fourier transform in boundary value problems; Laplace Transform: Laplace transform of a function, existence theorem, Laplace transform of derivatives and integrals, inverse Laplace transform, convolution theorem.	**13**	**MA102.1** **MA102.5**
II	**Ordinary Differential Equations:** First order ordinary differential equations: exact, integrating factors, linear and Bernoulli's equations, Higher order differential equations with constant coefficients, Cauchy-Euler equations, method of variation of parameters, system of differential equations. Use of Laplace and Fourier transform in solving ordinary differential equations**.**	**12**	**MA102.2** **MA102.5**
III	**Partial Differential Equations:** First order partial differential equation: linear, semi-linear, quasi-linear, and non-linear types. Classification of integrals. Lagrange's method of solution and its geometrical interpretation, compatibility condition, Charpit's method, special types of first order equations. Method of separation of variables to solve Wave equation, Laplace equation, Heat equation. Use of Laplace and Fourier transform in solving partial differential equations**.**	**13**	**MA102.2** **MA102.5**
IV	**Complex Analysis:** Basic concept of complex numbers, limits, continuity and differentiability of a complex valued function of a complex variable, analytic functions, Cauchy-Riemann Equations, harmonic functions, complex exponential, trigonometric, hyperbolic and logarithmic functions, line integral in complex plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Taylor and Laurent series, singularities.	**12**	**MA102.4** **MA102.5**
V	**Vector Calculus:** Gradient, divergence, curl; Green's theorem; Gauss' divergence theorem; Stokes' theorem.	**06**	**MA102.6**
	Total Hours (5 Modules)	**56**	

Essential Readings

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th edition 2023.
2. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2019.

Supplementary Readings
1. P. Dyke, “An Introduction to Laplace Transforms and Fourier Series”, Springer Nature; 2nd edition, 2014.
2. Shepley L. Ross, “Differential Equations”, John Wiley & Sons, Inc, 3rd edition 2007.
3. S. J. Farlow, “Partial Differential Equations for Scientist and Engineers”, Dover Publications, 2003.
4. J. W. Brown and R. V. Churchill, “Complex Variables and Applications”, McGraw Hill; 9th edition, 2021.

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CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-2025**
Department	**Physics**	Semester	**I/II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
PH101	**Engineering Physics**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To understand the concepts of fundamentals of em wave, vectors, vector calculus and its relevance to science and engineering	Course Outcomes	PH101.1	Able to gain the **knowledge** of electromagnetism **applied** to Engineering concepts	Understanding Applying
	To introduce various concepts of special theory of relativity		PH101.2	Able to gain the **knowledge** of special theory of relativity	Understanding
	To introduce various concepts of different optical phenomena observed in nature.		PH101.3	Able to gain the **knowledge** about Geometrical and Physical Optics and its **applications**.	Understanding Applying
	To introduce the developments of Quantum Physics in the beginning of 20th century and the development thereafter.		PH101.4	Able to understand the **concepts** and theories of 20-th century Physics and its **applications**.	Understanding Applying

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PH101.1	**3**	**2**													
PH101.2	**3**	**2**													
PH101.3	**3**	**2**													
PH101.4	**3**	**2**													
PH101	**3**	**2**													

SYLLABUS

No.	Content	Hours	COs
I	**Electromagnetism**: Vector calculus**,** Gauss's law and its applications, divergence and curl of electrostatic fields, electrostatic potential. Lorentz force, Biot-Savart and Ampere's laws and their applications, divergence and curl of magnetostatic fields, force and torque on a magnetic dipole, motional EMF, Faraday's law, Lenz's law, Maxwell's equations, Postulates of Special theory of relativity, Lorentz transformation, time dilation, length contraction.	**14**	**PH101.1, PH101.2**
II	**Optics:** Interference - coherence, principle of superposition, Young's double slit experiment, Newton's rings, diffraction - Fresnel and Fraunhofer diffracting, grating and its usages, polarization, Malus' law, polarization by reflection and Brewster's law.	**14**	**PH101.3**
III	**Modern Physics:** Old quantum theory, black body radiation, Planck's law, photoelectric effect, Compton effect, de-Broglie's hypothesis, Heisenberg uncertainty principle, wave packet, group and phase velocities, postulates of Quantum mechanics. Schrödinger's equation, application in 1-dimension: particle in a box.	**14**	**PH101.4**
	Total Hours	**42**	

Essential Readings

1. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers with Modern Physics", CENGAGE Learning Custom Publishing, 10th edition, 2017.
2. Paul G. Hewitt, "Conceptual Physics", Pearson, 13th edition, 2022.

Supplementary Readings

1. J. C. Morrison, Modern Physics for Scientists and Engineers, Elsevier; 2nd edition, 2015.
2. M. Mansfield and C. O'Sullivan, "Understanding Physics", Wiley-Blackwell; 3rd Edition, 2020.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-2025**
Department	**Physics**	Semester	**I/II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Assessment		Total
PH 151	**Engineering Physics Laboratory**	----------	**0**	**0**	**2**	**1**	**01 Experiment**	**10**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To understand the fundamentals of electromagnetism		PH151.1	Able to gain the **knowledge** of electromagnetism **applied** to Engineering	Understanding Applying
	To understand various concepts of Optical phenomena in Physics and Engineering		PH151.2	Able to gain the **knowledge** about Geometrical and Physical Optics	Understanding
	To understand the fundamentals of General Physics		PH151.3	Able to **understand** the concepts of General Physics and its **applications**	Understanding Applying
	To understand the fundamentals of Semiconductor Physics		PH 151.4	Able to gain the **knowledge** of Semiconductor Physics and its **applications**	Understanding Applying

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PH 151.1	**3**	**2**													
PH 151.2	**3**	**2**													
PH 151.3	**3**	**2**													
PH 151.4	**3**	**2**													
PH 151	**3**	**2**													

SYLLABUS

S. No.	Title of the Experiment	Hours	COs
I	To verify inverse square law (using a point source of light)	**02**	**PH 151.1**
II	To verify Coulomb's Law of force between two electric poles	**02**	
III	To determine the variation of magnetic field along the axis of the current carrying coil	**02**	
IV	To find resonance frequency in series and parallel LCR circuit	**02**	
V	To find the refractive index of prism by measuring angle of prism and angle of minimum deviation	**03**	**PH 151.2**
VI	Determination of wavelength of monochromatic light (LASER) using Fresnel Biprism	**02**	
VII	To determine the wavelength of sodium light by measuring the diameters of Newton's rings	**03**	
VIII	To determine the wavelength of LASER using Diffraction grating	**02**	
IX	To find the refractive index of a glass plate & water by using a travelling microscope	**02**	
X	To determine frequency of A.C. Mains using sonometer	**03**	**PH 151.3**
XI	To determine the Young's modulus of elasticity of the material of a sample beam by bending	**02**	
XII	I-V characteristic curve of a P-N junction in forward bias and reverse bias	**02**	**PH 151.4**
XIII	Half-wave rectifier circuit without and with filter (HWR)	**02**	
XIV	Evaluation and Viva of all experiments	**03**	**PH 151.1, PH 151.2, PH 151.3, PH 151.4**
XV	Laboratory written test	**01**	**PH 151.1, PH 151.2, PH 151.3, PH 151.4**
	Total Hours (for any 10 experiments from Sl. No. I to XIII)	**27**	

Essential Readings

1. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers with Modern Physics", CENGAGE Learning Custom Publishing, 10th edition, 2017.
2. Paul G. Hewitt, "Conceptual Physics", Pearson, 13th edition, 2022.
2.D. J. Griffiths, "Introduction to Electrodynamics", Prentice-Hall of India, 5th Edition, 2023
3.A. Ghatak, "Optics", Tata McGraw-Hill, 7th Edition, 2020

Supplementary Readings

1. D. Kleppner, and R. J. Kolenkow, "An Introduction to Mechanics", Cambridge University Press, 2nd Edition, 2021.
2. R. Eisberg, and R. Resnick, "Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles", Wiley, 2nd Edition, 2006

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology (All branches)**	Year of Regulation	**2024-2025**
Department	**Chemical and Biological Sciences**	Semester	**II**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CB 102	**Environmental Science**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

			COs		**Bloom's taxonomy**
Course Objectives	To introduce students to natural resources and the impact of various human activities on natural resources and the environment.	Course Outcomes	CB102.1	The students will be able to discuss various types of natural resources, their proper utilization, and conservation for maintaining ecological balance.	**Understand**
	To provide basic knowledge about the environment and its related socio-economic problems, environment protection, and environment improvement programs.		CB102.2	Able to analyze the impacts of various types of pollutants on the environment and provide a proper scientific and technical solutions to control them.	**Analyze**
	To study the causes and effects of air, and water pollution and the techniques for monitoring air and water quality in the environment.		CB102.3	Able to apply different techniques to manage solid wastes and recovery of useful materials from wastes.	**Apply**
	To provide basic knowledge and overview of solid waste management and its impact on human health and surrounding environments.		CB102.4	Able to understand the features of renewable energy resources and their importance for sustainable development.	**Understand**

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CB102.1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
2	CB102.2	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
3	CB102.3	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
4	CB102.4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
	CB102							2								

SYLLABUS

No.	Content	Hours	COs
I	**Natural resources:** Scope and importance, concept of sustainability and sustainable development. Land resources- Land degradation, soil erosion and desertification. Deforestation; impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water- Surface and ground water, floods, droughts, population growth, and associated problems.	**05**	CB102.1 CB102.2
II	**Human communities and the Environment:** Demography, population, population explosion and population control, family welfare programs, resettlement and rehabilitation of affected persons, case studies. Disaster management- flood, earthquake, cyclones and landslides. Environmental movements – Chipko, Silent valley and Bishnois of Rajasthan. Environmental ethics, environmental conservations, public awareness. Environmental Protection Acts.	**04**	CB102.1
III	**Air pollution:** Source and effect of pollutants, primary and secondary pollutants, control measures. Acid rain and its impacts. Green-house effects and their impact on global climate change. Depletion of the ozone layer and its effects. Air pollution monitoring techniques. **Water pollution:** Natural water, pollutants- their origin and effects, oxygen demanding wastes, pathogens, nutrients, salts, heavy metals, pesticides, volatile organic compounds. River/ lake/ ground water pollution. Water pollution monitoring techniques	**08**	CB102.2
IV	**Solid Waste Management:** Municipal, industrial, commercial, agricultural, hazardous solid wastes, recovery and conversion method of waste and waste management, land filling/disposal, incineration, composting. Environment management and sustainability tools (material management and recovery planning) for sustainable management including ISO, RIOS & R2 certifications, environment audit. E-waste- composition and generation, global context in e- waste, effects of pollutant (E- waste) on human health and surrounding environment, e-waste control measures, steps in recycling and recovery of materials from e-waste.	**07**	CB102.3
V	**Energy Resources:** Renewable and non-renewable energy sources, use of alternate energy sources [solar energy, hydro (tidal) energy, wind energy, geothermal, biomass, nuclear energy).	**04**	CB102.4
	Total Hours	**28**	

Essential Readings

1. A. Basak, "Environmental Studies", 2nd Edition, Pearson, 2015.
2. D. Dave and S.S. Katewa, "Text Book of Environmental Studies", Cenage Learning, 2nd Edition, 2012.

Supplementary Readings

1. R. Daniels and J. Khrishnaswamy, "Environmental Studies", 1st Edition, Wiley, 2009.
2. A. Khan, Inamuddin, A. M. Asiri "E-waste Recycling and Management", Springer Nature Switzerland AG, 2020

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CURRICULUM

Programme	**Bachelor of Technology in Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering & Electronics and Communication Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE102	**Basic Electrical & Electronics Engineering**	**No**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- To understand basic circuit theorems and laws
- To develop the skills to analyze the basic DC/AC system
- To introduce the principle of semiconductor physics
- To understand the concept of diode and its applications
- To understand the fundamentals of Bipolar Junction Transistors

Course Outcomes

CO's	Statement	Bloom's Taxonomy
EE102.1	Acquire knowledge of circuit theorems, understand and apply circuit theorems to DC circuits	Knowledge Application
EE102.2	Understand the laws of electricity and magnetism and apply them in simple circuits	Knowledge Synthesis
EE102.3	Analyze single phase AC circuits for voltage and circuit and calculate complex power	Comprehension Application
EE102.4	Able to acquire knowledge about the fundamentals of semiconductor physics.	Knowledge Synthesis
EE102.5	Able to gather knowledge about diode and its applications.	Knowledge Application
EE102.6	Able to understand the Bipolar Junction Transistors	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE102.1	**3**	**3**	**1**	**1**	**1**	**2**	**1**					**2**		**2**	**3**
EE102.2	**3**	**2**	**2**	**1**	**1**	**2**	**2**					**2**		**2**	**3**
EE102.3	**3**	**3**	**1**	**2**	**2**	**2**	**1**					**2**		**2**	**3**
EE102.4	**3**	**2**	**2**	**1**	**1**	**1**	**1**					**2**	**2**	**2**	**3**
EE102.5	**3**	**2**	**2**	**1**	**1**	**1**	**1**					**2**	**2**	**2**	**3**
EE102.6	**3**	**2**	**2**	**1**	**1**	**1**	**1**					**2**	**2**	**2**	**3**
EE102	**3.00**	**2.33**	**1.67**	**1.17**	**1.17**	**1.50**	**1.17**					**2.00**	**2.00**	**2.00**	**2.40**

SYLLABUS

No.	Content	Hours	COs
I	**Analysis of DC circuits** Mesh, node, branch, Ohm's law, series and parallel circuit, basic devices: resistors, capacitors, inductors, dependent and independent sources, Kirchhoff's Laws, Mesh and Node Analysis, Star-Delta conversion, Superposition theorem, Source conversion, Thevenin theorem, Norton theorem, Maximum power transfer theorem.	**07**	**CO1**
II	**Electromagnetic Induction & Magnetic Circuit** Magnetic field, Right hand rule, Left hand rule, Electromechanical laws, relation between electricity and magnetism, production of emfs (ac & dc), Faraday's law of electromagnetic induction, direction of induced emf, Lenz law, dynamically and statically induced emfs, self-inductances, and mutual inductances, coefficient of coupling, Inductance in series and parallel, energy stored in a magnetic field.	**07**	**CO2**
III	**A.C Fundamentals and R.L.C circuits** Phasors, Complex quantities, Application of complex algebra to A.C circuit, series and parallel RL, RC, RLC circuit, concept of impedance triangle, complex power: active, reactive and apparent power, power triangle, admittance triangle, series parallel circuit. Balanced two phase and three phase systems, Balanced Star-Delta connections, phase and line currents and voltages and their relations, Measurement of three phase power.	**07**	**CO3**
IV	**Introduction to Semiconductors:** Fundamentals of semiconductor, Energy Bandgap, intrinsic and extrinsic semiconductors, Mobility, Conductivity & Resistivity.	**05**	**CO4**
V	**Diodes & applications**: Physical structure and working mechanism of the p-n junction, p-n junction under forward & reverse bias, I/V characteristics, Half wave & full-wave, bridge rectifiers.	**08**	**CO5**
VI	**Bipolar Junction Transistors:** Physical structure and working mechanism of BJT transistors, Input Output characteristics, Regions of operation, Transistor configurations: CB, CE, CC.	**08**	**CO6**
	Total Hours	**42**	

Essential Readings

1. A. Hussain, Fundamental of Electrical Engineering, Dhanpat Rai & Co. Ltd., 3rd edition, 2007.
2. W.H. Hayt, J.E. Kemmerley, Engineering circuit analysis, Int. St. Ed. McGraw Hill, 8th edition 2013

3. D. Chattopadhyay, P.C. Rakshit, Electronics Fundamentals and Applications, New Age International Publisher, 7th Edition 2006

Supplementary Readings

1. A. Chakroborty, S. Nath and C.K. Chanda, YBasic Electrical EngineeringZ, McGraw Hill Education Pvt. Ltd., 1st Edition, 2009.
2. V.N Mittle, Basic Electrical Engineering, Tata McGraw Hill, 2nd edition 2017.
3. A. Malvino, Electronics Principles, Tata McGraw-Hill, 7th Edition, 2017.
4. T.L. Floyd, Electronics Devices, Publisher: Pearson Education, 9th Edition,2017.
5. https://onlinecourses.nptel.ac.in/noc21_ee55/preview

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	”ear of Regulation	**2024-25**
Department	**Electrical Engineering & Electronics and Communication Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE152	**Basic Electrical and Electronics Engineering Lab**	**EE**	**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To understand basic circuit theorems and laws		EE152.1	Acquire knowledge of circuit theorems, understand and apply circuit theorems to DC circuits	Knowledge Application
	To develop the skills to analyze the basic DC/AC system		EE152.2	Understand the laws of electricity and magnetism and apply them in simple circuits	Knowledge Synthesis
	To develop the student's ability to apply the basic principles of electronics in circuit designing		EE152.3	Analyze single phase AC circuits for voltage and circuit and calculate complex power	Comprehension Application
	To develop the student's ability to design circuits based on diode		EE152.“	Verify the V-I characteristics of the basic diodes	Knowledge Application
	To develop the student's ability to study characteristics of BJT		EE152.5	Study the operational mechanism of diode circuits as a rectifier	Knowledge Application
			EE152.6	Study the characterises of BJT	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO“	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO“
EE102.1	**3**	**3**	**1**	**1**	**1**	**2**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**0**
EE102.2	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**0**
EE102.3	**3**	**3**	**1**	**2**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**0**
EE102.4	**3**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**	**2**	**0**
EE102.5	**3**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**	**2**	**0**
EE102.6	**3**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**	**2**	**0**
EE102	**3.00**	**2.33**	**1.67**	**1.17**	**1.17**	**1.50**	**1.17**					**2.00**	**1.00**	**2.00**	**2.40**	

SYLLABUS

No.	Content	Hours	COs
1	Study and verification of Kirchhoff's Current Law & Kirchhoff's voltage law applied to D.C. circuit.	**02**	**CO1**
2	To Study & Verify the Maximum Power Transfer theorem.	**02**	**CO1**
3	To find the inductance of the choke coil.	**02**	**CO2**
“	To study the R-L-C series circuit.	**02**	**CO3**
5	To study three-phase power measurement using The two-wattmeter method.	**02**	**CO3**
6	I-V characteristics of forward biased P-N junction Diode.	**02**	**CO4**
7	Reverse characteristics of 4ener Diode.	**02**	**CO4**
8	Half-wave rectifier using diode.	**02**	**CO5**
9	Full-wave rectifier using diode.	**02**	**CO5**
10	Input & output characteristics of BJT in CE mode.	**02**	**CO6**
	Total Hours	**20**	

Essential Readings

1. A. Hussain, Fundamental of Electrical Engineering, Dhanpat Rai & Co. Ltd., 3rd edition, 2007.
2. W.H. Hayt, J.E. Kemmerley, Engineering circuit analysis, Int. St. Ed. McGraw Hill, 8th edition 2013
3. D. Chattopadhyay, P.C. Rakshit, Electronics Fundamentals and Applications, New Age International Publisher, 7th Edition 2006

Supplementary Readings

“. A. Chakroborty, S. Nath and C.K. Chanda, YBasic Electrical EngineeringZ, McGraw Hill Education Pvt. Ltd., 1st Edition, 2009.
5. V.N Mittle, Basic Electrical Engineering, Tata McGraw Hill, 2nd edition 2017.
6. A. Malvino, Electronics Principles, Tata McGraw-Hill, 7th Edition, 2017.
7. T.L. Floyd, Electronics Devices, Publisher: Pearson Education, 9th Edition,2017.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2024-25**
Department	**Mechanical Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisites	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Evaluation	Total
ME 152	**Workshop practice**	**--**	**0**	**0**	**2**	**1**	**100**	**100**

Course Objectives			CO's	Statement	Bloom's Taxonomy
	Explain the tools, equipment and safety procedures of carpentry, fitting, welding and foundry shops. (Understanding).	Course Outcomes	ME152.1	Utilize the tools and equipment to perform specified jobs in fitting shop and compare with prescribed dimensions.	Applying
			ME152.2	Utilize the tools and equipment to perform specified jobs in carpentry shop and compare with prescribed dimensions.	Applying
			ME152.3	Utilize the tools and equipment to perform specified jobs in welding shop and compare with prescribed dimensions.	Applying
			ME152.4	Utilize the casting process to develop the prescribed job	Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO 3
ME152.1	2	1				2			2				2	1	
ME152.2	2	1				2			2				2	1	
ME152.3	2	1				2			2				2	1	
ME152.4	2	1				2			2				2	1	
ME152	**2**	**1**				**2**			**2**				**2**	**1**	

SYLLABUS

No.	Content	Hours	COs
I	To perform T-join with drilling in the centre in the fitting with the use of specific tools	**07**	**ME152.1**
II	To develop cross join/dovetail join/ briddle join in carpentry shop with the use of specific tools	**07**	**ME152.2**
III	To develop T-join Oxy-acetylene gas welding	**07**	**ME152.3**
IV	To make specific job using casting process	**07**	**ME152.4**
	Total Hours	**28**	

Essential Readings

1. S.K. Hajra Chaudhary, Elements of Workshop Technology Vol-I and II, Asia Publishing House, 2008

Supplementary Readings

1. K.N. Gupta, J. P. Kaushish, Workshop Technology, New Delhi Heights Publications, 1992
2. H.S. Bava, Workshop Technology, Tata McGraw Hill Publishing Co. Ltd., 2nd Edition, 2009
3. W.A.J. Chapman, Workshop Technology, ELBS Low Price Text, Edward Donald Pub. Ltd., 5th Edition, 1972

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CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-25**
Department	**Humanities and Social Sciences**	Semester	**II**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
			2	**0**	**0**	**2**	**50**	**50**	**100**	**200**
HS102	**Creativity, Innovation and Entrepreneurship**	**Nil**		**COs**	**Statement**				**Bloom's Taxonomy**	
Course Objectives	To introduce the basic aspects of creativity, innovation and entrepreneurship		Course Outcomes	HS102.1	Describe the basic concepts of creativity, innovation and entrepreneurship				Understand	
	To familiarize the importance of creativity, innovation, and entrepreneurship			HS102.2	Describe and illustrate the importance of creativity				Apply	
	To discuss the role and importance of creativity, innovation, and entrepreneurship for social development			HS102.3	Describe and illustrate the importance of innovation				Apply	
	To discuss the stages of the entrepreneurial process for the successful development of entrepreneurial projects			HS102.4	Describe and illustrate the importance of entrepreneurship				Apply	

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
HS102.1	-	-	1	-	1	2	2	-	3	2	3	2			
HS102.2	-	-	1	-	1	2	2	-	3	2	3	2			
HS102.3	-	-	3	-	1	2	2	-	3	2	3	2			
HS102.4	-	-	3	-	1	2	2	-	3	2	3	2			
HS102	-	-	2.0	-	1.0	2.0	2.0	-	3.0	2.0	3.0	2.0			

SYLLABUS

No.	Content	Hours	COs
I	Meaning and definition of creativity, innovation, and entrepreneurship; Relation between creativity, innovation, and entrepreneurship; Differences between creativity and innovation; Differences between creativity and entrepreneurship; Differences between innovation and entrepreneurship; Event funding	06	HS102.1
II	Individual creativity, behaviour and psychological aspects of creativity; Idea generation; Creativity tools and techniques; Creativity in groups	06	HS102.2
III	Innovation and competitive advantage; Framework of innovative strategies; Organizational issues of innovation; Innovation in a competitive environment; Sources of innovation; Innovation selection; Effective implementation of innovative ideas	08	HS102.3
IV	Historical development of entrepreneurship; Types of entrepreneurship; Entrepreneurial opportunities; Entrepreneurial processes; Entrepreneurial strategies; Entrepreneurial practice; Sources of entrepreneurial ideas; Entrepreneurial project; Start-up; Contributions of entrepreneurs in society	08	HS102.4
	Total Hours	**28**	

Essential Readings

1. Pradip N. Khandwalla, *Lifelong Creativity: An Unending Quest*, Tata McGraw Hill, 2004.
2. Vinnie Jauhari and Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014.
3. Robert D. Hisrich et. al. *Entrepreneurship*, McGraw Hill Higher Education, 6th Edition, 2004.

Supplementary Readings

1. D. H. Holt, *Entrepreneurship: New Venture Creation*, Prentice Hall, 1992.
2. Lewrick, M., Link, P., and Leifer, L., *The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods,* John Wiley & Sons, 2020.
3. Hisrich, R. D., Peters, M. P., and Shepherd, D. A., *Entrepreneurship,* New York: McGraw-Hill, 2020.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS152	**Python Programming**		**0**	**1**	**2**	**2**	**70**	**30**	**100**

Course Objectives

- **To introduce programming using Python and to write programs in python on a computer, and to edit, compile, debug, correct, recompile and run those.**
- **To inculcate the ability to do algorithmic thinking to analyze real-world problems and develop algorithms to solve those.**
- **To train the students in choosing right data representation formats based on a problem specification.**

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CS152.1	**Able to understand the basic concepts of scripting and the contributions of scripting language.**	Understand
CS152.2	**Able to develop Python programs with conditionals and loops, functions and calling them.**	Create
CS152.3	**Able to analyse and explore python data structures like Lists, Tuples, Sets and dictionaries.**	Analyze
CS152.4	**Able to develop Python program to read and write data from/to files**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS152.1	3		1		1					1	1	1			
CS152.2	2	3	3	2	1				1					1	
CS152.3	3	3	3	2	1				1					3	
CS152.4	3	2	1	2										1	
CS152	2.75	2.67	2.00	2.00	1.00				1.00	1.00	1.00	1.00		1.67	

SYLLABUS

No.	Content	Hours	COs
I	1. Python program to print the paragraph as shown below: " Hello World " % Hello World % \\ Hello World \\ 2. Python program to print the result of the following arithmetic expression where a=4, b= 5. $\frac{5a+ab^2}{\sqrt{a^2+9}}$	**02**	**CS152.1 CS152.2 CS152.3 CS152.4**
II	3. Python program to check a given number is odd or even and positive or negative. 4. Python program to read three numbers and find the greatest one.	**02**	
III	5. Python program to read five numbers and find the second smallest number. 6. Python program to find GCD and LCM of two numbers.	**02**	
IV	7. Python program to store ten numbers in a list and find the largest and smallest. 8. Python program to store N numbers in a list and count the total positive, negative, odd and even numbers [0 < N < 11].	**02**	
V	9. Python program to check whether a given number is prime or not. 10. Python program to print first N numbers of Fibonacci series.	**02**	
VI	11. Python program to create a menu with the following options 1. TO PERFORM ADDITITON 2. TO PERFORM SUBTRACTION 3. TO PERFORM MULTIPICATION 4. TO PERFORM DIVISION Accepts users input and perform the operation accordingly. Use functions with arguments. 12. Python program to check whether the given string is palindrome or not.	**02**	
VII	13. Python program to find factorial of a given number using functions. 14. Python function that takes two lists and returns True if they are equal otherwise false	**04**	
VIII	15. Python program to open and write "hello world" into a file. 16. Python program to read a csv file using pandas module and print the first and last five lines of a file.	**04**	
IX	17. Python program to open a file and check what are the access permissions acquired by that file using os module. 18. Python program to copy the contents of a file to another file.	**04**	
X	19. Python program to count frequency of characters in a given file. 20. Python program to print each line of a file in reverse order.	**04**	
	Total Hours	**28**	

Essential Readings

1. Mark Lutz, " Programming Python", Prentice Hall India, 7th Edition, 2017
2. Mark Lutz, "Learning Python", McGraw-Hill publication, 6th Edition, 2021
3. Luciano Ramalho, "Fluent Python", O'Reilly Media, 2nd Edition, 2021

Supplementary Readings

1. Allen Downey, "Think Python", O'Reilly Media, 2nd Edition, 2015
2. Marl Pilgrim, "Dive into Python", APress Media LLC, 1st Edition, 2005
3. Brett Slatkin , "Effective Python: 59 Specific Ways to Write Better Python", Pearson Education, Inc, 2nd Edition 2019

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CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-25**
Department	**Humanities and Social Sciences**	Semester	**II**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
			2	**0**	**0**	**2**	**50**	**50**	**100**	**200**
HS104	**Ethics and Morals**	**Nil**								

Course Objectives		Course Outcomes			Bloom's Taxonomy
	To introduce the basic aspects of human values and ethics		HS104.1	Explain the basic aspects of ethics, values, and morals	Understand
	To familiarize a few ethical theories that guide human values and principles		HS104.2	Explain a few theories that guide ethics, values, and morals	Understand
	To discuss a multi-dimensional perspective of human values and ethics		HS104.3	Demonstrate a multi-dimensional perspective of human values and ethics	Apply
	To help in applying the concepts of ethics to personal ethical lifestyle choices and for community well-being		HS104.4	Apply the concepts of ethics to personal ethical lifestyle choices and decision making	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS104.1	-	-	2	-	-	3	2	3	1	1	1	-			
HS104.2	-	-	2	-	-	3	2	3	1	1	1	-			
HS104.3	-	-	2	-	-	3	2	3	1	1	1	-			
HS104.4	-	-	2	-	-	3	2	3	1	1	1	-			
HS104	-	-	2.0	-	-	3.0	2.0	3.0	1.0	1.0	1.0	-			

SYLLABUS

No.	Content	Hours	COs
I	Meaning and definition of ethics, morals, and values; Differences between ethics, morals, and values; Types of ethics; Dimensions of ethics; Ethics in human actions; Role of family, society, and educational institutions in inculcating values	06	HS104.1
II	Theories on ethics; Egoism; Ethical ideologies; Moral development; Moral thinking; Values; Transparent standards; Fair competition; Equal opportunity; Conflict of interest; Code of conduct	08	HS104.2
III	Emotional intelligence and ethics; Corporate social responsibility and consumer protection; Environment ethics; Industry and environment management; Discrimination; Privacy; Surveillance; Coping with failures; Performance appraisals	07	HS104.3
IV	Relationship between attitude, thought and behaviour; Ethics and attitude; Social influence and persuasion; Ethical decision making; Personal values and ethical decision making; Trustworthiness; Respect; Responsibility; Fairness; Integrity	07	HS104.4
	Total Hours	**28**	

Essential Readings

1. R. R. Gaur, R. Sangal and G. P. Bagaria, *A Foundation Course in Human Values and Professional Ethics*, Excel Books, 2010.
2. R. Subramanian, *Professional Ethics*, Oxford University Press, 2nd Edition, 2017.

Supplementary Readings

1. A. Carr, *Positive Psychology: The Science of Happiness and Human Strength*, Brunner-Routledge, 2004.
2. Charles E. Harris et.al. *Engineering Ethics: Concepts and Cases*, Wadsworth Publishing Co. Inc., 5th Edition, 2013.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2024-25**
Department	**Mechanical Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Evaluation	Total
VA 102	**Skill Development and Prototyping**	**-----**	**0**	**0**	**2**	**1**	**100**	**100**

Course Objectives

- To develop basic skills in the field of Electrical and Mechanical Engineering.
- To make students familiar with different electrical, automobile, and plumbing instruments, setups, assembly, and tools.
- To develop basic skills and understanding in 3-D printing technology

Course Outcomes

	CO's	Statement	Bloom's Taxonomy
	VA102.1	Students will be able to design domestic electric circuits and other basic circuits and function of different measuring instruments.	design
	VA102.2	Students will be able to understand the concept of battery charging/discharging systems and construction of machines, its starting, and fabrication of armature coil.	understand
	VA102.3	Students will be able to understand the functioning of different automobile parts and assemblies.	understand
	VA102.4	Students will be able to understand the functioning of different plumbing parts, tools, and assemblies.	understand
	VA102.5	Students will be able to understand the concepts of 3-D printing and its superiority over conventional manufacturing.	understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
VA102.1	3	3	3	2	1	3	3		1		1	1	3	3	2
VA102.2	3	3	3	2	1	1			1		1	1	3	3	3
VA102.3	3	3	2	3	3	3	3		1		1	1	3	3	3
VA102.4	3	3	3	3	3	2	1		1		1	1	3	3	3
VA102.1	3	3	3	2	1	3	3		1		1	1	3	3	2
VA102	**3**	**3**	**2.75**	**2.5**	**2**	**2.25**	**2.33**		**1**		**1**	**1**	**3**	**3**	**2.75**

SYLLABUS

No.	Content	Hours	COs
I	**Electrical Shop:** Study and design different types of electrical wiring with loads, Study the cut- section of different types of AC/DC machines, Design and fabricate an armature coil using a handy coil winding machine, Assembling different parts of the electrical machine and testing its operation, Charging and discharging circuit of Batteries, Familiarization with analog /digital universal IC tester and advanced digital measuring instruments, To study the measurement of earth resistance using an earth tester, Energy measurement using a smart energy meter, Measurement of insulation resistance of cable/machine using insulation tester/megger, Starting of machine using various starters.	**6**	**VA102.1 VA102.2**
II	**Automobile Shop:** Demonstration on the cut section of the single and multicylinder engine (diesel and petrol), anti-lock braking system, constructional view and internal details of common automobile parts, fuel supply system of petrol and diesel engine, and coil ignition and electrical ignition system of an automobile.	**5**	**VA102.3**
III	**Plumbing Shop:** Demonstration on full-scale sewerage system, assembly station pipes, valves and fittings, tools for plumbing (plumbing wrenches, drain tools, and tools and supports for PVC pipes), cut away models of straightway valve, corner valve, angle seat valve, nonreturn valve, pressure reducing valve, strainer, gate valve, straightway plug valve, three ways plug valve, safety valve, screwed pipe connections, changeover valve, nonreturn butterfly valve, and strainer.	**4**	**VA102.4**
IV	**Additive Manufacturing Lab:** Introduction to 3-d printing, additive v/s conventional manufacturing, Engineering graphics, coordinate systems and their transformation, CAD, product design and prototyping, solid modeling and slicing software, STL files, additive manufacturing techniques, FDM printing, printing materials, support materials.	**5**	**VA102.5**
V	**Prototyping:** Circuit designing based on Electrical Shop, prototyping of automobile parts, plumbing tools, and parts, 3-D printing, etc.	**8**	**All COs**
	Total Hours	**28**	

Essential Readings

1. R.P. Singh, 'Electrical Workshop, Dreamtech Press, 3rd Edition, 2019
2. S.L. Uppal, "Electrical Wiring Estimating and Costing", Khanna Publishers, 6th Edition, 2015
3. K. Singh, "Automobile Engineering", Standard Publishers, 2020.
4. U. Rathore, N. K. Sharma, "A Textbook of Electrical Workshop Practices", S.K. Kataria & Sons, 1st Edition 2019
5. C.K. Chua, K. F. Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.

Supplementary Readings

1. R.C. Mullin, P. Simmons, "Electrical Wiring Residential", Cengage Learning, 17th Edition, 2011.

Third Semester Courses

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 201	**Data Structures & Algorithms**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To understand the fundamental concept of data structures and algorithms.**	Course Outcomes	CS201.1	**Students shall be able to understand of basic concepts of dynamic memory management, data types, algorithms, asymptotic notation and basic data structures.**	Understand
	To develop skill for choosing data structures for different applications.		CS201.2	**Students shall be able to design, analyze and implement searching and sorting algorithms using different data structures for various applications.**	Create
	To develop skill for solving problems using algorithm design techniques such as divide and conquer and writing programs for these solutions.		CS201.3	**Students shall be able to find the bugs in programs with data structures, formulate new solutions and improve in existing code using learned algorithms and data structures**	Evaluate
	To develop skill for designing, analyzing, correctness and implementing algorithms using various data structures.		CS201.4	**Students shall be able design of algorithm for representing and implementing nonlinear data structure such as Tree, Graph in real world applications.**	Create
	To implement hashing, linear and nonlinear data structures for real word application as per requirements.		CS201.5	**Students shall be able to analysis of algorithms in terms of space and time complexities for different application using linear and nonlinear data structures.**	Analyse
			CS201.6	**Students shall be able to understand the basic concepts of hashing schemes, collision concepts and implement hashing shames for applications.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS201.1	**3**	**2**	**3**	**2**	**2**			**1**	**2**				**3**	**2**	**3**
CS201.2	**2**	**2**	**3**	**3**	**1**		**1**	**1**	**2**	**1**	**2**	**2**	**2**	**3**	**2**
CS201.3	**1**	**3**	**3**	**2**	**2**		**2**	**2**	**1**	**1**	**2**		**2**	**3**	**3**
CS201.4	**2**	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**
CS201.5	**2**	**2**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**3**	**2**	**3**
CS201.6	**2**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**3**	**2**	**2**
CS201	2.00	2.50	3.00	2.50	1.67	1.00	1.20	1.17	1.33	1.00	2.00	2.00	2.50	2.33	2.67

SYLLABUS

No.	Content	Hours	COs
I	**Introduction & Overview:** Concept of data type, definition and brief description of various data structures, operations on data structures, algorithm complexity, Big Oh notation, recursion, some illustrative examples of recursive functions. **Review of Pointers and Dynamic Memory Management**: Understanding pointers, usage of pointers, memory management functions, debugging pointers. **Arrays:** Linear and multi-dimensional arrays and their representation, operations on arrays, sparse matrices and their storage.	**10**	**CS201.1, CS201.2**
II	**Linked Lists:** Linear linked list, operations on linear linked list, doubly linked list, operations on doubly linked list, application of linked lists. **Stacks:** Sequential and linked representations, operations on stacks, multi stacks, application of stacks such as parenthesis checker, evaluation of postfix expressions, conversion from infix to postfix representation, implementing recursive functions. **Queues:** Sequential representation of queue, linear queue, circular queue, operations on linear and circular queue, linked representation of a queue and operations on it, priority queues, applications of queues.	**11**	**CS201.2, CS201.3**
III	**Sorting & Searching:** Sorting arrays using bubble sort, selection sort, insertion sort, quick sort, merge sort, heap sort, shell sort, tree sort, radix sort, etc., searching an element using linear search and binary search techniques, concatenation of arrays and merging sorted arrays. **Heaps:** Representing a heap in memory, operations on heaps, application of heap in implementing priority queue and heapsort algorithm.	**05**	**CS201.3, CS201.4**
IV	**Trees:** Basic terminology, array and linked representations of trees, traversing a binary tree using recursive and non-recursive procedures, inserting a new node, deleting a node, counting nodes, finding height, finding a mirror image of a binary tree, threaded binary trees, AVL trees and B-trees. **Graphs:** Basic terminology, representation of graphs (adjacency matrix, adjacency list), traversal of a graph (breadth first search and depth-first search), adding nodes, deleting nodes, applications of graphs in problems such as finding shortest paths, obtaining minimum cost spanning tree, etc.	**10**	**CS201.4, CS201.5**
V	**Hashing:** Comparing direct address tables with hash tables, hash functions, concept of collision and its resolution using open addressing and separate chaining, double hashing, rehashing	**04**	**CS201.5, CS201.6**
	Total Hours	**40**	

Essential Readings

1. Dr. D.S. Kushwaha, Dr. Arun Kumar Mishra, "A Programming approach with C ", 2nd Edition, PHI India, 2014.
2. Seymour Lipschutz, "Data Structures", Revised 1st Edition, Tata McGraw hill Publication, 2013.

3. Mark Allen Weiss, “Data Structures And Algorithm Analysis In C”, 2nd Edition, Pearson Education, 2002.

Supplementary Readings

1. A.K. Sharma,” Data Structures using C”, Pearson, 2011.
2. Yedidyah Langsam, Aaron M. Tenenbaum, Moshe J. Augenstein, “Data Structures Using C and C++, 2nd Edition, PHI, 2011.
3. Kyle Loudon ,“Mastering Algorithms With C Useful Techniques From Sorting To Encryption”1st Edition, O'Reilly, 2009.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 203	**Digital Logic Design**	**……**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- To introduce the concept of digital and binary systems, number representation and conversion between different representations in digital electronic circuits and to acquire the knowledge of digital logic levels and Boolean logic.
- To make students be able to design and analyse combinational logic circuits.
- To make students be able to design and analyse sequential logic circuits.
- To understand the concept of Programmable Devices, RAM, ROM, PLA, PAL.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CS203.1	Able to acquire knowledge about fundamental concepts and techniques used in digital electronics.	Understand
CS203.2	Able to acquire knowledge about the structure of various number systems and its application in digital design.	Understand
CS203.3	Able to design various combinational circuits by understanding and analysing different primitive combinational circuits .	Create
CS203.4	Able to design various combinational circuits by understanding and analysing various basic sequential circuits.	Create
CS203.5	Able to design and develop a digital logic and apply it to solve real life problems.	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS203.1	**3**	**2**	**2**	**1**								**1**	**1**	**1**	**1**
CS203.2	**2**	**1**	**2**	**1**								**1**	**1**	**1**	**1**
CS203.3	**3**	**2**	**2**	**1**								**2**	**1**	**1**	**1**
CS203.4	**3**	**2**	**2**	**1**	**1**							**2**	**1**	**1**	**1**
CS203.5	**3**	**3**	**3**	**1**	**1**							**2**	**2**	**1**	**2**
CS203	**2.8**	**2**	**2.2**	**1**	**1**							**1.6**	**1.2**	**1**	**1.2**

SYLLABUS

No.	Content	Hours	COs
I	Number systems and codes: Addition, Subtraction, Multiplication and Division using Different Number Systems; Representation of Binary Number in Sign-Magnitude, Sign 1's Complement and Sign 2's Complement Notation; Rules for Addition and Subtraction with Complement Representation; BCD, EBCDIC, ASCII, Extended ASCII, Gray and other Codes.	**05**	**CS203.1,CS203.2**
II	Boolean algebra and switching functions : Basic Logic Operation and Logic Gates, Truth Table, Basic Postulates and Fundamental Theorems of Boolean Algebra, Standard Representations of Logic Functions- SOP and POS Forms, Simplification of Switching Functions-K-Map and Quine-Mccluskey Tabular Methods, Synthesis of Combinational Logic Circuits.	**06**	**CS203.1, CS203.5**
III	Combinational logic circuits using msi integrated circuits: Binary Parallel Adder, BCD Adder, Encoder Priority Encoder, Decoder, Multiplexer and Demultiplexer Circuits, Implementation of Boolean Functions using Decoder and Multiplexer, Arithmetic and Logic Units, BCD-To-Segment Decoder, Common Anode and Common Cathode, 7-Segment Displays, Random Access Memory, Read Only Memory and Erasable Programmable ROMs, Programmable Logic Arrays(PLA) and Programmable Array Logic(PAL).	**10**	**CS203.1, CS203.3**
IV	Introduction to flip-flops: Basic Concepts of Sequential Circuits, Cross Coupled SR Flip-Flop Using NAND or NOR Gates, JK Flip-Flop Rise Conditions, Clocked Flip-flops, D-Types and Toggle Flip-flops, Truth Tables and Excitation Tables for Flip-flop. Master Slave Configuration, Edge Triggered and Level Triggered Flip-flop, Elimination of Switch Bounce using Flip-flop, Flip-flop with Preset and Clear.	**08**	**CS203.1,CS203.4**
V	Sequential logic circuit design : Introduction to State Machine, Mealy and Moore Model, State Machine Notation, State Diagram, State Table, Transition Table, Table Excitation, Table and Equation, Basic Concepts of Counters and Register, Binary Counters, BCD Counters, Up Down Counter, Johnson Counter, Module-N Counter, Design of Counter using State Diagrams and Tables, Sequence Generators, Shift Left and Right Register, Registers with Parallel Load, Serial -in-Parallel-Out(SIPO) and Parallel-In-Serial-Out(PISO), Register Using Different Types of Flip-flop.	**10**	**CS203.1, CS203.4**
VI	Digital logic families : Digital IC Terminology, Transistor-Transistor Logic(TTL), Integrated Injection Logic(I2L), Emitter Coupled Logic (ECL), Metal Oxide Semiconductor(MOS) Logic, Complementary Metal oxide semiconductor (CMOS) Logic.	**03**	**CS203.1, CS203.5**
	Total Hours	**42**	

Essential Readings

1. L. Thomas Floyd and R.P. Jain, "Digital Fundamentals", 11th ed., 2017, Pearson Education.
2. Kime Charies R and Morris Mano, "Logic and Computer Design Fundamentals", 5th ed., 2015, Pearson Education.

3. Morris Mano, “Digital Logic and Computer Design”, 1st ed., 2004, Pearson Education.
Supplementary Readings:
1. R.P. Jain and M.H.S. Anand, “Digital Electronics Practice using Integrated Circuits”, 1st ed., 2004, Tata McGraw Hill.
2. Samuel C. Lee, “Digital Circuits and Logic Design”, 2009 edition, PHI (Prentice-Hall of India).
3. Stephen Brown and Zvonko Vranesic, “Fundamentals of Digital Logic with Verilog Design”, 2nd ed., 2017, Tata McGraw Hill.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS205	**Discrete Mathematical Structures**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	1. This course introduces the elementary structures such as sets, graphs, and trees used in computer algorithms and systems. Define and understand the properties of some of the discrete structures in Mathematics.	Course Outcomes	CS205.1	Able to acquire knowledge about different discrete structures of mathematics and identification of its application in computer science area	Understand
	2. This course illustrates elementary proofs, proofs by induction, deductive proofs in propositional and first order logic.		CS205.2	Able to acquire knowledge about different methods of proofs in propositional logic and first order predicate logic and identification of application in real world problems	Understand
	3. This course explains the principles of counting; understand recurrence relations and generating functions.		CS205.3	Able to work out on different problems on counting, recurrence relations and generating functions and solve these problems in real world scenarios	Evaluate
	4. This course illustrates the understand the basic concepts of graphs, group and ring theory		CS205.4	Students will be able to apply discrete structure such as graphs to solve problems of connectivity, scheduling, optimization etc.	Apply
	5. This course introduces the formulation of generating function and series evaluations		CS205.5	Students will be able to interpret recurrence relations and solve them, represent sequences and series using generating functions.	Evaluate

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS205.1	**3**	**3**		**1**					**2**				**3**		**3**
CS205.2	**3**	**3**		**1**					**2**				**2**		**2**
CS205.3	**2**	**3**	**3**	**1**	**2**								**2**	**3**	**2**
CS205.4	**2**	**2**	**3**	**0**	**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
CS205.5	**2**	**2**	**3**	**0**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
CS205	2.40	2.60	3.00	0.60	2.00	2.00	3.00		2.00			1.00	2.40	3.00	2.40

SYLLABUS

No.	Content	Hours	COs
I	Introduction History and Overview of discrete structure and general problems:Basic operations on sets, cartesian products, disjoint union, power sets, inverse of functions, composition of functions, relations, properties of binary relations, equivalence relations and partitions. Principle of inclusion and exclusion, pigeonhole principle	**08**	**CS205.1**
II	Propositional Logic: Syntax and semantics, proof systems, satisfiability, validity, soundness and completeness. Introduction to first order logic.	**08**	**CS205.1**
III	Introduction to recurrence relations and generating functions	**06**	**CS205.1 CS205.2**
IV	Posets, lattices, chains and anti-chains	**05**	**CS205.2 CS205.3 CS205.4**
V	Graphs and their basic properties – degree, path, cycle, subgraphs, isomorphism, Eulerian and Hamiltonian cycles, trees	**05**	**CS205.4 CS205.5**
VI	Groups and Rings: Groups, Subgroups, Cosets, Lagrange's theorem, Homomorphisms and Normal subgroups, Rings.	**08**	**CS205.2 CS205.4**
	Total Hours	**40**	

Essential Readings

1. Trembly, Manohar, "Discrete Mathematical Structures with Applications to Computer Science", McGraw Hill.
2. C. L. Liu, D. P. Mahapatra, "Elements of Discrete Mathematics", Tata McGraw Hill.
3. Harry Lewis and Rachel Zax, "Essential Discrete Mathematics for Computer Science", Princeton University Press, 2019

Supplementary Readings

1. Norman L. Biggs, "Discrete Mathematics", Oxford University Press.
2. Albert R. Meyer, Eric Lehman, and Frank Thomson Leighton, "Mathematics for Computer Science", Samurai Media Limited, 2010

3. V.K. Balakrishnan, “Introductory Discrete Mathematics”, Dover Publications Inc., 2000

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Department	**Computer Science & Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 207	**Computer Organization**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**COB1: To develop the student's ability to understand the concept of Instruction execution model, instruction set architecture and types, instruction formats and Addressing modes.**	Course Outcomes	CS255.1	**Students should be able to Understand how different functional units of a digital computer are organized and design, performance enhancement strategies**	Understand
	COB2: To develop the student's ability to understand the concept of control unit design based on hardwired as well as micro-programmed control approach.		CS255.2	**Students should be able to Solve the performance related problems of arithmetic logic unit, cache and virtual memory.**	Evaluate
	COB3: To provide the students with some knowledge and analysis skills associated with the design of Arithmetic and Logic unit.		CS255.3	**Analyze the performance differences of different mapping techniques of cache memory, different adder circuits of ALU and different page replacement algorithms of virtual memory.**	Analyse
	COB4: To develop the student's ability to understand the concept of memory design, cache memory and its mapping techniques and virtual memory.		CS255.4	**Able to analyzeSynchronization and I/O mechanism of data transfer.**	Analyse
	COB5: To provide the students with some basic knowledge of I/O mapping and control, interrupt and DMA mechanism.				

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS207.1	3	1	1					1	1			2		1	3
CS207.2	3	3	2	2	2			1	1			2	1	1	3
CS207.3	3	3	3	2	2			2	2			2	2	2	3
CS207.4	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
CS207	2.75	2.25	2.25	2	2.00	2.00	3	**1.33**	1.5			1.75	1.67	1.75	2.75

SYLLABUS

No.	Content	Hours	COs
Overview: (Hrs.: 6)	Block diagram of a computer system	**03**	**CS207.1**
	Instruction execution model.	**03**	**CS207.1**
Processor Organization: (Hrs.: 10)	Instruction set architecture- types, formats, addressing modes	**03**	**CS207.1 & CS207.2**
	Data path organization, Control unit design - Hardwired control, Microprogramming.	**04**	**CS207.1 & CS207.2**
	CISC and RISC architecture, Instruction pipelining.	**03**	**CS207.1 & CS207.2**
Arithmetic and Logic unit: (Hrs.: 9)	Computer arithmetic- Review of addition and subtraction	**03**	**CS207.1, CS207.2 & CS207.3**
	Multiplication- Booth's, Array; Division- Restoring and non-restoring	**03**	**CS207.1 & CS207.2**
	Floating point arithmetic	**03**	**CS207.1 & CS207.2**
Memory Organization: (Hrs.: 9)	Interfacing of memory with processor, Memory hierarchy, Multiple-module memory,	**03**	**CS207.1**
	Cache memory, Virtual memory.	**06**	**CS207.1, CS207.2 & CS207.3**
Input/output Organization: (Hrs.: 6)	Synchronization of data transfer- strobed and handshaking;	**02**	**CS207.4**
	I/O mapping and control- Program controlled, Interrupt driven, DMA, Interrupt and DMA mechanisms.	**04**	**CS207.4**
Total Hours		**40**	

Essential Readings

1. Hamacher, Carl, Zvonko Vranesic, and Safwat Zaky. *Computer organization*. McGraw-Hill, 2002.
2. Mano, M. Morris. *Computer system architecture*. Prentice-Hall of India, 2003.
3. Stallings, William. *Computer organization and architecture: designing for performance*. Pearson Education India, 2003.

Supplementary Readings

1. Hennessy, John L., and David A. Patterson. *Computer architecture: a quantitative approach*. Elsevier, 2011.
2. Bryant, Randal E., O'Hallaron David Richard, and O'Hallaron David Richard. *Computer systems: a programmer's perspective*. Vol. 2. Upper Saddle River: Prentice Hall, 2003.
3. Ramachandran, Umakishore. *Computer systems: An integrated approach to architecture and operating systems*. Pearson Education India, 2011.

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Department	**Computer Science and Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 209	**Computer Graphics**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

1. To introduce the use of the components of a graphics system and become familiar with building approach of graphics system components and algorithms related with them.
2. To introduce the mathematical foundation of computer graphics like the basic principles of 2D and 3D concept of computer graphics.
3. To introduce Color perception, color models (RGB model), color transformations.
4. To provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
5. Provide an understanding of mapping from a world coordinates to device coordinates, clipping, and projections.
6. To be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CS209.1	Able to acquire knowledge about the basic concepts used in computer graphics	Understand
CS209.2	Able to describe the mathematical foundation of the concepts like 2D and 3D geometrical concepts of computer graphics.	Understand
CS209.3	Able to implement various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling, clipping.	Apply
CS209.4	Able to describe the importance of viewing and projections.	Understand
CS209.5	Students will be able to acquire knowledge about rasterization: line drawing via Bresenham's algorithm, clipping, polygonal fill etc.	Apply
CS209.6	Students will be able to understand a typical graphics pipeline and 3D modelling.	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS209.1	**2**	**1**		**1**					**2**				**3**		**3**
CS209.2	**1**	**1**		**1**					**2**				**2**		**2**
CS209.3	**1**	**2**	**3**	**1**	**2**								**2**	**3**	**2**
CS209.4		**2**	**3**		**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
CS209.5		**2**	**3**		**2**	**2**			**2**			**1**	**3**	**3**	**3**
CS209.6			**1**	**2**					**1**		**2**	**1**	**2**	**2**	
CS209	1.33	1.60	2.50	1.25	2.00	2.00	3.00		1.80		2.00	1.00	2.33	2.75	2.40

SYLLABUS

No.	Content	Hours	COs
I	Introduction Graphic areas, Major Applications, Graphic APIs, 3D Geometric Models, Graphics Pipeline, Numerical Issues, Efficiency	08	CS209.1 CS209.2
II	Miscellaneous Math Sets and Mappings, Solving Quadratic Equations, Trigonometry, Vectors, 2D Implicit and Parametric Curves, 3D Implicit and Parametric Curves, Linear Interpolation, Determinants and Matrices, Basic 2D and 3D transforms, Inverses of Transformation Matrices.	08	CS209.2 CS209.3
III	Raster Algorithms Raster Displays, Monitor Intensities, RGB color, Line Drawing, Simple Anti-aliasing, Image Capture and Storage, Graph Algorithms	05	CS209.2 CS209.3
IV	Ray Tracing The basic Ray Tracing Algorithm, Computing Viewing Rays, Ray-Object Intersection, A Ray Tracing Program, Shadows, Specular Reflection, Refraction, Instancing, Constructive Solid Geometry, Distribution Ray Tracing.	03	CS209.4 CS209.3 CS209.4
V	Data Structures for Graphics Triangle Meshes, Winged Edge Data Structure, Scene Graphs, Scene Graphs, Tiling Multidimensional Arrays.	04	CS209.4 CS209.5
VI	Sampling Integration, Continuous Probability, Monte Carlo Integration, Choosing Random Points.	08	CS209.5 CS209.6
VII	Reflection Models Real World Materials, Implementing Reflection Models. Specular Reflection Material, Smooth Layered Model, Rough Layered Model.	04	CS209.6
Total Hours		**40**	

Essential Readings

1. Computer Graphics: Principles and Practice in C (3rd Edition), by James D. Foley, Andries van Dam, Steven K. Feiner, John F. Hughes, 2014.
2. Fundamentals of Computer Graphics, by Peter Shirley, Michael Ashikhmin, Steve Marschner, A K Peters/CRC Press; 3 edition, 2009.

3. Computer Graphics, C Version (2nd Edition) by Donald Hearn, M. Pauline Baker, Prentice Hall; 1996.
Supplementary Readings
1. Introduction to Computer Graphics, David J. Eck, Hobart and William Smith Colleges, Copyright Year: 2016, Publisher: David J. Eck.
2. Computer Graphics: using OpenGL / F.S. Hill, Jr., Prentice Hall ; 2001.
3. Interactive computer graphics: data structures, algorithms, languages, By W. K. Giloi, Prentice-Hall, 1989.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 211	**Principles of Programming Languages**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To enable the students to learn about various constructs and their respective comparisons in different high-level languages so that he can choose a suitable programming language for solving a particular problem.**	Course Outcomes	CS211.1	**Able to understand the history of programming languages and introduce abstraction, the concept of different language paradigms, and an overview of language design criteria.**	Understand
	To develop the student's ability to understand the salient features in the landscape of programming languages.		CS211.2	**Able to understand how the syntactic structure of a language can be precisely specified using context-free grammar rules in Backus-Naur form (BNF).**	Understand
	To provide the students to gain experience with these paradigms by using example programming languages.		CS211.3	**Able to understand the abstractions of the operations that occur during the translation and execution of programs.**	Understand
	To develop the student's ability to gain experience with these paradigms by using example programming languages.		CS211.4	**Able to understand the usage of data types in various languages.**	Understand
			CS211.5	**Able to understand the procedure activation and parameter passing; and exceptions and exception handling.**	Understand
			CS211.6	**Able to understand the concepts like abstract data types, subprograms, and will be able to apply them in a realistic manner.**	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS211.1	**2**					**1**	**2**		**1**	**1**			**2**	**1**	**1**
CS211.2	**2**	**3**	**1**	**1**		**2**	**1**		**3**	**2**	**1**	**2**	**1**	**2**	**2**
CS211.3	**3**	**2**	**1**		**2**	**3**		**1**		**1**	**3**	**1**	**3**	**2**	**2**
CS211.4	**1**		**3**	**2**		**2**	**1**		**3**	**2**	**1**		**1**	**2**	**2**
CS211.5	**2**		**1**		**2**	**3**	**1**		**1**	**2**	**1**		**3**	**2**	**3**
CS211.6	**1**	**2**		**3**	**1**	**2**		**2**		**1**			**2**	**3**	**2**
CS211	**1.83**	**2.33**	**1.50**	**2.00**	**1.67**	**2.17**	**1.25**	**1.50**	**2.00**	**1.50**	**1.50**	**1.50**	**2.00**	**2.00**	**2.00**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** **The Origins of Programming Languages, Abstractions in Programming Languages, Computational Paradigms, Language Definition, Language Translation, The Future of Programming Languages;**	**3**	**CS211.1**
II	**Language Design Criteria:** **Historical Overview, Efficiency, Regularity, Security, Extensibility, C++: An Object-Oriented Extension of C, Python: A General-Purpose Scripting Language;**	**3**	**CS211.1**
II	**Syntax and Analysis Parsing:** **Lexical Structure of Programming Languages, Context-Free Grammars and BNFs, Parse Trees and Abstract Syntax Trees, Ambiguity, Associativity, and Precedence, EBNFs and Syntax Diagrams, Parsing Techniques and Tools, Lexics vs. Syntax vs. Semantics, Case Study: Building a Syntax Analyzer for TinyAda;**	**6**	**CS211.2**
IV	**Basic Semantics:** **Attributes, Binding, and Semantic Functions, Declarations, Blocks, and Scope, The Symbol Table, Name Resolution and Overloading, Allocation, Lifetimes, and the Environment, Variables and Constants, Aliases, Dangling References, and Garbage, Case Study: Initial Static Semantic Analysis of TinyAda;**	**6**	**CS211.3**
V	**Data Types:** **Data Types and Type Information, Simple Types, Type Constructors, Type Nomenclature in Sample Languages, Type Equivalence, Type Checking, Type Conversion, Polymorphic Type Checking, Explicit Polymorphism, Case Study: Type Checking in TinyAda;**	**5**	**CS211.4**
VI	**Expressions and Statements:** **Expressions, Conditional Statements and Guards, Loops and Variations on WHILE, The GOTO Controversy and Loop Exits, Exception Handling, Case Study: Computing the Values of Static Expressions in TinyAda;**	**5**	**CS211.5**
VII	**Procedures and Environments:** **Procedure Definition and Activation, Procedure Semantics, Parameter-Passing Mechanisms, Procedure Environments, Activations, and Allocation, Dynamic Memory Management, Exception Handling and Environments, Case Study: Processing Parameter Modes in TinyAda;**	**6**	**CS211.5**
VIII	**Abstract Data Types and Modules:** **The Algebraic Specification of Abstract Data Types, Abstract Data Type Mechanisms and Modules, Separate Compilation in C, C++ Namespaces, and Java Packages, Ada Packages, Modules in ML, Modules in Earlier Languages, Problems with Abstract Data Type Mechanisms, The Mathematics of Abstract Data Types;**	**6**	**CS211.6**
	Total Hours	**40**	

Essential Readings

1. Louden KC, "Programming languages: principles and practices", 3rd Edition, Cengage Learning, 2011.
2. Sebesta RW. Concepts of programming languages. Pearson Education India; 2016.

3. Gabbrielli M, Martini S. Programming languages: principles and paradigms. Springer Science & Business Media; 2010.

Supplementary Readings

1. Sethi R, Sethi R. Programming languages: concepts and constructs. Reading: Addison-Wesley; 1996.
2. Dowek G. Principles of programming languages. Springer Science & Business Media; 2009.
3. Kedar S, Thakare S. Principles of Programming Languages. Technical Publications; 2009.

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Department	**Computer Science and Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 271	**Object Oriented Paradigm**		**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To provide students basic and fundamental concepts of Object Oriented Programming paradigm		CS271.1	**Able to understand the fundamental concepts of OOP and the basic of Java OOPL, with its decision-making capabilities through branching and looping**	Understand
	To prepare students to design, code and solve real-life problems following Object Oriented Programming paradigm		CS271.2	**Able to demonstrate the object-oriented concepts and its various features using Java Language and apply them to solve real-world problems**	Apply
			CS271.3	**Able to use interfaces, packages, threads of Java Language and to learn how to handle errors and exceptions**	Apply
			CS271.4	**Able to test the advanced concepts of Java Language such as Applet, Graphic design, File handling and Collections**	Evaluate

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS271.1	2	2	1		1					1		1	2	1	1
CS271.2	3	3	3	2	1	1	1		1		1		1	2	1
CS271.3	3	3	3	2	1	1	1		1		1		1	3	2
CS271.4	3	2	1	2	1		1		1				1	2	3
CS271	2.75	2.5	2	2	1	1	1		1	1	1	1	1.25	2	1.75

SYLLABUS

No.	Content	Hours	COs
I	**Fundamentals of OOP and Introduction to Java:** Objects and classes, Data abstraction and encapsulation, Inheritance, Polymorphism; History and Features of JAVA, Difference from C and C++, Association with Internet, WWW, Web Browsers; Java Environment; Overview of Java; Constants, Variables, Data Types, Type Casting; Operators, Expressions, Precedence and Associativity; Decision Making with Branching and Looping.	**06**	**CS271.1**
II	**Basic OOP using Java:** Classes, Objects, Methods, Inheritance, Overriding, Abstract Methods and Classes; Arrays, Strings, Vectors, Wrapper Classes.	**08**	**CS271.2**
III	**Interfaces, Packages, Threads, Errors and Exceptions:** Interfaces – Multiple Inheritance; Defining, Extending, Implementing, Accessing Interfaces. Packages – Putting classes together, API packages, System packages, Naming conventions; Creating, assessing, using packages. Threads – Creating, Extending, Stopping, and Blocking; Life Cycle of a Thread. Error and Exceptions – Types of Errors, Exceptions, Syntax of Exception Handling, Throwing own Exceptions.	**09**	**CS271.3**
IV	**Advanced Concepts:** Applet Programming – Introduction; Applet life cycle; Building, creating applets; Designing a web page. Graphics Programming – Graphics class; Lines, rectangles, circles, ellipses, arcs, polygons. Managing I/O in Java – Streams; File Handling. Java Collections – Interfaces, classes, algorithms.	**05**	**CS271.4**
	Total Hours	**28**	

Essential Readings

1. E. Balagurusamy, "Programming with Java", 7th Edition, McGraw Hill Education, 2023.
2. M.T. Somashekara, D.S. Guru, K.S. Manjunatha, "Object Oriented Programming with Java", PHI Learning, 2017.
3. Y. Kanetkar, "Let Us JAVA", 6th Edition, BPB Publications, 2022.

Supplementary Readings

1. R.N. Rao, "Core Java: An Integrated Approach", Dreamtech Press, 2016.
2. C.S. Horstmann, "Core Java Volume I - Fundamentals", 12th Edition, Pearson Education, 2023.
3. H. Schildt, "Java The Complete Reference", 13th Edition, McGraw Hill Education, 2024.

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Department	**Computer Science and Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS213	**Web Design Using JavaScript**		**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To gain a solid grasp of fundamental JavaScript concepts including variables, data types, operators, functions, and control structures.	Course Outcomes	CS213.1	Able to understand HTML documents with JavaScript to prepare interactive web pages that respond to user actions through event handling, DOM manipulation, and dynamic content generation.	Apply
	To enhance HTML documents with JavaScript to create dynamic and interactive web pages, utilizing events, methods, and DOM manipulation effectively.		CS213.2	Able to design JavaScript code, applying fundamental concepts such as variables, functions, loops, and conditional statements to solve programming challenges.	Create
	To acquire skills to script forms for user input validation, automated formatting, and dynamic calculations using JavaScript, ensuring robust and user-friendly web forms.		CS213.3	Able to develop the ability to script web forms using JavaScript to perform client-side validation, automate data formatting, calculate values dynamically, and enhance user experience with responsive form behavior.	Create
	To master techniques to dynamically change web page content based on time, date, user interactions, or external data sources, leveraging arrays, objects, and external file access for richer user experiences.		CS213.4	Able to dynamically modify web page content based on time, user interactions, or external data sources, utilizing arrays, objects, and external file access to create engaging and responsive web applications.	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS213.1				**1**	**2**				**1**			**1**	**1**		**1**
CS213.2	**1**	**1**		**1**	**1**										
CS213.3	**2**	**2**	**3**	**2**	**3**							**2**	**2**	**2**	**1**
CS213.4	**3**	**2**	**3**	**2**	**3**							**2**	**2**	**2**	**1**
CS213	2.00	1.67	3.00	1.50	2.25				1.00			1.67	1.67	2.00	1.00

SYLLABUS

No.	Content	Hours	COs
I	**Introduction**: Introduction to Objects, Methods, and Events, Events and Program Flow, Running Scripts. **Script Writing Basics**: Enhancing HTML Documents with JavaScript, The Quintessential Building Blocks, Script Mechanics	**6**	**CS213.1**
II	**Names, Objects and Methods**: Names and References in JavaScript, Built-in Objects, Home-Built Objects, The Hierarchy of Names, Using Methods, Operators and Variables, Keywords, Functions, Object interaction. **Control, Looping and functions**: Controlling Script Flow, Storing Tasks within Functions, Using Conditional Statements for Decision Making, if Statements, if-else Conditional Statements, Using the Date Object, for Conditional Statements, while Conditional Statements, break and continue Statements, with Statements, Creating Functions in JavaScript, declaring a Function, Designing a Simple Function.	**8**	**CS213.2**
III	**Creating Dynamic web page**: Changing Pages Based on Time and Date, Displaying the Quote of the Day, Using Arrays, Constructing the Quotes Script, Considerations When Accessing External Files, Changing the Background Color through a Random Number, Turning the Color Generator into a Function, Using the Image and Area Objects, Creating an Image Object, Creating an Area Object, Selecting a Guide.	**8**	**CS213.3, CS213.4**
IV	**Java Scripting Your Forms**: Basic Script Construction, Talking to Your Form Objects, Organizing Your Objects and Scripts, Field-Level Validation, Check Required Fields ,Validate Zip Code, Automated Formatting, Format Phone, Format Money, Automatic Calculation, Calculate Expiration Date, Calculate Amount	**6**	**CS213.3, CS213.4**
Total Hours		**28**	

Essential Readings

1. Laurence Lars Svekis, Maaike van Putten, Rob Percival, "JavaScript from Beginner to Professional" , Packt Publishing, 2021
2. David Flanagan, "JavaScript: The Definitive Guide", 7th Edition, O'Reilly Media, 2020
3. Fritz Schneider, Thomas Powell, "JavaScript : The Complete Reference", 3rd Edition, Tata McGraw - Hill Education,2012
4. David Flanagan, "JavaScript: Pocket Reference", 3rd Edition, O'Reilly, 2012

Supplementary Readings

1. Danny Goodman Michael Morrison Paul Novitski Tia GustaffRayl, "Javascript Bible", 7th Edition, Wiley India Pvt Ltd, 2010
2. Douglas Crockford , "JavaScript: The Good Parts", 2nd Edition, Tata McGraw - Hill Education, 2008
3. Ivan Bayross, "Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML (With CD) and PHP", 4th Edition, BPB Publication, 2010

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS251	**Data Structures & Algorithms Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To develop the student's ability to understand the basic concept of data structure.**	Course Outcomes	CS251.1	**Able to understand and implement the basic data structure such as array using pointers.**	Apply
	To provide the students with various kinds of sorting and searching algorithm required in various applications.		CS251.2	**Able to implement and analyse the various types of sorting and searching and algorithms using different data structures for various applications.**	Analyse
	To develop the student's ability to implement and analyse the various linear and non-linear data structure applicable to various applications		CS251.3	**Able to implement using data structure such linked list, stack, queue and analyse which particular data structure will be efficient according to the application.**	Analyse
	To familiarize the student the various hashing schemes.		CS251.4	**Able to implement using nonlinear data structure such as Tree, Graph and analyse which particular data structure will be efficient according to the application.**	Analyse
			CS251.5	**Able to understand and implement the various hashing schemes for applications.**	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS251.1	**3**	**2**											**2**		**3**
CS251.2	**3**	**3**	**2**	**2**								**1**	**2**	**2**	**2**
CS251.3	**3**	**3**	**2**	**2**			**2**					**1**	**2**	**3**	**2**
CS251.4	**3**	**3**	**2**	**2**	**2**	**1**	**1**					**1**	**3**	**2**	**2**
CS251.5	**3**	**3**	**2**	**2**	**2**	**1**	**1**					**1**	**2**	**1**	**3**
CS251	3.00	2.80	2.00	2.00	2.00	1.00	1.33					1.00	2.20	2.00	2.40

SYLLABUS

No.	Content	Hours	COs
I	Implement an algorithm to insert and delete an element at any arbitrary position in an array of integer numbers and also implement an algorithm to display the condition of the array before and after insertion.	**2**	**CS251.1**
II	Write a C program to implement sorting of n numbers using a. Bubble sort. b. Selection sort c. Insertion sort. d. Quick sort. e. Merge sort.	**6**	**CS251.2**
III	a. Write a program for addition of two polynomial using linked list. b. Write a program for multiplication of two polynomial using linked list c. Implement algorithms to insert an element in a stack(push), to delete an element from a stack(pop) and to display the elements of the stack.[Assume: initially, top= -1] d. Implement algorithms to insert an element in a queue, to delete an element from a queue and to display the elements of the queue.[Assume: initially, front= -1, rear= -1] e. Implement algorithms to insert an element in a circular queue, to delete an element from a circular queue and to display the elements of the circular queue.[Assume: initially, front= 0, rear= -1] 17.	**6**	**CS251.3**
IV	a. Write a C program to implement searching of a key from n numbers (given in Descending order) using Binary search. b. Write a C program to find a key from n numbers using sequential search (Linear search) & if found, show the position	**2**	**CS251.2**
V	a. Implement a binary tree using array. b. Implement a binary search tree using linked list and traverse in pre- order, in-order and post-order c. Create a binary search tree of N nodes with given N elements and search a given key element. d. Write a C program to implement sorting of n numbers using binary search tree e. Implement an AVL tree.	**6**	**CS251.4**
VI	a. Create a Hash table to store the account number and balance of the customers. Provide proper option to create, search and delete customer details. b. Write a c program to create a file, named "StudentDatabase" . Store the the name, roll number, phone number and average marks of N students, where N is a natural number between 2 to 10. Ex: Sl.No. Name roll number phone number average marks 1. xyz 1234567 9900221188 8.2 After creating database, modify the phone no. and marks of ith student, 1< i < =N	**6**	**CS251.5**
Total Hours		**28**	

Essential Readings
1. Dr. D.S. Kushwaha, Dr. Arun Kumar Mishra, “A Programming approach with C “, 2nd Edition, PHI India, 2014.
2. Seymour Lipschutz, “Data Structures”, Revised 1st Edition, Tata McGraw hill Publication, 2013.
3. Mark Allen Weiss, “Data Structures And Algorithm Analysis In C”, 2nd Edition, Pearson Education, 2002.
Supplementary Readings
1. A.K. Sharma,“Data Structures using C”, Pearson, 2011.
2. Yedidyah Langsam, Aaron M. Tenenbaum, Moshe J. Augenstein, “Data Structures Using C and C++, 2nd Edition, PHI, 2011.
3. Kyle Loudon ,“Mastering Algorithms With C Useful Techniques From Sorting To Encryption”1st Edition, O'Reilly, 2009.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS 253	**Digital Logic Design Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To introduce the concept of digital and binary systems, number representation and conversion between different representations in digital electronic circuits and to acquire the knowledge of digital logic levels and Boolean logic.**	Course Outcomes	CS253.1	Have a thorough understanding of the fundamental concepts and techniques used in digital electronics.	Understand
	To make students be able to design and analyse combinational logic circuits.		CS253.2	To understand and examine the structure of various number systems and its application in digital design.	Understand
	To make students be able to design and analyse sequential logic circuits.		CS253.3	The ability to understand, analyse and design various combinational circuits.	Create
	To understand the concept of Programmable Devices, RAM, ROM, PLA, PAL.		CS253.4	The ability to understand, analyse and design various sequential circuits.	Create
			CS253.5	Develop a digital logic and apply it to solve real life problems.	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS253.1	**3**	**2**	**2**	**1**									**1**	**1**	**1**
CS253.2	**2**	**1**	**2**	**1**									**1**	**1**	**1**
CS253.3	**3**	**2**	**2**	**1**									**1**	**1**	**1**
CS253.4	**3**	**2**	**2**	**1**	**1**								**1**	**1**	**1**
CS253.5	**3**	**3**	**3**	**1**	**1**							**1**	**2**	**1**	**2**
CS253	**2.8**	**2**	**2.2**	**1**	**1**							**1**	**1.2**	**1**	**1.2**

SYLLABUS

No.	Content	Hours	COs
I	Logic Gates using Discrete Components.	**02**	**CS253.1,CS253.2**
II	Half-Adder/ Half-subtarctor Circuits using a serial Input.	**02**	**CS253.1, CS253.3**
III	Full-Adder/ Full-subtarctor Circuits using a serial Input.	**04**	**CS253.1, CS253.3**
IV	4-Bit Gray to Binary/ Binary to Gray Code convertor using Select input.	**02**	**CS253.1,CS253.3**
V	Implementing Logic Functions using MUX IC 74153.	**02**	**CS253.1, CS253.3**
VI	Flip-flops using NAND/ NOR Gate.	**02**	**CS253.1, CS253.4**
VII	Modulo-m Ripple Counter.	**02**	**CS253.1, CS253.4, CS253.5**
VIII	4-Bit Shift Left/Right Register	**04**	**CS253.1, CS253.4, CS253.5**
IX	Sequence Generator	**02**	**CS253.1, CS253.4, CS253.5**
X	Excess-3 BCD Adder/ Subtractor with Select Input.	**04**	**CS253.1, CS253.4, CS253.5**
XI	Quiz/Viva	**02**	**CS253.1-CS253.5**
Total Hours		**28**	

Essential Readings
1. L. Thomas Floyd and R.P. Jain, “Digital Fundamentals”, 11th ed., 2015, Pearson Education.
2. Kime Charies R and Morris Mano, “Logic and Computer Design Fundamentals”, 4th ed., 2014, Pearson Education.
3. Morris Mano, “Digital Logic and Computer Design”, 1st ed., 2004, Pearson Education.
Supplementary Readings
1. R.P. Jain and M.H.S. Anand, “Digital Electronics Practice using Integrated Circuits”, 1st ed., 2004, Tata McGraw Hill. 2. Samuel C. Lee, “Digital Circuits and Logic Design”, 2009 edition, PHI (Prentice-Hall of India). 3. Stephen Brown and Zvonko Vranesic, “Fundamentals of Digital Logic with Verilog Design”, 2nd ed., 2017, Tata McGraw Hill.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS 255	**Computer Organization Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	Connect the theory of computer organization with hardware		CS255.1	Able to understand different operations on number systems	Understand
	To develop knowledge about ALU operations		CS255.2	Able to acquire knowledge about assembly language code	Understand
	Apply fundamentals of digital design and extend the learning to design sequential circuits		CS255.3	Understanding of addition and subtraction, Multiplication- Booth's, Array	understand
	To apply the concept of memory design, cache memory and its mapping techniques and virtual memory.		CS255.4	Introduce basics understanding of Division- Restoring and non-restoring; Floating point arithmetic	Understand
			CS255.5	Able to Designing Adder, Multiplier, ALU on a simulator.	Create
			CS255.6	Exhibit the design of Registers and Counters on a simulator.	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS255.1	**3**	**3**		**1**					**2**				**3**		**3**
CS255.2	**3**	**3**		**1**					**2**				**2**		**2**
CS255.3	**2**	**3**	**3**	**1**	**2**								**2**	**3**	**2**
CS255.4	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
CS255.5	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
CS255.6	**2**	**3**	**2**	**1**	**2**	**2**	**2**		**2**			**1**	**2**	**3**	**3**
CS255	2.33	2.67	2.75	1.00	2.00	2.00	2.67		2.00			1.00	2.33	3.00	2.50

SYLLABUS

No.	Content	Hours	COs
1	Computer arithmetic	**02**	**CS255.1 CS255.2 CS255.3 CS255.4 CS255.5 CS255.6**
2	Addition and subtraction, Multiplication	**02**	
3	Booth's, Array	**02**	
4	Division- Restoring	**02**	
5	Non-restoring	**02**	
6	Floating point arithmetic.	**02**	
7	Designing Adder, Multiplier	**04**	
8	Design of Registers and Counters	**04**	
9	Designing memory unit on a simulator.	**04**	
10	Designing CPU on a simulator.	**04**	
	Total Hours	**28**	

Essential Readings

1. Hamacher, Carl, Zvonko Vranesic, and Safwat Zaky. *Computer organization*. McGraw-Hill, 2002.
2. Mano, M. Morris. *Computer system architecture*. Prentice-Hall of India, 2003.
3. Stallings, William. *Computer organization and architecture: designing for performance*. Pearson Education India, 2003.

Supplementary Readings

1. Hennessy, John L., and David A. Patterson. *Computer architecture: a quantitative approach*. Elsevier, 2011.
2. Bryant, Randal E., O'Hallaron David Richard, and O'Hallaron David Richard. *Computer systems: a programmer's perspective*. Vol. 2. Upper Saddle River: Prentice Hall, 2003.
3. Ramachandran, Umakishore. *Computer systems: An integrated approach to architecture and operating systems*. Pearson Education India, 2011.

Fourth Semester Courses

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS202	**Software Engineering**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the Software Development life cycles Models		CS202.1	**Able to identify, formulate, and solve complex engineering problems**	Create
	To analyse the software requirements		CS202.2	**Able to recognize ethical and professional responsibilities in engineering situations**	Understand
	To introduce various design methods for software Development		CS202.3	**Able to analyze, design, verify, validate, implement, apply, and maintain software systems**	Create
	To develop an ability and skill to test software systems		CS202.4	**Able to develop software in one or more significant application domain**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS202.1	**2**												**1**	**1**	
CS202.2	**2**	**1**	**1**	**1**				**1**			**1**	**1**	**2**	**1**	**1**
CS202.3	**1**	**1**	**1**	**1**								**1**	**1**	**1**	**1**
CS202.4	**1**	**1**	**1**	**1**					**1**		**1**	**1**	**1**	**1**	**1**
CS202	1.50	1.00	1.00	1.00				1.00	1.00		1.00	1.00	1.25	1.00	1.00

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** **Software process - software development life cycle models.**	**04**	**CS202.1**
II	**Software Requirement and Analysis** **Techniques: feasibility analysis, requirements elicitation, validation, rapid prototyping, OO paradigms vs. structured paradigm - OO analysis.** **Case Study: Analyzing and documenting requirements for any software application.**	**06**	**CS202.2** **CS202.4**
III	**Software Specifications** **Specification document, specification qualities, uses, system modelling: context, interaction, structural, behavioural, DFD, specification techniques using UML, ER diagrams, logic, algebraic specifications: comparison of various techniques, formal specifications – model checking, introduction to binary decision diagrams. Case Study: Designing the architecture for an e-commerce platform.**	**12**	**CS202.2** **CS202.3**
IV	**Object Oriented Methodology** **Introduction to objects, relationships, unified approach to modelling, use-case modelling, activity, state and interaction diagrams, classification approaches, cohesion, coupling, reuse. Case studies - object oriented paradigm, software design: architectural - distributed - data oriented design & object oriented design - real-time systems design techniques.**	**10**	**CS202.2** **CS202.3**
V	**Stepwise Refinement** **Stepwise refinement, software versions and configuration control.**	**04**	**CS202.1** **CS202.4**
VI	**Software Testing & Evolution** **Verification & validation – non-execution based testing – software inspections, code reviews, code walkthroughs– automated static analysis – Clean room software development – quality issues – execution based testing – module test-case selection, testing process: black-box, white-box, unit, integration.** **Case Study: Developing test cases and conducting quality assurance for any software application.**	**06**	**CS202.3** **CS202.4**
	Total Hours	**42**	

Essential Readings

1. Roger S Pressman: "Software Engineering – A Practitioner's Approach", 7th Edition, McGraw-Hill, 2009.
2. Rajib Mall, "Fundamentals of Software Engineering", 5th Edition, PHI, 2018.
3. Ian Sommerville: "Software Engineering". 10th Edition, Pearson Education, 2017.

Supplementary Readings

1. S.L. Pfleeger, Software Engineering – Theory and Practice, 2nd Edition, Pearson Education, 2015.
2. Paul Ammann, and Jeff Offutt, "Introduction to Software Testing", 2nd Edition, Cambridge University Press, 2016.
3. Eric Gamma, "Design Patterns: Elements of Reusable Object-Oriented Software", 1st Edition, Addison-Wesley Longman Publishing, 1995.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 204	**Object Oriented Programming and Design**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	**To provide students in-depth understanding of Object Oriented Programming using C++**	Course Outcomes	CS204.1	**Able to acquire identify the paradigm change of C to C++ and able to infer the basic concepts, the concepts of function and operator overloading in C++, and write C++ code to solve real-life problems**	Create
	To prepare students to design and code various projects using Object Oriented Programming paradigm in C++		CS204.2	**Able to interpret and use the concept of Inheritance and polymorphism, with their various types in C++, by writing C++ code to design solutions**	Create
			CS204.3	**Able to infer the concepts of file handling and exception handling in C++, and able to write C++ code using those concepts**	Create
			CS204.4	**Able to interpret the concept of templates, Standard Template Libraries and use them to write C++ codes**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS204.1	2	2	1		1					1		1	2	1	1
CS204.2	3	3	3	2	1	1	1		1		1		1	2	1
CS204.3	3	3	3	2	1		1		1		1		1	3	2
CS204.4	3	2	1	2			1						1	2	3
CS204	2.75	2.50	2.00	2.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.25	2.00	1.75

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to C++:** **Journey from C to C++; Revisiting the concepts of classes, objects, data encapsulation, data hiding, static members, friend functions, pointers to members, constructors and destructors;**	**05**	**CS204.1**
II	**Function and Operator Overloading:** **Function overloading, operator overloading of unary, binary, special operators; Type conversion – basic to class, class to basic, class to class.**	**06**	
III	**Inheritance:** **Introduction to inheritance, different types; Single inheritance – public and private derivation, protected member, constructor and destructor in derived class; Multilevel and multiple inheritance; Ambiguity resolution; Hierarchical and hybrid inheritance; Virtual base class; Object slicing.**	**09**	**CS204.2**
IV	**Polymorphism:** **Compile-time polymorphism – function overloading, recapping operator overloading;** **Run-time polymorphism – pointer to base and derived class, virtual functions, concept of VPTR and VTABLE;**	**06**	**CS204.3**
V	**Input/Output and Exception Handling:** **Streams, classes for file stream, opening a file, detecting the EOF, file modes, file pointers and their functions, types of files, i/p and o/p functions for sequential and random access, error handling.**	**09**	
VI	**Templates and STL:** **Function templates, class templates, advantages and disadvantages, Standard Template Library.**	**05**	**CS204.4**
	Total Hours	**40**	

Essential Readings

1. Robert Lafore, "Object-Oriented Programming in C++", 4th Edition, Sams Publishing, 2001.
2. E Balagurusamy, "Object-Oriented Programming in C++", 8th Edition, McGraw-Hill Education India, 2020.
3. Yashvant Kanetkar, "Let Us C++ ", BPB Publication, 2020.

Supplementary Readings

1. P.J. Deitel and H.M Deitel ,"C++ How to Program", 10th Edition, Pearson Publication, 2016.
2. Herbert Schildt, "C++: The Complete Reference", 4th Edition, McGraw-Hill Education India, 2017.
3. Bjarne Stroustrup, "The C++ Programming Language", 3rd Edition, Pearson Education India, 2002.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS206	**Data Communication**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the components of Data Communication		CS206.1	**Able to learn the fundamentals of data communication**	Understand
	To analyse the Analog and Digital Transmission		CS206.2	**Able to Understand the digital signal and analog signal transmission over different types of transmission media.**	Understand
	To describe the structure of Physical and Data Link Layer		CS206.3	**Able to distinguish different techniques of error detection and correction and medium access control.**	Analyse
	To describe the function of wireless networks		CS206.4	**Able to acquire knowledge about the generations of wireless networks.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS206.1	**2**												**2**	**1**	
CS206.2	**2**	**1**	**1**	**1**				**1**			**1**	**1**	**1**	**1**	**1**
CS206.3	**1**	**1**	**1**	**1**								**1**	**1**	**1**	**1**
CS206.4	**1**	**1**	**2**	**2**					**1**		**1**	**1**	**1**	**1**	**1**
CS206	1.50	1.00	1.33	1.33				1.00	1.00		1.00	1.00	1.25	1.00	1.00

SYLLABUS

No.	Content	Hours	COs
I	**Overview** **Objectives and Applications of Computer Communication. Computer Communication Network Architecture: ISO - OSI reference model, design philosophy, layer, protocol, interface, and service concepts. Layer - wise functionality**	**08**	**CS206.1, CS206.4**
II	**Physical Layer** **Concepts of Data and Signals, Analog and Digital Data Transmission, Bandwidth utilization: Multiplexing techniques, Transmission Media, Switching Techniques and Telephone and Cable Networks for Data transmission.**	**12**	**CS206.2**
III	**Data Link Layer** **Framing and Coding techniques, Error Detecting and Correcting Codes, data link control protocols and their performances. Medium Access Control in broadcast networks : ALOHA, CSMA, CSMA/CD, token ring, token bus.**	**12**	**CS206.3**
IV	**Wired and Wireless LANs** **Ethernet, Connecting Devices, Backbone Networks, Standard LAN Protocols (IEEE 802.X). Wireless LANs and WANs : IEEE 802.11, Bluetooth, Cellular telephony, satellite networks. SONET/SDH, Frame Relay and ATM.**	**08**	**CS206.4**
	Total Hours	**40**	

Essential Readings

1. Behrouz A Forouzan, "Data Communication and Networking", 5th Edition, McGraw-Hill Education, 2018.

2. Andrew S Tanenbaum, David J. Wetherall "Computer Networks", 5th Edition, Prentice Hall. 2011.
3. William Stallings, "Data and Computer Communication", 10th Edition, Pearson, 2017.

Supplementary Readings

1. James F Kurose, Kaith W Ross, "Computer Networking | A Top-Down Approach", 6th Edition, Pearson, 2017.
2. A L Garcia, I Widjaja, "Communication Networks: Fundamental Concepts and Key Architectures", 2nd Edition, Tata McGraw Hill, 2017.
3. B. Buchanan, "The Handbook of Data Communications and Networks", 1st Edition, Springer, 2004.
4. James F Kurose, Kaith W Ross, "Computer Networking | A Top-Down Approach", 6th Edition, Pearson, 2017.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 208	**Automata and Formal Languages**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To introduce students to theory of computation: automata, computability, and complexity with application of mathematical techniques and logical reasoning to important problems,	Course Outcomes	CS208.1	Able to acquire knowledge about fundamental understanding of the core concepts in automata theory and formal languages.	Understand
	To develop a strong background in reasoning about finite state automata and formal languages.		CS208.2	Able to design grammars and automata for different language classes.	Create
	To introduce students to different ways of parsing a formal language.		CS208.3	Able to acquire knowledge to identify formal language classes and prove language membership properties.	Understand
	To introduce students to theory of computability and complexity.		CS208.4	Able to acquire knowledge to prove and disprove theorems establishing key properties of formal languages and automata.	Understand
			CS208.5	Able to acquire knowledge to demonstrate a fundamental understanding of computation and computational models including decidability and intractability.	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS208.1	**3**	**1**	**1**	**1**								**1**	**2**	**3**	**1**
CS208.2	**2**	**2**	**3**	**1**									**2**	**2**	**1**
CS208.3	**2**	**2**	**2**	**1**									**2**	**2**	**1**
CS208.4	**1**	**2**	**3**	**1**									**2**	**2**	**1**
CS208.5	**3**	**3**	**1**	**3**								**1**	**3**	**3**	**1**
CS208	**2.2**	**2**	**2**	**1.4**								**2**	**2.2**	**2.4**	**1**

SYLLABUS

No.	Content	Hours	COs
I	Basic Mathematical Objects: Sets Logic, Functions, Relations, Strings, Alphabets, Languages, Mathematical Induction: Inductive proofs, Principles; Recursive definitions.	**02**	**CS208.1**
II	Regular Languages and Finite Automata (FA), Deterministic and Nondeterministic Finite Automata, Equivalence and minimization of Automata, Finite Automata with output- Mealy and Moore Machines, Properties of Regular Sets: The Pumping Lemma for Regular sets, Closure properties and Decision properties of regular languages, Regular Expressions (RE), Relation Between RE and FA.	**14**	**CS208.1, CS208.2**
III	Grammar , Types of Grammar and Languages- Chomsky Hierarchy, Context Free Grammar (CFG), Derivation trees & Ambiguity, Inherent ambiguity, Parse tree, Application of CFG, Simplification of CFG, Normal form of CFG, Relations between classes of languages and Automata, Closure properties and Decision properties of CFG, Properties of Context Free Languages: The Pumping Lemma,	**14**	**CS208.1, CS208.2, CS208.3**
IV	Push Down Automata(PDA), Languages of PDA, Equivalence of PDA and CFG, Deterministic PDA	**06**	**CS208.1, CS208.2,CS208.4**
V	Turing Machine(TM) - Standard Model, Variations of TM (Multi-Track TM, Multi-Tape TM, Multi-Dimensional TM, Universal TM), Deterministic and Non deterministic TM, Turing Thesis, Halting Problem, Language of a Turing Machine-Recursively Enumerable Language, Unrestricted Grammar, Linear Bounded Automata(LBA), Computability and Decidability. Time and Space Complexity, Growth Rate, Complexity classes, Tractable and Non tractable Problems: P and NP, Cooks's theorem.	**6**	**CS208.1, CS208.4,CS208.5**
	Total Hours	**42**	

Essential Readings

1. Peter Linz, "An Introduction To Formal Languages And Automata", 3rd ed., 2001, Narosa Publication.
2. K.L.P.Mishra, N. Chandrasekaran," Theory Of Computer Science: Automata, Languages and Computation", 3rd ed., 2016, PHI.
3. S. Kandar, "Introduction to Automata Theory, Formal Languages and Computation", 1st ed., 2013, Pearson.

Supplementary Readings

1. John E. Hopcroft, Rajeev Motwani, Jeffrey Ullman, "Introduction to Automata theory, languages computation ", 2nd ed., 2005, Pearson India, Indian Reprint.
2. Michael Sipser, "Introduction to the Theory of. Computation", 3rd ed., 2013, Cengage Learning.

3. H. R. Lewis, C. H. Papadimitriou, “Elements of the Theory of Computation”, 2nd ed., 1998, Prentice-Hall.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS210	**Augmented and Virtual Reality**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To understand the basic concepts of augmented and virtual reality		CS210.1	**Able to analyse the components of Virtual Reality**	Analyse
	To apply the various concepts of virtual reality.		CS210.2	**Able to understand the3D user hardware interface**	Understand
	To explore the application area of augmented and virtual reality		CS210.3	**Able to assess and compare technologies of Virtual Reality**	Understand
			CS210.4	**Able to design application of Virtual Reality**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS210.1	**1**												**1**	**1**	
CS210.2	**1**	**1**	**2**	**1**				**1**			**1**	**1**	**1**	**1**	**1**
CS210.3	**2**	**1**	**1**	**1**		**1**						**1**	**1**	**2**	**1**
CS10.4	**1**	**3**	**1**	**1**		**1**						**1**	**2**	**1**	**1**
CS210	1.25	1.67	1.33	1.00		1.00		1.00			1.00	1.00	1.25	1.25	1.00

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** **The historical development of Virtual Reality, Fundamental concept and components of Virtual Reality, Primary features and present development on Virtual Reality, Virtual environment, Requirements of Virtual Reality**	**10**	**CS210.1**
II	**3D User Interface Input/output Hardware** **Input Device Characteristics, Desktop Input Devices, Tracking Devices, 3D Mice, Special-Purpose Input Devices, Direct Human Input, Choosing Input Devices for 3D Interfaces, Visual Displays, Auditory Displays, Haptic Displays, Choosing Output Devices for3D User Interfaces**	**12**	**CS210.2**
III	**3D Interaction Techniques** **Representation of the Virtual World and Rendering Systems- Visual Representation, Aural Representation, Haptic Representation, Manipulating a Virtual World, Navigating in a Virtual World, Wayfinding - Theoretical Foundations, User-CenteredWayfinding Support, Environment-Centered Wayfinding Support, Design Guidelines**	**12**	**CS210.3**
IV	**Applications** **What makes an application a good candidate for Virtual Reality, Business and manufacturing, Science, Medical, Education, Public Safety and Military, Entertainment**	**08**	**CS210.4**
	Total Hours	**42**	

Essential Readings

1. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", 2nd Edition, AddisonWesley, USA, 2017.
2. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design", 1st Edition, Morgan Kaufmann Publishers, San Francisco, CA, 2002.
3. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", 2nd Edition Morgan Kaufmann, 2009.

Supplementary Readings

1. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology",2nd Edition, Wiley Interscience, India, 2010.
2. John Vince, "Virtual Reality Systems", 1st Edition, Addison Wesley, 1995.
3. Oliver Bimber, Ramesh Raskar, "Spatial Augmented Reality Merging Real and Virtual Worlds", 1st Edition, CRC Press, 2005.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS212	**Artificial Intelligence**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	This course familiarizes the basic principles, techniques and applications of Artificial Intelligence (AI).		CS212.1	**Able to analyze concepts and principles of Artificial Intelligence (AI) for their proper selection for applications of AI.**	Analyze
	This course explains the basic principles to solve problems using Artificial Intelligence.		CS212.2	**Able to appraise AI techniques based on their strengths and limitations and decide their applicability to human-centered problems.**	Understand
	This course introduces logic based AI technique, planning algorithms, probability based AI technique and some machine learning models for problem solving.		CS212.3	**Able to develop formal representations of problems w. r. t. different algorithms of AI techniques to solve those problems.**	Create
			CS212.4	**Able to solve problems using logic based algorithms and planning algorithms.**	Apply
			CS212.5	**Able to solve problems using probability based algorithms.**	Apply
			CS212.6	**Able to solve problems using basic supervised and unsupervised machine learning models.**	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS212.1	3	2	1	1	1							1	1	1	1
CS212.2	3	2	1	1	1							1	1	1	1
CS212.3	3	3	3	3	2				1	1	1		3	2	
CS212.4	3	3	3	3	2				1	1	1		3	2	
CS212.5	3	3	3	3	2				1	1	1		3	2	
CS212.6	3	3	3	3	2				1	1	1		3	2	
CS212	3.00	2.67	2.33	2.33	1.67				1.00	1.00	1.00	1.00	2.33	1.67	1.00

SYLLABUS

No.	Content	Hours	COs
I	**Overview; Types of AI; Turing test; Intelligent agents; Knowledge representation; AI technique Solving Problems by Searching: AND/OR Graphs; Uninformed search - Depth First Search, Breadth First Search, DFID; Heuristic search - Generate and Test, Hill Climbing, stochastic heuristic search:- Simulated Annealing, Best First Search, Beam Search, A*, Problem reduction search, AO* Constraint satisfaction problems - constraint satisfaction search; Means-ends analysis Stochastic search methods - Particle Swarm Optimization Game Playing - Minimax algorithm, Alpha-beta pruning**	**20**	**CS212.1, CS212.2, CS212.3**
II	**Building a knowledge base: Propositional logic, first order predicate logic (FOPL); Inference in first order predicate logic; Resolution - refutation proofs strategies in FOPL; Theorem Proving in First Order Logic Planning; goal stack planning; partial order planning**	**06**	**CS212.4**
III	**Uncertain knowledge and reasoning; Knowledge representation using probabilities; Bayesian Networks**	**05**	**CS212.5**
IV	**Overview of different forms of learning: unsupervised, supervised, semi-supervised; K-means clustering algorithm; Decision Trees; Naive Bayes' Classifier; Artificial Neural Networks**	**08**	**CS212.6**
V	**Introduction to Expert Systems**	**03**	**CS212.1, CS212.2, CS212.3, CS212.6**
	Total Hours	**42**	

Essential Readings

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach," Pearson, 4th edition, 2020.
2. E. Rich, K. Knight and S. B. Nair, "Artificial Intelligence," McGraw Hill Education, 3rd edition, 2017.
3. C. Bishop,"Pattern Recognition and Machine Learning," Springer, 1st ed. 2006. Corr. 2nd printing 2011 edition.

Supplementary Readings

1. D. W. Patterson, "Introduction to artificial intelligence and expert systems," Pearson Education India, 1st edition, 2015.
2. I. Bratko, "Prolog Programming for Artificial Intelligence," Addison Wesley, 4th edition, 2011.
3. S. O. Haykin, "Neural Networks and Learning Machines," Pearson Education India, 3rd edition, 2016.

4. D. Jurafsky and J. H. Martin, “Speech and Language Processing,” Pearson Education India, 2nd edition, 2013.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 272	**App Design**		**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To Understand the core components of Android development		CS272.1	**Able to understand fundamental components of Android programming, activities, layouts, views, and resources to create functional user interfaces and implement basic application logic.**	Understand
	To Explore advanced Android topics and learn how to manage data persistently, perform background operations, and communicate effectively between app components.		CS272.2	**Able to design intuitive user interfaces utilizing principles of user interaction, menus, custom views, and material design guidelines to enhance usability and provide a seamless user experience**	Create
	To Gain proficiency in user interaction principles and be able to design responsive and accessible applications that adheres to best practices in user experience.		CS272.3	**Able to implement advanced Android features including background tasks, services, broadcast receivers, SQLite databases, and content providers to manage data effectively and ensure responsive application behavior.**	Evaluate
	To Learn the process of deploying Android applications and understand strategies for app monetization.		CS272.4	**Able to design intuitive user interfaces utilizing principles of user interaction, menus, custom views, and material design guidelines to enhance usability and provide a seamless user experience**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS272.1		1	2	2	3	2		1	1					**1**	**1**
CS272.2		**1**		**3**		**1**		**1**		**2**				**1**	**1**
CS272.3	**1**			**1**	**2**		**1**		**2**				**1**		**1**
CS272.4			**1**	**2**	**2**	**3**	**1**						**1**	**1**	**2**
CS272	1.00	1.00	1.50	2.00	2.33	2.00	1.00	1.00	1.50	2.00			1.00	1.00	1.25

SYLLABUS

No.	Content	Hours	COs
I	Introduction to mobile computing, installing of required software and preparing the working environment, creating your first Android Application. Layouts, Views, Resources, Activities, Intents, Background tasks, Connecting to the Internet, Fragments, Preferences	**6**	**CS272.1**
II	User Interaction – input, menu items, custom views, User Experience – themes and styles, material design, adaptive layouts, accessibility, localization, debugging the UI.	**8**	**CS272.2**
III	Storing Data,SQLite database, Sharing Data, content resolvers and providers, loaders to load data, Services, background work, alarms, broadcast receivers.	**8**	**CS272.3**
IV	Notification, widgets, transferring data efficiently, publishing app, Multiple form factors, sensors, Google cloud messaging, monetizing your app	**6**	**CS272.4**
	Total Hours	**28**	

Essential Readings

1. Phillips,Stewart, Hardy and Marsicano, "Android Programming : Big Nerd Ranch Guide", 5th Edition, Big Nerd Ranch Guides, 2022
2. John Horton, "Android Programming for Beginners", 3rd Edition, Packt Publishing ,2021

Supplementary Readings

1. Dawn Griffiths and David Griffiths, "Head First Android Development: A Brain-Friendly Guide", 3rd Edition, Shroff/O'Reilly, 2021
2. E Hellman, "Android Programming – Pushing the limits by Hellma", 1st Edition, John Wiley & Sons Inc, 2013

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM
Programme	**Bachelor of Technology (All Branches)**	Year of Regulation: **2024-25**
Department	**Mechanical Engineering**	Semester: **IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
ME218	**Indian Health, Wellness and Psychology**	**-----**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

			COs	Statement	Bloom's Taxonomy
Course Objectives	Understanding the fundamental principles of Indian health systems such as Ayurveda and yoga which are useful in maintaining the health of a healthy person	Course Outcomes	ME218.1	Students will be able to know about the IKS and its role in Indian as well as World history.	Knowledge
	Practical implementation of health principles to correct the intake of our food, air, water and sunlight to achieve perfect health.		ME218.2	Students will be able to understand the contributions of IKS in health and the role of Ayurveda	Knowledge
	Understanding unique Mind Body Constitution and choosing the right lifestyle suitable to maintain the internal balance.		ME218.3	Students will be able to understand the role of IKS in Wellness and learn the benefits of Yoga.	Knowledge
			ME218.4	Students will be able to understand the role of IKS in Psychology and learn different aspects of the mind.	Knowledge
			ME218.5	Students will be able to design and present cognitive problem-solving kits.	Analysis, Synthesis, Creation

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ME218.1		2						2				2	2	2	
ME218.2	3	3		2			2	2				2	2	2	
ME218.3	3	3		2			2	2				2	2	2	
ME218.4	3	2		2			2	2				2	2	2	
ME218.5	3	3	3	2	2	3	3	3	3	3	3	3	2	2	
ME218	**3**	**2.6**	**3**	**2**	**2**	**3**	**2.25**	**2.2**	**3**	**3**	**3**	**2.2**	**2**	**2**	

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to IKS:** What is IKS? Why do we need IKS? Organization of IKS, Historical authenticity of IKS, some salient aspects of IKS	**4**	**ME218.1**
II	**Health:** Introduction to health; Definition of health in Ayurveda; Introduction to Ayurveda, the Knowledge of Life, Health and treatment aspects in Ayurveda; Influence of Pancha maha bhuta or the five elements on Internal environment of Human being	**6**	**ME218.2**
III	**Wellness:** Understanding Swastha vritta, the healthy regimen to maintain state of wellbeing; Dinacharya, the Daily regimen including Daily detoxification, exercise, Intake of Food, Water, Air and Sunlight, work and ergonomics, Rest and sleep hygiene; Meaning and objectives of Yoga, Introduction to hatha yoga and other forms of karma yoga, raja yoga, gnan yoga and bhakti yoga; Approaches to lead a healthy life;	**7**	**ME218.3**
IV	**Psychology:** Indian approach to psychology; Concept of Manas in Ayurveda and understanding Mind Body harmony, Triguna based Psychology in Ayurveda and Yoga, Influence of Tri dosha on Mind, Mind body intellect and consciousness complex	**7**	**ME218.4**
V	**Minor project:** Development of cognitive materials/kits for problem solving, creativity, intelligence; Presentation.	**4**	**ME218.5**
	Total Hours	**28**	

Essential Readings

1. B. Mahadevan, V. R. Bhat, R. N. Nagendra Pavana, "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Pvt. Ltd, 2022.
2. K. Kapur and A. K. Singh (Eds), "Indian Knowledge Systems, Vol. 1", Indian Institute of Advanced Study, Shimla, 2005.
3. D. Chopra, "Perfect Health--Revised and Updated: The Complete Mind Body Guide", Harmony Publications, 2001
4. V. Lad, "Ayurveda, the Science of Self-healing: A Practical Guide", Lotus Press, 1984
5. B.K.S. Iyengar, "Light on Yoga: The Classic Guide to Yoga by the World's Foremost Authority", Thorsons Publications, 2006.
6. B. Avari, "India: The Ancient Past: A History of the Indian Subcontinent from c. 7000 BCE to CE 1200", 2nd edition, London: Routledge, 2016.

Supplementary Readings

1. B. S. Sukumar and H. K. Shashirekha, "Charaka Samhita, General Principles (Volume I)", Chaukhambha Publications, 2017.
2. "Tatvabodh of Sankaracharya", Central Chinmay Mission Trust, Bombay, 1995.
3. B. Bhattacharya, "Everyday Ayurveda", Penguin Random House India, 2015.
4. D. Vora, "Health in your Hands: Vol 1", Navneet Education Limited, 1989.
5. "Healthy Mind, Healthy Body", Ramakrishna Math, Chennai, 2022
6. S. Gokulanananda, "How to overcome Mental Tension", RKMIC, Kolkata, 2019.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS252	**Software Engineering Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the Software Development life cycles Models		CS252.1	**Able to identify, formulate, and solve complex engineering problems**	Create
	To analyse the software requirements		CS252.2	**Able to recognize ethical and professional responsibilities in engineering situations**	Understand
	To introduce various design methods for software Development		CS252.3	**Able to analyze, design, verify, validate, implement, apply, and maintain software systems**	Create
	To develop an ability and skill to test software systems		CS252.4	**Able to develop software in one or more significant application domain**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS252.1	**2**												**1**	**1**	
CS252.2	**2**	**1**	**1**	**1**				**1**			**1**	**1**	**2**	**1**	**1**
CS252.3	**1**	**1**	**1**	**1**								**1**	**1**	**1**	**1**
CS252.4	**1**	**1**	**1**	**1**					**1**		**1**	**1**	**1**	**1**	**1**
CS252	1.50	1.00	1.00	1.00				1.00	1.00		1.00	1.00	1.25	1.00	1.00

SYLLABUS

No.	Content	Hours	COs
I	**Software Development life cycles Models, Agile Process Models Software**	**04**	**CS252.1 CS252.2 CS252.3 CS252.4**
II	**Static program verification tool (SLAM) for verifying critical program behaviour, Data Modelling Concepts, Object Oriented Analysis, Flow-Oriented Modelling,**	**04**	
III	**Formal verification of concurrent systems using SPIN model checker.**	**05**	
IV	**DFD and UML Development for the requirements**	**05**	
V	**Design and coding using software development languages**	**05**	
VI	**Taxonomy of Quality Attributes, Perspectives of Quality, Quality System, Software Quality Assurance, Manual and automated testing tools.**	**05**	
	To be done necessarily as mini-project group-wise in groups of at least two/three students.		
Total Hours		**28**	

Essential Readings

1. Roger S Pressman: "Software Engineering – A Practitioner's Approach", 7th Edition, McGraw-Hill, 2009.
2. Rajib Mall, "Fundamentals of Software Engineering", 5th Edition, PHI, 2018.
3. Ian Sommerville: "Software Engineering". 10th Edition, Pearson Education, 2017.

Supplementary Readings

1. SLAM Reference- http://research.microsoft.com/en-us/projects/slam/
2. SPIN Model Checker Reference: http://spinroot.com/spin/whatispin.html
3. Paul Ammann, and Jeff Offutt, "Introduction to Software Testing", 2nd Edition, Cambridge University Press, 2016.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS 254	**Object Oriented Programming and Design Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	To provide students in-depth theoretical base and fundamentals of Object Oriented Programming paradigm		CS254.1	**Able to acquire identify the paradigm change of C to C++ and able to infer the basic concepts, the concepts of function and operator overloading in C++, and write C++ code to solve real-life problems**	Create
	To prepare students to design and code various projects using Object Oriented Programming paradigm		CS254.2	**Able to interpret and use the concept of Inheritance and polymorphism, with their various types in C++, by writing C++ code to design solutions**	Create
			CS254.3	**Able to infer the concepts of file handling and exception handling in C++, and able to write C++ code using those concepts**	Create
			CS254.4	**Able to interpret the concept of templates, Standard Template Libraries and use them to write C++ codes**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS254.1	**2**					**1**		**2**				**2**	**1**	**1**	**1**
CS254.2	**2**	**2**	**2**	**1**	**2**			**2**		**2**		**1**	**2**	**2**	**1**
CS254.3	**3**	**2**	**2**	**3**			**2**	**1**		**1**	**1**	**1**	**2**	**1**	**1**
CS254.4	**1**	**1**		**1**				**2**	**1**	**1**		**2**	**3**	**1**	**3**
CS254	2.00	1.67	2.00	1.67	2.00	1.00	2.00	1.75	1.00	1.33	1.00	1.50	2.00	1.25	1.50

SYLLABUS

No.	Content	Hours	COs
I	Assignments and Tutorials on basic classes and objects, string class, friend function, constructors and destructors, function and operator overloading.	**10**	**CS254.1**
II	Assignments and Tutorials on inheritance and its various types, run-time polymorphism	**06**	**CS254.2**
III	Assignments and Tutorials on file and exception handling	**06**	**CS254.3**
IV	Assignments and Tutorials on templates	**06**	**CS254.4**
	Total Hours	**28**	

Essential Readings

1. Robert Lafore, "Object-Oriented Programming in C++", 4th Edition, Sams Publishing, 2001.
2. E Balagurusamy, "Object-Oriented Programming in C++", 8th Edition, McGraw-Hill Education India, 2020.
3. Yashvant Kanetkar, "Let Us C++ ", BPB Publication, 2020.

Supplementary Readings

1. P.J. Deitel and H.M Deitel, "C++ How to Program", 10th Edition, Pearson Publication, 2016.
2. Herbert Schildt, "C++: The Complete Reference", 4th Edition, McGraw-Hill Education India, 2017.
3. Bjarne Stroustrup, "The C++ Programming Language", 3rd Edition, Pearson Education India, 2002.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS256	**Data Communication Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the components of Data Communication		CS256.1	**Able to learn the fundamentals of data communication**	Understand
	To analyse the Analog and Digital Transmission		CS256.2	**Able to Understand the digital signal and analog signal transmission over different types of transmission media.**	Understand
	To describe the structure of Physical and Data Link Layer		CS256.3	**Able to distinguish different techniques of error detection and correction and medium access control.**	Analyse
	To describe the function of wireless networks		CS256.4	**Able to acquire knowledge about the generations of wireless networks.**	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS256.1	**2**												**2**	**1**	
CS256.2	**2**	**1**	**1**	**1**				**1**			**1**	**1**	**1**	**1**	**1**
CS256.3	**1**	**1**	**1**	**1**								**1**	**1**	**1**	**1**
CS256.4	**1**	**1**	**2**	**2**					**1**		**1**	**1**	**1**	**1**	**1**
CS256	1.50	1.00	1.33	1.33				1.00	1.00		1.00	1.00	1.25	1.00	1.00

SYLLABUS

No.	Content	Hours	COs
I	Study and discussion on various Computer network commands such as Ping, Netstat, Tracert, ARP, Nbtstat, Netsh and execution of the commands.	**03**	**CS256.1 CS256.2 CS256.3 CS256.4**
II	Installation and Setup of Packet Tracer Tool. Study and execution of basic commands of Packet Tracer such as Traceroute, ifconfig, Telnet and others.	**03**	
III	Setting up a Local Area Network in Packet Tracer with Static Routing – (i) Static Routing without CLI and (ii) Static Routing with CLI.	**03**	
IV	Initialization and Setting up a Router with Encryption in Packet Tracer.	**03**	
V	Configuration of DHCP Server and Network Address Translation in Packet Tracer.	**05**	
VI	(i) To understand the working of LAN Trainer kit. (ii) Stop & Wait Protocol implementation on LAN Trainer kit. (iii) Go-Back N Protocol implementation on LAN Trainer kit. Selective-Repeat Protocol implementation on LAN Trainer kit.	**05**	
VII	Data Transmission through wired and wireless communication without any outside support.	**03**	
VIII	Setting a local server for access of files	**03**	
	To be done necessarily as mini-project group-wise in groups of at least two/three students.		
	Total Hours	**28**	

Essential Readings

1. Behrouz A Forouzan, "Data Communication and Networking", 5th Edition, McGraw-Hill Education, 2018.
2. Andrew S Tanenbaum, David J. Wetherall "Computer Networks", 5th Edition, Prentice Hall. 2011.
3. William Stallings, "Data and Computer Communication", 10th Edition, Pearson, 2017.
4. A Jesin, "Packet Tracer Network Simulator", 1st Edition, Packt Publishing Ltd., 2014.

Supplementary Readings

1. James F Kurose, Kaith W Ross, "Computer Networking | A Top-Down Approach", 6th Edition, Pearson, 2017.
2. A L Garcia, I Widjaja, "Communication Networks: Fundamental Concepts and Key Architectures", 2nd Edition, Tata McGraw Hill, 2017.
3. B. Buchanan, "The Handbook of Data Communications and Networks", 1st Edition, Springer, 2004.
4. James F Kurose, Kaith W Ross, "Computer Networking | A Top-Down Approach", 6th Edition, Pearson, 2017.

Fifth Semester Courses

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS301	**Operating Systems**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the components of operating system		CS301.1	**Able to learn the fundamentals of Operating Systems**	Understand
	To analyse the process scheduling and execution		CS301.2	**Able to acquire knowledge about different process scheduling techniques.**	Understand
	To describe the structure of main memory, virtual memory		CS301.3	**Able to solve process synchronization and deadlock handling strategies**	Apply
	To describe the function of file systems		CS301.4	**Able to acquire knowledge about different memory management techniques and page replacement algorithms.**	Understand
	To explore the structure of an operating system's I/O subsystem and hardware.		CS301.5	**Able to describe file concepts and analyse various disk scheduling and storage strategies**	Analyse

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS301.1	**2**												**2**	**1**	
CS301.2	**2**	**1**	**1**	**1**				**1**			**1**	**1**	**2**	**1**	**1**
CS301.3	**2**	**2**	**2**	**1**								**1**	**2**	**1**	**1**
CS301.4	**2**	**2**	**2**	**2**					**1**		**1**	**1**	**1**	**1**	**1**
CS301.5	**1**		**1**	**1**								**1**	**1**	**1**	
CS301	1.80	1.67	1.50	1.25				1.00	1.00		1.00	1.00	1.60	1.00	1.00

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** **Operating Systems Functionalities - Formal Definition - Evolution – Types of operating system, Services, Operating system Design and Implementation, Operating System Structure.**	**04**	**CS301.1**
II	**Process Management** **Process concept - Process control block, Process Hierarchy, Threads – Single Thread and Multi Thread Model, IPC models: shared memory and message passing. CPU Scheduling algorithms, Multiprocessor Scheduling, Process Synchronization - Peterson's Solution, Process Synchronization - Semaphores, Critical Regions, Monitors - Deadlock prevention- Deadlock avoidance and Deadlock Detection and Recovery - Bankers Algorithm.**	**14**	**CS301.2, CS301.3**
III	**Memory Management** **Overview of Swapping - Multiple Partitions – Paging, Page table, Segmentation, Demand paging- Fragmentation & Compaction- Page replacement algorithms, Memory allocation algorithms: first fit, Best fit, worst fit.**	**12**	**CS301.1, CS301.4**
IV	**File System** **Access Methods, Contiguous-Sequential and Indexed Allocation, File system interface - File System implementation, Secondary Storage Structure.**	**08**	**CS301.1, CS301.5**
V	**I/O System** **RAID-disk scheduling- Device drivers - block and character devices-streams, Character and Block device switch tables**	**04**	**CS301.1, CS301.5**
	Total Hours	**42**	

Essential Readings

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley & Sons Inc. 2012.
2. Andrew S Tanenbaum, "Modern Operating Systems", 4th Edition, Prentice Hall. 2014
3. William Stallings, "Operating System: Internals and Design Principles", 9th Edition, Pearson, 2018.

Supplementary Readings

1. Harvey M. Deitel, Paul J. Deitel, David R. Choffnes, "Operating System", 3rd Edition, Pearson, 2013.
2. D M Dhamdhere, "System Programming and Operating Systems", 2nd Edition, Tata McGraw Hill, 2009.
3. Gary Nutt, " Operating Systems: A Modern Perspective", 2nd Edition, Addison Wesley, 2001.
4. Achyut S Godbole, "Operating Systems", 3rd Edition, Tata McGraw Hill, 2010.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 303	**Database Management Systems**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To understand the fundamentals concepts of database, operation of relational data model and its requirement in an organization.**	Course Outcomes	CS303.1	**Able to understand the fundamental components of database systems, Relational Database Management System and its need towards an organization.**	**understand**
	To understand the various relational data models, application of relational data models to design logical database including E- R diagrams and database normalization. And also write the simple and optimized advanced database queries using Structured Query Language (SQL).		CS303.2	**Able to demonstrate the data models, analyse the real world problems and requirements, to give the appropriate solution using the principles of Entity Relationship Diagram.**	**Analyse**
	To develop and ability to design and implement a small database project using Structured Query Language (SQL).		CS303.3	**Able to attain the practical understanding of SQL, convert the Entity relationship model to relational tables, operations to store the data using queries.**	**Analyse**
	To understand the requirement of database tuning, concept of a database transaction, including concurrency control, backup & recovery, data object locking protocols and role of database administrator.		CS303.4	**Able to apply the principles of normalization to remove the redundancy and inconsistency to improve the performance using database tuning and query optimization.**	**Apply**
			CS303.5	**Able to understand the concurrent transactions, Problems such as failures, solutions to solve the concurrency problems & recovery from failure using protocols**	**Understand**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS303.1	3	3							2				3		3
CS303.2	3	3	3	1	2				1				2	3	2
CS303.3	1	2	3	3	2	2							2	3	3
CS303.4	1	2	3	3	3	2	3		2			1	2	3	2
CS303.5	2	3	3	2	2	3	2		2			1	3	3	3
CS303	**2**	**2.6**	**2.4**	**1.8**	**1.8**	**1.4**	**1**		**1.4**			**0.4**	**2.4**	**2.4**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Database: Purpose of database systems, data abstraction and modeling, instances and schemes, database manager, database users and their interactions, data definition and manipulation language, data dictionary, overall system structure.**	**03**	**CS303.1 CS303.2**
II	**Entity-relationship model: Entities and entity sets, relationships and relationship sets, mapping constraints, E-R diagram, primary keys, strong and weak entities, reducing E-R diagrams to tables, trees or graphs, generalization and specialization, aggregation.**	**05**	**CS303.1 CS303.2**
III	**Brief Introduction to hierarchical and network model: Data description and tree structure diagram for hierarchical model, retrieval and update facilities, limitations; Database task group (DBTG) model, record and set constructs retrieval and update facilities, limitations.**	**05**	**CS303.2 CS303.3**
IV	**Relational model and Query optimization: Structure of a relational database, operation on relations, relational algebra, tuple and domain relational calculus, salient feature of a query language, Structured query language: Description an actual RDBMS and SQL. Importance of query processing, equivalence of queries, cost Estimation for processing a query, general strategies, bi-relational and multi-relational join algorithms, algebraic manipulation.**	**08**	**CS303.2 CS303.3 CS303.4**
V	**Normalization: Pitfalls in RDBMS, importance of normalization, functional, multi-valued and join dependencies, 1NF to 5NF, limitations of RDBMS.**	**07**	**CS303.4 CS303.5**
VI	**Database tuning: Index selection and clustering, tuning of conceptual schema, denormalization, tuning queries and views.**	**04**	**CS303.2 CS303.4**
VII	**Crash recovery: Failure classification, transactions, log maintenance, check point implementation, shadow paging, example of an actual implementation**	**04**	**CS303.5**
VIII	**Concurrency Control in RDBMS: Testing for serializability, lock based and time-stamp based protocols; Deadlock detection and Recovery**	**06**	**CS303.4 CS303.5**
	Total	**42**	

Essential Readings

1. Silberschatz, Korth and Sudarshan, Database system concepts, McGraw Hill, 7th Edition, 2019.
2. C.J. Date, An Introduction to Database Systems (8th Edition), Pearson, 8th Edition, 2004.
3. Steven Feuerstein, Bill Pribyl, "Oracle PL/SQL Programming,", O'Reilly Media, 6th Edition, 2014.

Supplementary Readings

1. Elmasri and Navathe, Fundamentals of database systems; Pearson, 7th Edition, 2016.
2. Raghu Ramakrishnan and Gehrke, Database Management System, McGraw-Hill, 3rd Edition, 2014.
3. C. J. Date, SQL and Relational Theory: How to Write Accurate SQL Code , O'Reilly Media, 3rd Edition, 2015.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 305	**Computer Networks**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To develop the student's ability to understand the basic concept of networking, packet switching and circuit switching etc.**	Course Outcomes	CS305.1	**Able to identify and interpret the basics of the internet and evaluate answers by applying the concepts of circuit switching and packet switching**	Evaluate
	To develop the student's ability to understand the application layer of the network model along with the ability to perform socket programming.		CS305.2	**Able to infer the purpose of application layer and articulate various application layer protocols such as DNS, FTP, SMTP.**	Apply
	To provide the students with some knowledge and analysis skills associated with transport layer protocols TCP and UDP.		CS305.3	**Able to explain the purpose of transport layer, make use of transport layer protocols - UDP & TCP, and evaluate various congestion control mechanisms**	Evaluate
	To develop the student's ability to understand the network layer of network model like IPv4 addressing NAT etc.		CS305.4	**Able to outline the functions of the network layer, experiment with IPV4 addressing and determine solutions of relevant problems.**	Evaluate
			CS305.5	**Able to demonstrate routing and forwarding process and make use of different routing algorithms.**	Apply
			CS305.6	**Able to understand the concepts of network security and management, and the future trends of networking.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS305.1	**2**					**1**		**2**				**2**	**1**	**1**	**1**
CS305.2	**2**	**2**	**2**	**1**	**2**			**2**		**2**		**1**	**2**	**2**	**1**
CS305.3	**3**	**2**	**2**	**3**			**2**	**1**		**1**	**1**	**1**	**2**	**1**	**1**
CS305.4	**1**	**1**		**1**				**2**	**1**	**1**		**2**	**3**	**1**	**3**
CS305.5		**1**	**1**	**1**	**2**	**3**		**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**
CS305.6	**2**		**3**		**1**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**3**	**3**	**3**
CS305	2.00	1.50	2.00	1.50	1.67	1.67	1.50	1.67	1.00	1.40	1.00	1.33	2.00	1.67	1.67

SYLLABUS

No.	Content	Hours	COs
I	**Basics of Internet:** **Internet Service Providers (ISPs); protocols and standards; Network edge - access networks: dial-up, DSL, cable, FTTH, Ethernet, WiFi, WiMax; Network core - circuit switching: multiplexing; packet switching: traffic, congestion; delays; traffic intensity; throughput; protocol layering;**	**05**	**CS305.1**
II	**Application Layer:** **Architecture – client-server, peer-to-peer, hybrid; DNS: brief, hierarchical database; Internet transport services; The Web and HTTP - What actually happens, HTTP request and response, web cache; Process communication; Socket programming; File transfer: FTP; Electronic mail: SMTP, POP3, IMAP, Web-based e-mail;**	**06**	**CS305.2**
III	**Transport Layer:** **Real Life Analogy; Multiplexing and De-multiplexing; TCP and UDP sockets; Web Servers and TCP; Why UDP?; TCP UDP Examples; UDP Segment; TCP Segment; Flow Control - Stop and Wait, Go-Back-N, Selective Repeat; Transmission Control Protocol; TCP Connection Establishment - Three-Way Handshaking, Data Transfer, Connection Termination; SYN Flooding Attack; TCP Congestion Control - congestion window, congestion detection, Slow Start: Exponential Increase, Congestion Avoidance: Additive Increase, Additive Increase Multiplicative Decrease; TCP Variants - Tahoe and Reno;**	**06**	**CS305.3**
IV	**Network Layer – Part 1:** **Functions; Packet Switching - Virtual Circuit, Datagram; What's inside a router? - Input Processing, Switching, Output Processing; IPV4 Address - Classful Addressing, Classless Addressing - address mask, block allocation, subnetting; Special Addresses; IP Datagram, Fragmentation; Dynamic Host Configuration Protocol - properties, protocol steps; Network Address Translation;**	**08**	**CS305.4**
V	**Network Layer – Part 2 (Routing Algorithms and Protocols):** **Distance Vector Routing; Link State Routing; Path Vector Routing; Routing Information Protocol; Open Shortest Path First; Border Gateway Protocol; Multicast routing protocol; Wireless routing protocol;**	**09**	**CS305.5**
VI	**Security and Network Management:** **Cryptography and Network Security; Internet Security: IPSec, SSL/TLS and PGP; SNMP;**	**03**	**CS305.6**
VII	**Future Trends:** **Internet-of-Things (IoT); Software Defined Networking (SDN)**	**03**	
	Total Hours	**40**	

Essential Readings

1. J. F. Kurose, K. W. Ross, "Computer Networking: A Top-Down Approach", Pearson Publication, 7th Edition, 2016.

2. B. Forouzan, “Data Communication and Networks”, McGraw-Hill Publication, 5th Edition, 2012.
3. A. S. Tanenbaum, D. J. Wetherall, “Computer Networks”, Pearson Publication, 5th Edition, 2011.

Supplementary Readings

1. W. Stalling, “Data and Computer Communications”, Pearson Publication, 8th Edition, 2007.
2. L. L. Peterson, B. S. Davie, “Computer Networks: A Systems Approach”, Morgan Kaufmann Publishers, 5th Edition, 2012.
3. A. L. Garcia and I. Widjaja, “Communication Networks Fundamental Concepts and Key Architectures”, Tata McGraw-Hill Publication, 2nd Edition, 2004.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS307	**Cryptography and Network security**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To develop the student's ability to understand the concept of security goals in various applications.**	Course Outcomes	CS307.1	**Able to understand about security goals, background of cryptographic mathematics and identification of its application**	**Understand**
	To provide the students with some fundamental cryptographic mathematics used in various symmetric and asymmetric key cryptography.		CS307.2	**Able to acquire knowledge about the background mathematics of symmetric key cryptography and understand, analyse and implement – the symmetric key algorithm.**	**Analyse**
	To develop the student's ability to analyse the cryptographic algorithms.		CS307.3	**Able to acquire knowledge about the background mathematics of asymmetric key cryptography and understand and analyse – asymmetric key encryption algorithms, digital signatures**	**Analyse**
	To familiarize the student the need of security in computer networks.		CS307.4	**Able to understand and analyse the concept of message integrity and the algorithms for checking the integrity of data.**	**Analyse**
			CS307.5	**Able to understand and analyse the existing cryptosystem used in networking**	**Analyse**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS307.1	**3**	**3**											**2**		**3**
CS307.2	**3**	**3**				**1**			**2**				**3**	**3**	**2**
CS307.3	**3**	**3**	**3**	**1**	**2**	**1**			**2**				**3**	**3**	**2**
CS307.4	**2**	**3**	**3**	**1**	**2**	**2**	**3**		**2**			**1**	**3**	**2**	**2**
CS307.5	**2**	**3**	**3**	**1**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
CS307	**2.6**	**3**	**1.8**	**0.6**	**1.2**	**1.2**	**1.2**		**1.6**			**0.4**	**2.8**	**2.2**	**2.4**

SYLLABUS

No.	Content	Hours	COs
I	Introduction Security goals, cryptographic attacks. Mathematics of cryptography: modular arithmetic, Euclidean and extended Euclidean algorithm. Traditional symmetric key ciphers; Monolithic ciphers: addition and multiplication ciphers, Polyalphabetic ciphers: Vigenere's ciphers, Hill ciphers, playfair ciphers.	**08**	**CS307.1**
II	Symmetric key cryptography Mathematics of symmetric key cryptography: Groups, Rings, Fields, GF, Inverse of a number and polynomial using extended Euclidean algorithm. Modern Block ciphers and its components, DES, AES	**08**	**CS307.2**
III	Asymmetric key cryptography Mathematics of asymmetric key cryptography: Euler's Phi-Function, Fermat's Little Theorem, Euler's theorem, Chinese remainder theorem. Diffie-Hellman, Digital signature: RSA, Elgamal, Entity authentication	**08**	**CS307.3**
IV	Message Integrity and authentication: MAC, HMAC. Cryptographic Hash Function: Merkle-Damgard, MD5, SHA512.	**06**	**CS307.4**
V	Network Security Key Management, PGP, IPSec, SSL, Firewalls, Intrusion Detection, Password management, Virus. Virtual Private Network.	**10**	**CS307.5**
	Total Hours	**40**	

Essential Readings

1. Behrouz A. Forouzan, "Cryptography and Network Security", McGraw-Hill publication, 2nd Edition, 2010.
2. William Stallings ,"Cryptography and Network Security: Principles and Standards", Prentice Hall India, 7th Edition, 2017.
3. John R. Vacca, "Computer and Information Security Handbook", Morgan Kaufmann Publishers, 3rd Edition, 2017.

Supplementary Readings

1. Richard H. Baker, Network Security, McGraw Hill International 3rd Edition,1996.
2. B. Schneier, Applied Cryptography, John Wiley New York, 2nd Edition, 1996.
3. C. Kaufman et. al, Network Security, Prentice Hall International, 2nd Edition, 2002.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 309	**Internet of Things**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To provide the students with some knowledge about the definition and significance of the Internet of Things.		CS309.1	**Able to demonstrate the basic concept of IoT, the architecture of IoT, and applications of IoT in the real life.**	Understand
	To develop the student's ability to understand the architecture, operation, and business benefits of an IoT solution.		CS309.2	**Able to explain the mechanism of various protocols used in different layers of IoT.**	Undestand
	To develop the student's ability to understand different protocols used for communication between various IoT devices.		CS309.3	**Able to identify the challenges of Interoperability and techniques used for Interoperability in IoT.**	Analyse
	To develop the student's ability to understand the relationship between IoT, cloud computing, and big data.		CS309.4	**Able to examine different Service and Resource Discovery in IoT.**	Evaluate
	To provide knowledge to students about various privacy and security issues in IoT.		CS309.5	**Able to interpret about various privacy and security issues in IoT communication.**	Understand
			CS309.6	**Able to imagine and improve the relationship between IoT, cloud computing, fog computing and big data.**	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS309.1	**2**					**1**	**2**		**1**	**1**			**2**	**1**	**1**
CS309.2	**2**	**3**	**1**	**1**		**2**	**1**		**3**	**2**	**1**	**2**	**1**	**2**	**2**
CS309.3	**3**	**2**	**1**		**2**	**3**		**1**		**1**	**3**	**1**	**3**	**2**	**2**
CS309.4	**1**		**3**	**2**		**2**	**1**		**3**	**2**	**1**		**1**	**2**	**2**
CS309.5	**2**		**1**		**2**	**3**	**1**		**1**	**2**	**1**		**3**	**2**	**3**
CS309.6	**1**	**2**		**3**	**1**	**2**		**2**		**1**			**2**	**3**	**2**
CS309	1.83	2.33	1.50	2.00	1.67	2.17	1.25	1.50	2.00	1.50	1.50	1.50	2.00	2.00	2.00

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** **What is IoT, Ad-hoc and Sensor Networks, Architecture of IoT, Application of IoT: Smart home, Intelligent transportation systems, Industrial aumtomation, Smart healthcare, Smart grids;**	**5**	**CS309.1**
II	**IoT Standards:** **Designing the architecture of an IP-based IoT, Application Protocols: Constrained Application Protocol (CoAP), CoSIP, Message Queue Telemetry Transport (MQTT), Extensible Message and Presence protocol (XMPP), Advanced Message Queuing Protocol (AMQP), Data Distribution Service (DDS); Service Discovery Protocols: Multicast DNS (mDNS), DNS Service Discovery (DNS-SD); Infrastructure Protocols: Routing Protocol for Low Power and Lossy Networks (RPL), 6LoWPAN, IEEE 802.15.4 and ZigBee, Bluetooth Low Energy (BLE), Low-power Wi-Fi, IEEE 802.15.6, EPCglobal, LTE-A, Z-Wave;**	**11**	**CS309.2**
III	**Interoperability:** **Applications in the IoT, The verticals: Cloud-based solutions, REST Architecture: The Web of Things, Messaging Queues and Publish/Subscribe Communications, Session initiations for the IoT, Optimized Communications: the Dual-network Management Protocol, Discoverability in Constrained Environments, Data Formats: Media types for sensor markup language;**	**6**	**CS309.3**
IV	**Discoverability:** **Service and Resource Discovery, Local and Large-scale Service Discovery, Sclable and self-configuring Architecture for Discovery in the IoT, Lightweight Service Discovery in Low-power IoT Networks;**	**4**	**CS309.4**
V	**Security and Privacy in the IoT:** **Security issues in the IoT: Traditional vs Lightweight security, Lightweight Cryptography, Key Agreement, Distribution and Security Bootstrapping, Processing data in the encrypted domain: Secure data aggregation, Authorization mechanisms for secure IoT services;** **Privacy issues in the IoT: The role of Authentication, IoT-OAS: Delegation-based authorization for the IoT, IoT-OAS application scenarios, Hybrid gateway-based communication;**	**7**	**CS309.5**
VI	**Cloud and Fog Computing for IoT:** **Cloud computing, Big data processing pattern, Big stream, Big stream and security, Fog computing and the IoT, Role of the IoT hub: Virtualization and replication, Operational scenarios, Synchronization protocol;**	**7**	**CS309.6**
	Total Hours	**40**	

Essential Readings

1. Cirani S, Ferrari G, Picone M, Veltri L. Internet of Things: Architectures, Protocols and Standards. John Wiley & Sons; 2018.
2. Lea P. Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security. Packt Publishing Ltd; 2018.
3. Buyya R, Dastjerdi AV, editors. Internet of Things: Principles and paradigms. Elsevier; 2016.

Supplementary Readings

1. Chou T. Precision-Principles, Practices and Solutions for the Internet of Things. McGraw-Hill Education; 2017.
2. Santos M, Moura E. Hands-On IoT Solutions with Blockchain: Discover how converging IoT and blockchain can help you build effective solutions. Packt Publishing Ltd; 2019.
3. Al-Fuqaha A, Guizani M, Mohammadi M, Aledhari M, Ayyash M. Internet of things: A survey on enabling technologies, protocols, and applications. IEEE communications surveys & tutorials. 2015 Jun 15;17(4): 2347-76.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS371	**Advanced Python Programming**		**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To learn how to design object-oriented programs with Python classes.		CS371.1	**Able to understand basic concepts of Python programming.**	Understand
	To learn about reading, writing and implementing other operation on files in Python.		CS371.2	**Able to demonstrate working with files and perform operations on it using Python.**	Analyse
	To implement threading concept and multithreading on Python		CS371.3	**Able to implement regular expression and concept of threads for developing efficient program**	Apply
	To design GUI Programs and implement database interaction using Python.		CS371.4	**Able to implement exception handling in Python applications for error handling.**	Apply
	To know about use of regular expression and handling exceptions for writing robust python programs.		CS371.5	**Able to work with databases, designing GUI in Python**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS371.1	3		1		1					1	1	1			
CS371.2	2	3	3	2	1				1					1	
CS371.3	3	3	3	2	1				1					3	
CS371.4	3	2	2	2										1	
CS371.5	3	2	3	2	1				1					2	2
CS371	2.80	2.50	2.40	2.00	1.00				1.00	1.00	1.00	1.00		1.75	2.00

SYLLABUS

No.	Content	Hours	COs
I	**Functional Programming:** Arrays**,** Lambdas, List Comprehensions, Set and Dictionary Comprehensions, Closures and Decorators, Generators and Co-routines, Generator Expressions, Declarative Programming**.** **Date and time in python**: Date and time now, combining date and time, formatting dates and times, finding durations using "time delta", comparing two dates, sorting dates, stopping execution temporarily, knowing the time taken by a program, calendar module.	**5**	**CS371.1**
II	**Working with files**: Files, opening and closing a file, working with text files containing strings, knowing whether a file exists or not, working with binary files, the „with" statement, the seek() and tell() methods, random accessing of binary files, zipping and unzipping files, working with directories, running other programs from python program	**6**	**CS371.2**
III	**Regular expressions**: Sequence characters in regular expressions, quantifiers in regular expressions, special characters in regular expressions, using regular expression on files, retrieving information from an html file. **Threads:** Difference between process and thread, types of threads, benefits of threads, creating threads, single tasking and multitasking, thread synchronization, deadlock in threads, daemon threads.	**6**	**CS371.3**
IV	**Exceptions in python**: Errors in a python program, compile & run-time errors, logical error, exceptions-exception handling, types of exceptions, the except block, the assert statement, user-defined exceptions, logging the exceptions	**5**	**CS371.4**
V	**Database in python**: Using SQL with python, retrieving rows from a table, inserting rows into a table, deleting rows from a table, updating rows in a table, creating database tables through python, Exception handling in databases. **Graphical user interface**: Creating a GUI in python, Widget classes, Working with Fonts and Colours, working with Frames, Layout manager, Event handling.	**6**	**CS371.5**
	Total Hours	**28**	

Essential Readings

1. Paul Gries , Jennifer Campbell, Jason Montojo, Practical Programming: An Introduction to Computer Science Using Python 3, Pragmatic Bookshelf, 3rd Edition, 2018
2. Programming through Python, M. T Savaliya, R. K. Maurya, G M Magar, Revised Edition, Sybgen Learning India, 2020
3. Advanced Python Programming, Dr. Gabriele Lanaro, Quan Nguyen, SakisKasampalis, Packt Publishing, 2019

Supplementary Readings

1. Programming in Python 3, Mark Summerfield, Pearson Education, 2nd Ed, 2018
2. Python: The Complete Reference, Martin C. Brown, McGraw Hill, 2018
3. Beginning Python: From Novice to Professional, Magnus Lie Hetland, Apress,2017
4. Programming in Python 3, Mark Summerfield, Pearson Education, 2nd Ed, 2018

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS351	**Operating Systems Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives

- **To introduce the components of operating system**
- **To analyse the process scheduling and execution**
- **To describe the structure of main memory, virtual memory**
- **To describe the function of file systems**

Course Outcomes

	CO's	Statement	Bloom's Taxonomy
	CS351.1	**Able to understand the fundamentals of Operating Systems**	**Understand**
	CS351.2	**Able to acquire knowledge about different process scheduling techniques.**	**Understand**
	CS351.3	**Able to evaluate process synchronization and deadlock handling strategies**	**Evaluate**
	CS351.4	**Able to acquire knowledge about different memory management techniques and page replacement algorithms.**	**Understand**

COs

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS351.1	**2**												**2**	**1**	
CS351.2	**2**	**1**	**1**	**1**				**1**			**1**	**1**	**2**	**1**	**1**
CS351.3	**2**	**2**	**2**	**1**								**1**	**2**	**1**	**1**
CS351.4	**2**	**2**	**2**	**2**					**1**		**1**	**1**	**1**	**1**	**1**
CS351	**2**	**1.25**	**1.25**	**1**				**0.25**	**0.25**		**0.5**	**0.75**	**1.75**	**1**	**0.75**

SYLLABUS

No.	Content	Hours	COs
I	**Basic Commands of UNIX, Shell Programming, Implementation of CPU scheduling algorithms, Performance Comparison of CPU scheduling algorithms. Implementation of IPC.**	**08**	**CS351.1 CS351.2 CS351.3 CS351.4**
II	**Implementation of Peterson's Solution, Semaphores, Monitors**	**06**	
III	**Classical Process Coordination & Synchronization Problems like, Bounded Buffer, Producer- Consumer, Readers-Writers, Dinning philosophers, The Cigarette-Smokers Problem, Dining-Philosophers Solution Using Monitors**	**08**	
IV	**Implementation of Deadlock Avoidance Algorithms, Detection Algorithms**	**03**	
V	**Implementation of contiguous memory allocation techniques, Paging Techniques, Page Replacement Algorithms, Disk Scheduling Algorithms**	**03**	
	To be done necessarily as mini-project group-wise in groups of at least two/three students.		
Total Hours		**28**	

Essential Readings

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley & Sons Inc. 2012.
2. Andrew S Tanenbaum, "Modern Operating Systems", 4th Edition, Prentice Hall. 2014
3. William Stallings, "Operating System: Internals and Design Principles", 9th Edition, Pearson, 2018.

Supplementary Readings

1. Harvey M. Deitel, Paul J. Deitel, David R. Choffnes, "Operating System", 3rd Edition, Pearson, 2013.
2. D M Dhamdhere, "System Programming and Operating Systems", 2nd Edition, Tata McGraw Hill, 2009.
3. Gary Nutt, " Operating Systems: A Modern Perspective", 2nd Edition, Addison Wesley, 2001.
4. Achyut S Godbole, "Operating Systems", 3rd Edition, Tata McGraw Hill, 2010.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS353	**Database Management Systems Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	**To understand the concept of Database Management System in practical view and software specific tools for information processing oriented framework.**	Course Outcomes	CS353.1	**Able to understand and demonstrate the real time challenges in the Database Management Systems, components of various software tools.**	Apply
	To understand and demonstrate the E-R data model in formal way and implementation of relational data model (E-R data model) in relational data model using query and procedure.		CS353.2	**Able to design, Normalize, and implement the database schema for the given problems.**	Create
	To understand the real time problem, design an application as the developer to accomplish the given task.		CS353.3	**Able to construct the query using the SQL commands i.e. DDL/DML, declare and keep the integrity constraints on the developing database using the concept of Relational Database Management System.**	Create
	To understand and implement JDBC/ODBC concept for the operations for the developing database, Concurrent transaction processing and recovery in multiuser database environment.		CS353.4	**Able to improve the performance of query and write the programming SQL such as stored procedure, cursor, stored functions.**	Apply
			CS353.5	**Able to design and develop the graphical user interface application using fourth generation language to access the database.**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS353.1	**3**	**3**							**2**				**3**		**3**
CS353.2	**3**	**3**	**3**	**1**	**2**				**1**				**2**	**3**	**2**
CS353.3	**1**	**2**	**3**	**3**	**2**	**2**							**2**	**3**	**3**
CS353.4	**1**	**2**	**3**	**3**	**3**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
CS353.5	**2**	**3**	**3**	**2**	**2**	**3**	**2**		**2**			**1**	**3**	**3**	**3**
CS353	2.00	2.60	3.00	2.25	2.25	2.33	2.50		1.75			1.00	2.40	3.00	2.60

SYLLABUS

No.	Content	Hours	COs
I	Assignment on Entity Relationship modeling of real world problems.	**02**	**CS353.1**
II	Assignment on creating relational databases with simple tables	**02**	**CS353.1, CS353.2**
III	Assignment on implementation of indexing structures	**02**	**CS353.1, CS353.2**
IV	Assignment on creating databases with indexing structures	**02**	**CS353.3**
V	Assignment on implementing SQL queries	**02**	**CS353.3**
VI	Assignment on creating views and queries based on views	**02**	**CS353.3, CS353.4**
VII	Assignment on write SQL queries using logical operations (=,<,>,etc)	**02**	**CS353.3, CS353.4**
VIII	Assignment on implementing embedded SQL queries	**02**	**CS353.4**
IX	Assignment on PL/SQL	**02**	**CS353.4**
X	Assignment on check pointing and recovery	**02**	**CS353.4**
XII	Assignment on implementing multi-user database.	**04**	**CS353.5**
XII	Mini Project using the selected RDBMS and front end tools.	**04**	**CS353.5**
Total Hours		**28**	

Essential Readings

1. Silberschatz, Korth and Sudarshan, Database system concepts, McGraw Hill, 7th Edition, 2019.
2. C.J. Date, An Introduction to Database Systems (8th Edition), Pearson, 8th Edition, 2004.
3. Steven Feuerstein, Bill Pribyl, "Oracle PL/SQL Programming,", O'Reilly Media, 6th Edition, 2014.

Supplementary Readings

1. Elmasri and Navathe, Fundamentals of database systems; Pearson, 7th Edition, 2016.
2. Raghu Ramakrishnan and Gehrke, Database Management System, McGraw-Hill, 3rd Edition, 2014.
3. C. J. Date, SQL and Relational Theory: How to Write Accurate SQL Code, O'Reilly Media, 3rd Edition, 2015.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS355	**Computer Networks Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To develop the student's ability to understand the basic concept of networking, packet switching and circuit switching etc.		CS355.1	**Able to understand the brief of internet and also the concept of circuit switching and packet switching.**	Apply
	To develop the student's ability to understand the application layer of the network model along with the ability to perform socket programming.		CS355.2	**Able to understand the purpose of application layer and various application layer protocols such as DNS, FTP, SMTP.**	Apply
	To provide the students with some knowledge and analysis skills associated with transport layer protocols TCP and UDP.		CS355.3	**Able to understand various transport layer protocol like UDP, TCP, and various mechanisms to control TCP congestion.**	Create
	To develop the student's ability to understand the network layer of network model like IPv4 addressing NAT etc.		CS355.4	**Able understand the IPV4 addressing and forwarding mechanism and solve relevant problems.**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS355.1	**2**					**1**		**2**				**2**	**1**	**1**	**1**
CS355.2	**2**	**2**	**2**	**1**	**2**			**2**		**2**		**1**	**2**	**2**	**1**
CS355.3	**3**	**2**	**2**	**3**			**2**	**1**		**1**	**1**	**1**	**2**	**1**	**1**
CS355.4	**1**	**1**		**1**				**2**	**1**	**1**		**2**	**3**	**1**	**3**
CS355	2.00	1.67	2.00	1.67	2.00	1.00	2.00	1.75	1.00	1.33	1.00	1.50	2.00	1.25	1.50

SYLLABUS

No.	Content	Hours	COs
I	Assignment on Error Detection using Single Parity Check	**02**	**CS355.1**
II	Assignment on Error Detection using CRC	**02**	
III	Assignment on Error Detection using Checksum	**03**	
IV	Assignment on UDP Socket Programming – UDP Echo	**03**	**CS355.2 CS355.3 CS355.4**
V	Assignment on TCP Socket Programming – Client and Server both in same machine	**03**	
VI	Assignment on TCP Socket Programming – Client and Server in different machines	**03**	
VII	Assignment on TCP Socket Programming – Students' Database	**03**	
VIII	Assignment on TCP Socket Programming – English Dictionary	**03**	
IX	Assignment on TCP Socket Programming – Involving Files	**03**	
X	Assignment on TCP Socket Programming – Upload and Download	**03**	
	Total Hours	**28**	

Essential Readings

1. J. F. Kurose, K. W. Ross, "Computer Networking: A Top-Down Approach", Pearson Publication, 7th Edition, 2016.
2. B. Forouzan, "Data Communication and Networks", McGraw-Hill Publication, 5th Edition, 2012.
3. A. S. Tanenbaum, D. J. Wetherall, "Computer Networks", Pearson Publication, 5th Edition, 2011.

Supplementary Readings

1. W. Stalling, "Data and Computer Communications", Pearson Publication, 8th Edition, 2007.
2. L. L. Peterson, B. S. Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann Publishers, 5th Edition, 2012.
3. A. L. Garcia and I. Widjaja, "Communication Networks Fundamental Concepts and Key Architectures ", Tata McGraw-Hill Publication, 2nd Edition, 2004.

Sixth Semester Courses

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 302	**Design and Analysis of Algorithm**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To teach paradigms and approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice.		CS302.1	**Analyze the asymptotic performance of algorithms.**	Analyze
	To make students understand how asymptotic notation is used to provide a rough classification of algorithms.		CS302.2	**Write rigorous correctness proofs for algorithms.**	Create
	To explain different computational models and various complexity measures to analyze the complexity/performance of different algorithms.		CS302.3	**Apply important algorithmic design paradigms and methods of analysis.**	Apply
	To teach various advanced design and analysis techniques such as greedy algorithms, dynamic programming.		CS302.4	**Synthesize efficient algorithms in common engineering design situations.**	Create
	Know the concepts of tractable and intractable problems and the classes P, NP and NP-complete problems.				

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS302.1	2	1	1		1					1	1	1	1		1
CS302.2	2	1	1	1	1	1			1				1	1	1
CS302.3	1	1	1	1	1				1				2	2	
CS302.4	2	2	2	2									1	1	1
CS302	1.75	1.25	1.25	1.33	1.00	1.00			1.00	1.00	1.00	1.00	1.25	1.33	1.00

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** **Algorithm Specification, Algorithm Analysis, Analysis of Recursive Algorithms.**	**06**	**CS302.1** **CS302.2**
II	**Sorting and Selection** **Brute Force Approaches- Sequential Search, Bubble Sort, Selection Sort, Exhaustive Searching,** **Divide-and-Conquer Approach – Merge Sort, Quick Sort, Closest-pair Problem, Convex Hull Problem,** **Decrease-and-Conquer Approach – Insertion Sort, Topological Sort,** **Linear Sorting – Counting Sort, Bucket Sort, Radix Sort**	**09**	**CS302.2** **CS302.3**
III	**Greedy Algorithms** **Introduction, Knapsack Problem, Optimal Tree Problems – Optimal Merge, Huffman Coding; Optimal Graph Problems – Minimum Spanning Trees, Single-source Shortest-Path; Scheduling Problems – Scheduling without deadline, Scheduling with deadline**	**08**	**CS302.2** **CS302.3**
IV	**Dynamic Programming** **Basics of Dynamic Programming, Fibonacci Problem, Multistage Graph Problem, All Pairs Shortest-path Algorithm, Travelling Salesman Problem, Chain Matrix Multiplication, Knapsack Problem, Optimal Binary Search Trees,**	**08**	**CS302.2** **CS302.3**
V	**String processing** **String searching and Pattern matching, Knuth-Morris-Pratt algorithm and its analysis.**	**05**	**CS302.2** **CS302.4**
VI	**Computational Complexity Classes** **Upper and Lower Bound Theory, Class P, NP Class, NP- Complete**	**04**	**CS302.1** **CS302.4**
	Total Hours	**40**	

Essential Readings

1. A. Aho, J. Hopcroft and J. Ullman, "The Design and Analysis of Computer Algorithms", 4th Impression, Addison-Wesley, 2009.
2. E Horowitz, S Sahni, and S Rajasekhran, "Fundamentals of Computer Algorithms", 2nd Edition, Universities Press, 2008.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Pearson, 2010.
4. S. Sridhar, "Design and Analysis of Algorithms", 1st Edition, Oxford University Press, 2015.

Supplementary Readings

1. J. Kleinberg, E Tardos, "Algorithm Design", 1st Edition, Pearson, 2014.
2. S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani, "Algorithms", 2nd Edition, Tata McGraw Hill, 2016.
3. Steven S Skiena, "The Algorithm Design Manual", 2nd Edition, Springer, 2011.
4. H Bashin, "Algorithms Design and Analysis", 1st Edition, Oxford University Press, 2015.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 304	**Compiler Design**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

The Objectives of this course is to explore the principles, algorithms, and data structures involved in the design and construction of compilers.

To discuss context-free grammars, and front-end phases of a compiler: lexical analysis, parsing techniques, symbol tables, error recovery.

To discuss back-end phases of a compiler: code generation, and different code optimization techniques.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CS304.1	Able to acquire knowledge about lexical, syntactic and semantic structures of any computer programming language.	Understand
CS304.2	Able to analyse and separate the lexical, syntactic and semantic analysis into meaningful phases for a compiler to undertake language translation.	Analyse
CS304.3	Able to design Write a scanner, parser, and semantic analyser for limited form of C like programming languages.	Create
CS304.4	Able to convert source code in simple language into machine code for a novel computer.	Create
CS304.5	Able to describe techniques for intermediate code and machine code optimisation.	Create
CS304.6	Able to design the structures and support required for compiling advanced language features.	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS304.1	**3**	**2**	**3**	**1**									**1**	**2**	**2**
CS304.2	**3**	**3**	**3**	**3**								**2**	**1**	**1**	**3**
CS304.3	**2**	**3**	**3**	**1**	**3**				**1**				**1**	**1**	**3**
CS304.4	**2**	**1**	**1**	**2**	**2**				**1**				**1**	**1**	**3**
CS304.5	**2**	**1**	**2**	**1**	**1**								**1**	**1**	**3**
CS304.6	**2**	**2**	**2**	**3**								**2**	**1**	**1**	**3**
CS304	**2.3**	**2**	**2.3**	**1.8**	**2.0**				**2**			**2**	**1**	**1.2**	**2.8**

SYLLABUS

No.	Content	Hours	COs
I	Introduction to Compiler, Phases and passes,	**02**	**CS304.1**
II	Finite state machines and regular expressions and their applications to lexical analysis, Implementation of lexical analyzers, lexical-analyzer generator, LEX-compiler: LEX/FLEX,	**06**	**CS304.1, CS304.2, CS304.3**
III	Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG. Basic Parsing Techniques: Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items, Constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, Using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables, constructing LALR sets of items.	**14**	**CS304.1, CS304.3**
IV	Syntax-directed Translation: Syntax-directed Translation schemes, Implementation of Syntax directed Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, Translation of assignment statements, Boolean expressions, statements that alter the flow of control, Postfix translation, translation with a top down parser.	**11**	**CS304.4,CS304.5**

	More about translation: Array references in arithmetic expressions, procedures call, declarations, case statements. Symbol Tables: Data structure for symbols tables, representing scope information.		
V	Run-Time Administration: Implementation of simple stack allocation scheme, Storage allocation in block structured language. Error Detection & Recovery: Lexical Phase errors, syntactic phase errors semantic errors. Introduction to code optimization: Loop optimization, DAG representation of basic blocks, Value numbers and algebraic laws, Global Data-Flow analysis.	**09**	**CS304.1, CS304.6**
Total Hours		**42**	

Essential Readings

1. A.V. Aho, M. S. Lam, R. Sethi and J. D. Ullman, "Compilers-Principles, Techniques and Tools", 2nd ed., 2007, Pearson Education.
2. K. Muneeswaran, "Compiler Design", 1st ed., 2013, Oxford Publication.
3. P.H. Dave, H.B. Dave, "Compilers: Principles and Practice", 1st ed. 2012, Pearson Education.

Supplementary Readings

1. Allen I. Holub, "Compiler Design in C", 1st ed.(Indian print), 2012, PHI.
2. John Levine, "Flex & Bison ", 1st ed., 2009, O'reilly.
3. Torben Ægidius Mogensen, "Basics of Compiler Design", 1st ed., 2007, DIKU, University of Copenhagen

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 306	**Machine Learning**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To understand the different learning models and its usage in computer vision and data analytics.	Course Outcomes	CS306.1	Able to identify and understand potential applications of machine learning in practice	Understand
	To understand the different classification algorithms and its application in image understanding and data clustering		CS306.2	Able to understand the differences in approaches and applicability of regression, classification, and clustering	Understand
	To understand forecasting and different learning theory applied for prediction of desired conclusion in data analytics.		CS306.3	Able to implement forecasting and prediction models using different learning theory	Apply
	Apply different unsupervised learning and reinforcement learning models in application areas like image forgery, image classification, data clustering and decision making process		CS306.4	Able to understand and select the suitable machine learning models for decision making process	Understand
	To understand the dimension reduction process and handling of big data using machine learning models		CS306.5	Able to apply the dimension reduction process, feature selection process and use of machine learning models for big data	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS306.1	**3**	**3**		**1**					**2**				**3**		**3**
CS306.2	**3**	**3**		**1**					**2**				**2**		**2**
CS306.3	**2**	**3**	**3**	**1**	**2**								**2**	**3**	**2**
CS306.4	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
CS306.5	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
CS306	**2.4**	**2.6**	**1.8**	**0.6**	**1.2**	**0.8**	**1.2**		**1.6**			**0.4**	**2.4**	**1.8**	**2.4**

SYLLABUS

No.	Content	Hours	COs
I	Introduction, Machine learning basics, Supervised Learning: Artificial Neural Network, classifying with k- Nearest Neighbour classifier, Support vector machine classifier, Decision Tree classifier, Naive Bayes classifier, Bagging, Boosting, Improving classification with the AdaBoost meta algorithm.	**10**	**CS306.1**
II	Forecasting and Learning Theory: Predicting numeric values: regression, Linear Regression, Logistic regression, Tree-based regression. Bias/variance tradeoff, Union and Chernoff/Hoeffding bounds, Vapnik– Chervonenkis (VC) dimension, Worst case (online) learning.	**10**	**CS306.2**
III	Unsupervised Learning: Grouping unlabeled items using k- means clustering, Association analysis with the Apriori algorithm, efficiently finding frequent item sets with FP-growth.	**8**	**CS306.1, CS306.3**
IV	Reinforcement learning: Markov decision process (MDP), Bellman equations, Value iteration and policy iteration, Linear quadratic regulation, Linear Quadratic Gaussian, Q-learning, Value function approximation, Policy search, Reinforce, POMDPs.	**6**	**CS306.2, CS306.3**
V	Dimensionality reduction: Feature extraction - Principal component analysis, Singular value decomposition. Feature selection – feature ranking and subset selection, filter, wrapper and embedded methods. Machine Learning for Big data: Big Data and MapReduce.	**6**	**CS306.4, CS306.5**
	Total Hours	**40**	

Essential Readings

1. Title: Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Publisher: O'Reilly Media, Inc , 2nd Edition, 2019.
2. Title: Introduction to Machine Learning, Author E. Alpaydin, Publisher: MIT Press Edition, 2nd Edition, 2009.
3. Title: Machine Learning, Author: T. M. Mitchell, Publisher: McGraw-Hill, Edition 1997.

Supplementary Readings

1. Title: Machine learning in action, Author: P. Harrington, Publisher: Manning Publications, 2012 Edition.
2. Title: Pattern recognition and Machine Learning, Author C. M. Bishop, Publisher: Springer, 2007 Edition.
3. Title: Machine Learning for Big Data, Author: J. Bell, Publisher: Wiley, 2014 Edition.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS308	**Fuzzy Logic and Soft Computing**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	This Course introduces the soft computing techniques		CS308.1	**Able to appraise Soft Computing applications**	Understand
	This course illustrates to design the fuzzy logic controller		CS308.2	**Able to appraise Fuzzy Logic and choose applications**	Apply
	This course develop an ability and skill to implement optimization techniques		CS308.3	**Able to Examine the single-objective and multi-objective optimization problems**	Evaluate
	This course illustrates to design the various neural networks		CS308.4	**Able to examine Neural Network and demonstrate the applications**	Evaluate
	This course familiarizes the application area of soft computing techniques		CS308.5	**Able to solve various real time problems in different application domains**	Evaluate

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS308.1															
CS308.2	**2**	**2**	**1**	**1**								**1**	**3**		**1**
CS308.3	**2**	**1**	**1**	**1**								**1**	**2**		**1**
CS308.4	**2**	**2**	**2**	**2**								**1**	**3**		**1**
CS308.5	**2**	**2**	**1**	**2**								**1**	**3**		**1**
CS308	2.00	1.75	1.25	1.50								1.00	2.75		1.00

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** **Characteristics of Soft Computing, Applications of Soft Computing.**	**02**	**CS308.1**
II	**Fuzzy Logic** **Fuzzy Sets And Membership Function, Set Operations on Fuzzy Sets, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzification and Defuzzification, Mamdani Fuzzy Models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Fuzzy Logic Controller, Applications of Fuzzy Logic, Fuzzy–C-Means Clustering**	**12**	**CS308.2** **CS308.5**
III	**Genetic Algorithm and Optimization Techniques** **Genetic Algorithm: Encoding, Selection, Crossover, Mutation, Fitness Function, Convergence, Multi Objective Genetic Algorithm, Particle Swarm Optimization, Ant Colony Optimization**	**10**	**CS308.3** **CS308.5**
IV	**Neural Networks** **The McCullock-Pitts Neural Model, Perceptron, Neural Network Architectures, Activation Functions, Learning by Neural Networks, Hebb Net, Backpropagation: Multi-layer Feedforward Net, Generalized Delta Rule, Backpropagation Algorithm**	**11**	**CS308.4** **CS308.5**
V	**Hybrid Systems** **Integration of Neural Networks, Fuzzy Logic and Genetic Algorithms, Genetic Algorithms Based Neural Networks, Fuzzy Neural Networks, Fuzzy Logic Controlled Genetic Algorithms.** **Applications to Solve Real Life Problems.**	**05**	**CS308.5**
	Total Hours	**40**	

Essential Readings

1. J-S. R. Jang, C-T Sun, E. Mizutani, "Neuro–Fuzzy and Soft Computing", 1st Edition, Pearson India Education, 2015.
2. S. N. Deepa and S. N. Sivanandam," Principles of Soft Computing", 3rd Edition, Wiley, 2018.
3. S. Rajasekaran, G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications", 2nd Edition, Prentice Hall of India, 2017

Supplementary Readings

1. Samir Roy, Udit Chakraborty, "Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms", 1st Edition, Pearson India Education, 2013.
2. Kwang H Lee, "First Course on Fuzzy Theory and Applications", 1st Edition, Springer-Verlag Berlin Heidelberg, 2005.
3. Andries P Engelbrecht, "Computational Intelligence An Introduction", 2nd Edition, Wiley, 2018.
4. Goldberg, David E." Genetic Algorithms in Search, Optimization & Machine Learning", 1st Edition, Pearson Education, 1989.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 310	**Natural Language Processing**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**This course introduces foundational linguistic and mathematical concepts and algorithms for analysis of natural languages.**	Course Outcomes	CS310.1	**Able to understand the techniques for basic linguistic processing for phonetic analysis, phonological analysis and morphological analysis.**	Understand
	This course introduces the advantages and disadvantages of different NLP technologies in different real-life applications.		CS310.2	**Able to design computational models of natural language text data in order to gain broader understanding of text data.**	Create
	This course familiarizes some statistical approaches and machine learning techniques used in Natural Language Processing (NLP) tasks.		CS310.3	**Able to evaluate common NLP tasks using models, methods, and algorithms for statistical NLP.**	Evaluate
			CS310.4	**Able to create software implementations of relevant pre-processing steps for different NLP problems.**	Create
			CS310.5	**Able to Evaluate and implement common NLP tasks using machine learning algorithms.**	Evaluate

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS310.1	3	1	1				1					1			
CS310.2	3	3	3	2	2								1	1	1
CS310.3	3	3	3	2	2	1			1		1			1	1
CS310.4	3	3	3	2	1	1								2	3
CS310.5	3	3	3	2	2	1			1	1	1			1	1
CS310	**3**	**2.6**	**2.6**	**1.6**	**1.4**	**0.6**	**0.2**		**0.4**	**0.2**	**0.4**	**0.2**	**0.2**	**1**	**1.2**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction; Motivation and challenges of Natural Language Processing (NLP); Tokenisation and Sentence Segmentation**	**03**	**CS310.1**
II	**Lexical Analysis: Morphology, Finite State Morphology**	**04**	**CS310.1, CS310.2**
III	**Syntactic Analysis: Linguistic Background - An outline of English Syntax, Grammars for Natural Language, Parsing techniques, Linking Syntax and Semantics; Semantic Analysis: Lexical Semantics, Word Sense Disambiguation; Pragmatics and Discourse Analysis: Dialogue and Conversational agents, Co-reference resolution; Natural Language Generation**	**12**	**CS310.2, CS310.3**
IV	**Overview of NLP applications: POS tagging, Information Retrieval, Question Answering, Information Extraction, Dialogue Systems, Text and Intent Mining, Machine Translation; Data pre-processing for NLP tasks**	**11**	**CS310.3**
V	**Empirical techniques for NLP tasks; machine learning techniques for NLP tasks; NLP application examples in real-life; Performance evaluation metrics for NLP systems**	**10**	**CS310.4, CS310.5**
	Total Hours	**40**	

Essential Readings

1. D. Jurafsky and J. H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition," Pearson Education India, 2nd edition, 2013.
2. Akshar Bharati, Vineet Chaitanya, Rajeev Sangal, "Natural Language Processing: A Paninian Perspective", PHI Learning Pvt. Ltd., 1st edition, 1995.
3. Daniel M. Bikel, "Multilingual Natural Language Processing Applications: From Theory to Practice", Pearson Education India, 1st edition, 2012.
4. C. D. Manning, H. Schütze, "Foundations of Statistical Natural Language Processing", MIT Press, 1st edition, 1999.

Supplementary Readings

1. Jacob Perkins, "Python 3 Text Processing with NLTK 3 Cookbook", Packt Publishing Limited, 1st edition, 2014.
2. Breck Baldwin, Krishna Dayanidhi, "Natural Language Processing with Java and LingPipe Cookbook", Packt Publishing Limited, 1st edition, 2014.
3. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Taylor and Francis, 2nd edition, 2010.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 372	**Data Analytics using Python**		**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**This course introduces understand the importance of data analytics**	Course Outcomes	CS372.1	**Able to analyse the different data representation and data pre- processing techniques**	Analyse
	This course explains the different types of data analytics techniques		CS372.2	**Able to assess and compare different data analytics techniques**	Apply
	This course familiarizes the data analytics techniques using python programming for publically available datasets		CS372.3	**Able to evaluate data analytics techniques using python libraries**	Evaluate
			CS372.4	**Able to apply data analytics techniques for real life applications**	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS372.1	**1**												**2**	**1**	
CS372.2	**1**	**1**											**2**	**1**	
CS372.3	**2**	**3**	**1**	**2**	**1**	**1**							**2**	**1**	**1**
CS372.4	**2**	**3**	**1**	**1**	**3**	**1**							**2**	**1**	**1**
CS372	**1.5**	**2.3**	**1**	**1.5**	**2**	**1**							**2**	**1**	**1**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction: Data analytics and its importance, introduction of python programming and installing Python, understanding operators, variables, data types, conditional statements , looping constructs , functions, lists and dictionaries in Python, Importing and exporting data in python**	**08**	**CS372.1**
II	**Data pre-processing : Handling missing values, data transformation, normalization, discretization** **Data Analysis Techniques: Supervised and unsupervised learning, Unsupervised techniques - K-means, Hierarchical clustering, Density based clustering, evaluation of clustering, Supervised techniques - Linear Regression, Logistic Regression, K-nearest neighbor, naive Bayes, support vector machine, artificial neural networks (ANNs)**	**10**	**CS372.2**
III	**Learn and installing Jupyter Notebook, Understanding the concept of Standard Libraries in python : Numpy, Pandas, sci-kit learn, MatplotLib,** **Case studies: Predicting loan defaulters, Customer segmentation, Time series forecasting etc.**	**10**	**CS372.3** **CS372.4**
Total Hours		**28**	

Essential Readings

1. A.C. Müller and S. Guido. "*Introduction to machine learning with Python: a guide for data scientists*". O'Reilly Media, Inc. 1st edition, 2016
2. D. Beazley and B.K. Jones. " *Python Cookbook: Recipes for Mastering Python".* O'Reilly Media, Inc. 2nd edition, 2013
3. J. Han, J. Pei, and M. Kamber. "*Data mining: concepts and techniques"*. Elsevier, 3rd edition, 2011

Supplementary Readings

1. W. McKinney. "*Python for data analysis: Data wrangling with Pandas. NumPy, and IPython".* O'Reilly Media, Inc. 2nd edition, 2017
2. P.N.Tan, M. Steinbach, A. Karpatne, and Vipin Kumar. "*Introduction to data mining"*. Pearson Education India, 2nd edition, 2016.
3. S. Raschka and V. Mirjalili. "*Python machine learning: Machine learning and deep learning with Python, scikit-learn, and TensorFlow"*. Packt Publishing Ltd. 2nd edition, 2019.

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Programme	**Bachelor of Technology**	Year of Implementation	**2024-25**
Department	**Humanities and Social Sciences**	Semester	**VI**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
			2	**0**	**0**	**2**	**50**	**50**	**100**	**200**
HS302	**Indian Culture and Civilization**	**Nil**								

Course Objectives	
	To introduce the fundamentals of Ancient Indian Science to understand the Indian systems of Mathematics, Physics, Chemistry, Metallurgy and Town Planning
	To help students to trace, identify, and develop knowledge in ancient knowledge systems
	To help to understand the rational, verifiable and universal solution from the ancient Indian knowledge system
	To build in the learners a deep-rooted pride in Indian knowledge, committed to sustainable development

Course Outcomes			
	COs	**Statement**	**Bloom's Taxonomy**
	HS302.1	Explain the concepts of Indian knowledge system and Indian culture and civilization.	Understand
	HS302.2	Explain the Fundamentals of Ancient Indian Science	Understand
	HS302.3	Explain the Fundamentals of Ancient Indian Mathematics and Computation	Understand
	HS302.4	Explain the Fundamentals of Ancient Indian Metallurgy and Architecture	Understand
	HS302.5	Explain the Fundamentals of Ancient Indian Philosophy, Literature, Culture, History and Governance	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS302.1	3	2	1	1	1	3	2	1	1	2	1	3			
HS302.2	3	2	1	1	1	3	2	1	1	2	1	3			
HS302.3	3	2	1	1	1	3	2	1	1	2	1	3			
HS302.4	3	2	1	1	1	3	2	1	1	2	1	3			
HS302.5	3	2	1	1	1	33	2	1	1	2	1	3			
HS302	3.0	2.0	1.0	1.0	1.0	3.0	2.0	1.0	1.0	2.0	1.0	3.0			

SYLLABUS

No.	Content	Hours	COs
I	**Introduction**: Introduction to Indian Knowledge System (IKS); Importance of Ancient Knowledge; Unique aspects of Indian Knowledge System; Wisdom through the ages; Indian Philosophers; Indian culture and Civilization; Ancient Indian Science and Technology	05	HS302.1
II	**Sciences**: **Physics**: Astronomy; Positional Astronomy, Mahayuga & Kalpa system, Yuga system, Ayanas, Months, tithis and seasons, Time units, sun and moon's motion, Planet position, Ayanachalana, Zero-precision year, Katapayaadi system, Indian nakshatra system **Chemistry**: Chemistry in India; Vatsyayana, Nagarjuna, Khanda, Al-Biruni, Vagbhata—Building of the Ras-shala (laboratory), Working arrangements of Ras-shala, Material and equipment, Yasodhara Bhatta—Process of distillation, Apparatus, Saranasamskara, Saranataila	06	HS302.2
III	**Mathematics and Computation**: **Mathematics**: Mathematics in India: Baudhayana's Sulbasutras, Aryabhata, Bhaskaracharya-I, Severas Sebokht, Syria, Brahmagupta, Bhaskaracharya-II, Jyesthadeva, Vedic Mathematics **Computer Science**: Brahamgupta (vargaprakrati, bhramasphuta siddhanta, bhavana), Ayatavftta, Ganitasarasamgraha, Lilavathi, Ganesadaivajna, Randavantika, Suryasidhhanta, Grahalaghava, Sadratnamala, Mandavrtta, Sighrartta, Bijaganita, Bakshali manuscript	06	HS302.3
IV	**Engineering**: **Mechanical**: Metals and Metallurgy in India: Survarna (gold) and its different types, prosperities, Rajata (silver), Tamra (copper), Loha (iron), Vanga (tin), Naga /sisa (lead), Pittala (brass), Manufacturing process and ship building **Civil**: Architecture in India: Nagara (northern style), Vesara (mixed style), and Dravida (southern style), Indian vernacular architecture, Temple style, Cave architecture, Rock cut architecture, Kalinga architecture, Chandels architecture, Rajput architecture, Jain architecture, Sikh architecture, Maratha architecture, Indo-Islamic architectural, Indo-Saracenic revival architecture, Greco-Buddhist style	06	HS302.4
V	**Humanities and Social Sciences**: Ancient Indian Philosophy; Basic history of India, Literature and the Epics; Ancient Indian culture and civilization; Health, Wellness & Psychology; Yoga way of life; Governance, Public Administration & Management reference to Ramayana, Artha Sastra, Kauṭilyan State; History and culture of the Northeast; Indigenous system of forest management in Meghalaya	05	HS302.5
	Total Hours	**28**	

Essential Readings

1. B Mahadevan, V. R. Bhat, N. Pavana R. N., *Introduction to IKS: Concepts and Applications*, PHI, 2023.
2. Kapur K. and A. K. Singh, *Indian Knowledge Systems*, *Vol. I.* Indian Institute of Advanced Study, Shimla, 2005.

Supplementary Readings

1. Sharma, A. K., *History of Science in India (Set)*, The Ramakrishna Mission Institute of Culture, 2012.
2. Nair, Shantha N., *Echoes of Ancient Indian Wisdom,* Hindology Books, 2008.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS 352	**Design and Analysis of Algorithm Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To teach paradigms and approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice.		CS352.1	**Analyze the asymptotic performance of algorithms.**	Analyse
	To make students understand how asymptotic notation is used to provide a rough classification of algorithms.		CS352.2	**Write rigorous correctness proofs for algorithms.**	Create
	To explain different computational models and various complexity measures to analyze the complexity/performance of different algorithms.		CS352.3	**Apply important algorithmic design paradigms and methods of analysis.**	Apply
	To teach various advanced design and analysis techniques such as greedy algorithms, dynamic programming.		CS352.4	**Synthesize efficient algorithms in common engineering design situations.**	Create
	Know the concepts of tractable and intractable problems and the classes P, NP and NP-complete problems.				

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS352.1	2	1	1		1					1	1	1	1		1
CS352.2	2	1	1	1	1	1			1				1	1	1
CS352.3	1	1	1	1	1				1				2	2	
CS352.4	2	2	2	2									1	1	1
CS352	1.75	1.25	1.25	1.33	1.00	1.00			1.00	1.00	1.00	1.00	1.25	1.33	1.00

SYLLABUS

No.	Content	Hours	COs
I	Assignments and Tutorials on Brute Force, Divide and Conquer	**06**	**CS352.1**
II	Assignments and Tutorials on Decrease and Conquer, Linear sorting	**06**	**CS352.2**
III	Assignments and Tutorials on Greedy methods	**08**	**CS352.3**
IV	Assignments and Tutorials on Dynamic Programming and string processing	**08**	**CS352.4**
	Total Hours	**28**	

Essential Readings

1. A. Aho, J. Hopcroft and J. Ullman, "The Design and Analysis of Computer Algorithms", 4th Impression, Addison-Wesley, 2009.
2. E Horowitz, S Sahni, and S Rajasekhran, "Fundamentals of Computer Algorithms", 2nd Edition, Universities Press, 2008.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Pearson, 2010.
4. S. Sridhar, "Design and Analysis of Algorithms", 1st Edition, Oxford University Press, 2015.

Supplementary Readings

1. J. Kleinberg, E Tardos, "Algorithm Design", 1st Edition, Pearson, 2014.
2. S. Dasgupta, C. H. Papadimitriou, and U. V. Vazirani, "Algorithms", 2nd Edition, Tata McGraw Hill, 2016.
3. Steven S Skiena, "The Algorithm Design Manual", 2nd Edition, Springer, 2011.
4. H Bashin, "Algorithms Design and Analysis", 1st Edition, Oxford University Press, 2015.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS 354	**Compiler Design Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives

- The Objectives of this course is to explore the principles, algorithms, and data structures involved in the design and construction of compilers.
- To implement some phases of the front-end of a general compiler.
- To implement some phases of the backt-end of a general compiler

Course Outcomes

	CO's	Statement	Bloom's Taxonomy
	CS354.1	Specify and analyse the lexical, syntactic and semantic structures of any computer programming language.	Analyse
	CS354.2	Separate the lexical, syntactic and semantic analysis into meaningful phases for a compiler to undertake language translation.	Create
	CS354.3	Write a scanner, parser, and semantic analyser for limited form of C like programming languages.	Create
	CS354.4	Convert source code in simple language into machine code for a novel computer.	Create
	CS354.5	Describe techniques for intermediate code and machine code optimisation.	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS354.1	**3**	**2**	**3**	**1**									**1**	**2**	**2**
CS354.2	**3**	**3**	**3**	**3**								**2**	**1**	**1**	**3**
CS354.3	**2**	**3**	**3**	**1**	**3**				**1**				**1**	**1**	**3**
CS354.4	**2**	**1**	**1**	**2**	**2**				**1**				**1**	**1**	**3**
CS354.5	**2**	**1**	**2**	**1**	**1**								**1**	**1**	**3**
CS354	2.40	2.00	2.40	1.60	2.00				1.00			2.00	1.00	1.20	2.80

SYLLABUS

No.	Content	Hours	COs
I	1) Using Lex/Flex , write a program to append line number before each (i) lines(empty/non-empty). (ii) non-empty lines Input/output streams may be files. 2) Using Lex/Flex , write a program to count number of lines, words, visible characters, total characters. Input/output streams may be files.	**4**	**CS354.1, CS354.2, CS354.3**
II	3) Using Lex/Flex , write a program to identify some keywords, identifiers, integers and real numbers from a simple C program. Input/output streams may be files. 4) Lex program to copy a file by replacing multiple sequences of white spaces with a single white space. [blanks/tab => blank, more than one " \n" => " \n"]. 5) Also add removal of comments in above program.	**2**	**CS354.1, CS354.2, CS354.3**
III	6) Lex program to copy a C program by replacing each instance of the keyword *float* by *double*. 7) Write a Lex program that converts a file to "Pig Latin". Specifically, assume the file is sequence of English words (group of letters) separated by white space. Every time a word is encountered: 1. If the first letter is consonant, move it to the end of the word and then add ay. 2. If the first letter is a vowel, just add ay to the end of the word.	**2**	**CS354.1, CS354.2, CS354.3**
IV	8) Using Lex/Flex , write a program to encode and decode.	**2**	**CS354.1, CS354.2, CS354.3**
V	9) Using Lex/Flex , write a program to (i) identify the Roman numbers (ii) add 2 Roman numbers.	**2**	**CS354.1, CS354.2, CS354.3**
VI	10) Create a recursive predictive parser for a grammar(as given in lab class).	**2**	**CS354.1, CS354.2, CS354.3**
VII	11) Create a non-recursive predictive parser(LL parser) for a grammar(as given in lab class).	**2**	**CS354.1, CS354.2, CS354.3**

VIII	12) Using Flex and Bison tools, create a calculator program that support addition,subtraction, multiplication, division, power operations on numbers and variables.	**4**	**CS354.1, CS354.2, CS354.3**
IX	13) Using Flex and Bison tools, create a translator to convert a simple program written in arbitrary language to a program in C language.	**4**	**CS354.1,CS354.4**
X	14) Using Flex and Bison tools, create a program to convert a simple assignment expression into intermediate code. Ex:- input: z = -(a+b-c) output: t1 = a + b t2 = t1 – c t3 = - t2 z = t3	**4**	**CS354.1,CS354.5**
Total Hours		**28**	

Essential Readings

1. A.V. Aho, M. S. Lam, R. Sethi and J. D. Ullman, "Compilers-Principles, Techniques and Tools", 2nd ed., 2006, Pearson Education.
2. K. Muneeswaran, "Compiler Design", 1st ed., 2013, Oxford Publication.
3. P.H. Dave, H.B. Dave, "Compilers: Principles and Practice", 1st ed. 2012, Pearson Education.

Supplementary Readings

1. Allen I. Holub, "Compiler Design in C", 1st ed.(Indian print), 2012, PHI.
2. John Levine, "Flex & Bison ", 1st ed., 2009, O'reilly.
3. Torben Ægidius Mogensen, "Basics of Compiler Design", 1st ed., 2007, DIKU, University of Copenhagen

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS 356	**Internet Web Technology Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the basics of Internet and basic concepts of web technology.		CS356.1	**Able to explain the basic concepts of Internet and web technology.**	Understand
	To give knowledge of web designing principles.		CS356.2	**Able to design web pages with simpler HTML elements and their attributes.**	Create
	To train the students in writing code in HTML, CSS and JavaScript.		CS356.3	**Able to use links, images, multimedia, blocks, tables, frames, forms and HTML controls in web pages.**	Apply
			CS356.4	**Able to write CSS code and use inline, internal and external CSS styling.**	Create
			CS356.5	**Able to write JavaScript code and use predefined JavaScript events.**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS356.1	3		1		1					1	1	1	1		
CS356.2	3	3	3	2	2	1			1				2	1	
CS356.3	3	3	3	2	2	1			1				2	1	
CS356.4	3	3	3	2	2	1			1				2	1	
CS356.5	3	3	3	2	2	1			1				2	1	
CS356	3.00	3.00	2.60	2.00	1.80	1.00			1.00	1.00	1.00	1.00	1.80	1.00	

SYLLABUS

No.	Content	Hours	COs
1	Working with HTML - basic structure of an HTML document, creating an HTML document, markup tags, headings, paragraphs, line breaks	**02**	**CS356.1 CS356.2 CS356.3 CS356.4 CS356.5**
2	Working with HTML - attributes, metadata, working with text, tool tips, working with lists, tables	**02**	
3	Working with HTML - working with hyperlinks, images and multimedia, web page logo	**02**	
4	HTML blocks - div tag, HTML IDs, symbols	**02**	
5	Working with HTML - working with frames	**02**	
6	Working with HTML - working with forms and controls	**02**	
7	Introduction to CSS - sample examples for syntax introduction	**02**	
8	Concept of CSS - CSS styling (background, text format, fonts), CSS colours	**02**	
9	Concept of CSS - CSS IDs, classes and CSS Styling, working with lists and tables	**02**	
10	Concept of CSS - Box Model (introduction, border properties, padding properties, margin properties)	**02**	
11	Introduction to JavaScript - sample examples for syntax introduction	**02**	
12	JavaScript built-in functions, alert box, confirm box, prompt box	**02**	
13	Writing JavaScript user-defined functions	**02**	
14	Designing simple animations using JavaScript, JavaScript image slideshow	**02**	
	Total Hours	**28**	

Essential Readings

1. Laura Lemay, Rafe Colburn and Jennifer Kyrnin, "Mastering HTML, CSS & Javascript Web Publishing", BPB Publications, 1st edition, 2016.
2. DT Editorial Services, "HTML 5 Black Book", Dreamtech Press, 2nd edition, 2016.
3. P. Deitel, H. Deitel, A. Deitel, "Internet and World Wide Web: How to Program", Pearson Education, 5th edition, 2018.

4. w3schools Tutorials, http://www.w3schools.com/
Supplementary Readings
1. Thomas Powell, “HTML & CSS: The Complete Reference”, McGraw Hill Education, 5th edition, 2017.
2. Jeffrey C. Jackson, “Web Technologies: A Computer Science Perspective”, Pearson Education India, 1st edition, 2008.
3. Uttam K. Roy, “Web Technologies”, Oxford University Press, 1st edition, 2010.

Seventh Semester Courses

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 401	**Distributed Computing System**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**This course explains the advantages and challenges in designing distributed operating system, algorithms for different primitives, mutual exclusion, deadlock detection, agreement, etc.**	Course Outcomes	CS401.1	**Able to describe the fundamental components of distributed operating system such as algorithms for different primitives**	Understand
	This course describes the details of distributed computing techniques, synchronous and processes, minimum spinning tree and communication protocol algorithms.		CS401.2	**Able to design and demonstrate the distributed computing techniques for process synchronization and construction of minimum spinning tree for message forwarding and receiving.**	Create
	This course provides the methodologies to design and implement distributed mutual exclusion algorithm and distributed deadlock detection and termination algorithms		CS401.3	**Able to develop the practical understanding of Distributed mutual exclusion and deadlock detection for various processes.**	Create
	This course provides the techniques to design and develop applications based on requirements of various fault tolerance system, algorithm for failure recovery and fault tolerance in distributed systems.		CS401.4	**Able to design and analyse the fault tolerant system to achieve high reliability and accuracy using the principle of fault tolerant algorithms.**	Create
			CS401.5	**Able to develop, analyse real world applications**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS401.1	**3**	**3**							**2**				**3**		**3**
CS401.2	**3**	**3**	**3**	**1**	**2**				**1**				**2**	**3**	**2**
CS401.3	**1**	**2**	**3**	**3**	**2**	**2**							**2**	**3**	**3**
CS401.4	**1**	**2**	**3**	**3**	**3**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
CS401.5	**2**	**3**	**3**	**2**	**2**	**3**	**2**		**2**			**1**	**3**	**3**	**3**
CS401	2.00	2.60	3.00	2.25	2.25	2.33	2.50		1.75			1.00	2.40	3.00	2.60

SYLLABUS

No.	Content	Hours	COs
I	**Basics concepts Computer architecture** : CICS, RISC, Multi-core Computer networking : ISO/OSI Model Evolution of operating systems **Introduction to distributed computing systems** (DCS): DCS design goals, Transparencies, Fundamental issues	**10**	**CS401.1**
II	**Distributed Coordination:** Temporal ordering of events Lamport's logical clocks Vector clocks; Ordering of messages Physical clocks Global state detection **Process synchronization**: Distributed mutual exclusion algorithms Performance matrix,	**12**	**CS401.2**
III	**Inter-process communication**: Message passing communication Remote procedure call Transaction communication Group communication; Broadcast atomic protocols, Deadlocks in distributed systems, Load scheduling and balancing techniques	**12**	**CS401.3, CS401.4**
IV	Distributed database system : A Case study	**6**	**CS401.5**
	Total Hours	**40**	

Essential Readings

1. G. Coulouris, J. Dollimore, Addison Wesley, "Distributed Systems Concepts and Design", 5th Edition, Pearson, 2011
2. M. Singhal, N.G. Shivarathri, "Advanced Operating Systems", McGraw Hill, 2017
3. Randy Chow, T. Johnson, Addison Wesley, "Distributed Operating Systems and Algorithms", Pearson, 1997

Supplementary Readings

1. A.S. Tanenbaum, "Distributed Operating Systems", Prentice Hall
2. M. Tamer Ozsu, Patrick Valduriez, "Principles of Distributed Database Systems", 3rd Edition, Prentice Hall International, 2011

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 403	**Deep Learning**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	**To gain insight into the historical context and theoretical foundations of deep learning**	Course Outcomes	CS403.1 **Able to understand deep learning principles, including neural networks, optimization algorithms, and advanced architectures.**	Understand
	To analyze dimensionality Reduction and Feature Learning		CS403.2 **Able to develop practical skills in implementing and applying various deep learning techniques and algorithms across multiple domains.**	Create
	To explore Advanced Architectures and Training Techniques		CS403.3 **Able to enhance their critical thinking and problem-solving abilities through the analysis and evaluation of deep learning models and methodologies.**	Analyse
	To develop practical skills in implementing deep learning models for various tasks		CS403.4 **Able to Understand attention mechanisms and their role in machine translation, along with encoder-decoder architectures**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS403.1	**1**	**1**		**1**	**3**	**2**			**1**					**1**	**1**
CS403.2		**1**		**3**		**1**	**2**							**1**	**1**
CS403.3	**1**	**2**	**3**	**1**	**2**								**1**	**2**	
CS403.4			**1**	**2**	**2**	**3**	**1**						**1**	**2**	
CS403	1.00	1.33	2.00	1.75	2.33	2.00	1.50		1.00				1.00	1.50	1.00

SYLLABUS

No.	Content	Hours	COs
I	History of Deep Learning, McCulloch Pitts Neuron, Multilayer perceptrons, Sigmoid neurons, Gradient Descent, Feed Forward Neural Networks, Back Propagation	**10**	**CS403.1**
II	Principal Component Analysis and its interpretations, Singular Value Decomposition, Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders. Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization, Learning Vectorial Representations Of Words	**10**	**CS403.1, CS403.2**
III	Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet Recurrent Neural Networks, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs	**12**	**CS403.2, CS403.3**
IV	Encoder Decoder Models, Attention Mechanism, Attention over images	**8**	**CS403.4**
	Total Hours	**40**	

Essential Readings

1. Ian Goodfelllow, Yoshua Benjio, Aaron Courville, "Deep Learning", The MIT Press, 2016
2. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Edition, John Wiley & Sons Inc., 2012

Supplementary Readings

1. Adam Gibson, Josh Patterson, "Deep Learning: A Practitioner's Approach", 1st Edition, O'Reilly Media, 2017

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 405	**Social Network**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To Understand the fundamental concepts of network theory and Social Network Analysis (SNA), including terminology, basic metrics (e.g., centrality, clustering), and their applications in various domains.		CS405.1	**Able to explain key concepts in network theory, such as nodes, edges, centrality, and clustering coefficients and will demonstrate a thorough understanding of Social Network Analysis (SNA) principles and methodologies.**	Understand
	To Gain hands-on experience in handling real-world network datasets, including data acquisition, preprocessing, and analysis using appropriate software tools and techniques.		CS405.2	**Able to acquire practical skills in acquiring, cleaning, and analyzing real-world network datasets using appropriate software tools and will demonstrate proficiency in applying statistical and computational techniques to explore network properties and dynamics.**	Analyze
	To Explore the strength of weak ties, homophily, link analysis algorithms, and their applications in understanding network dynamics, cascading behaviors, and power-law distributions.		CS405.3	**Able to apply SNA techniques, including link analysis algorithms, to analyze and interpret social and information networks and will apply SNA methodologies to understand information diffusion, opinion formation, and network resilience.**	Analyse
	To Apply Social Network Analysis methodologies to real-world scenarios		CS405.4	**Able to critically analyze network structures and behaviors, identifying patterns and will synthesize findings from SNA studies to draw insights applicable across diverse fields, including sociology, epidemiology, business, and cybersecurity.**	Analyse

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS405.1	**3**	**3**	**2**	**2**	**3**	**2**	**1**	**1**	**2**	**3**	**1**	**2**	**3**	**2**	**3**
CS405.2	**3**	**3**	**2**	**3**	**3**	**2**	**1**	**1**	**2**	**3**	**1**	**2**	**3**	**2**	**3**
CS405.3	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**1**	**2**	**3**	**2**	**3**
CS405.4	**3**	**3**	2	**3**	**3**	**3**	2	2	2	**3**	1	2	**3**	2	**3**
CS405	3.00	3.00	2.00	2.75	3.00	2.50	1.50	1.50	2.00	3.00	1.00	2.00	3.00	2.00	3.00

SYLLABUS

No.	Content	Hours	COs
I	**Introduction- Python/Colab , NetworkX Challenges in social network, Google page rank, searching in a network, link prediction**	**6**	**CS405.1**
II	**Handling real world network datasets- Ingredients network, synonymy network, web graph, social network datasets. Datasets- different formats, how to download, analyzing using networkX , gephi. Emergence of connectedness. Strength of weak ties , Strong and Weak Relationships, Homophilly**	**10**	**CS405.2**
III	**+Ve / -Ve Relationships, Link Analysis, Cascading Behaviour in Networks**	**12**	**CS405.3**
IV	**Power Laws and Rich-Get-Richer Phenomena, Epidemics, Small World Phenomenon, Pseudocore (How to go viral on web)**	**12**	**CS405.4**
	Total Hours	**40**	

Essential Readings

1. **Tanmoy Chakraborty, "Social Network Analysis", Wiley, 2021**
2. **David Easley and Jon Kleinberg, "Networks, Crowds and Markets", Cambridge University Press, 2010**
3. **Matthew O. Jackson, "Social and Economic Networks", Princeton University Press, 2010.**

Supplementary Readings

1. **Albert-Lazzlo Barabasi, "Network Science", 1st Edition, Cambridge University Press, 2016**
2. **Stanley Wasserman, Katherine Faus, "Social Network Analysis: Methods and Applications", Cambridge University Press, 1994**

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 407	**Real time Systems**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To Gain a solid understanding of real-time systems**	Course Outcomes	CS407.1	**Able to demonstrate proficiency in designing real-time systems that meet stringent timing constraints and deterministic behavior requirements and will be able to model and specify timing constraints effectively for various types of real-time tasks.**	Create
	To Learn various scheduling algorithms used in real-time systems		CS407.2	**Able to master the implementation and analysis of scheduling algorithms such as table-driven, cyclic, Earliest Deadline First (EDF), and Rate-Monotonic Analysis (RMA) and will be capable of selecting appropriate scheduling strategies based on task characteristics and system requirements.**	Analyse
	To Study strategies and challenges in scheduling real-time tasks across multiple processors and in distributed environments and analyze synchronization techniques and methods for maintaining global timing guarantees in distributed real-time systems.		CS407.3	**Able to acquire skills in scheduling real-time tasks across multiple processors and in distributed environments and will understand synchronization techniques and methods to ensure global timing guarantees in complex distributed real-time systems.**	Understand
	To Investigate the architecture and features of commercial Real-Time Operating Systems (RTOS) and understand their capabilities, limitations, and application domains.		CS407.4	**Able to gain practical knowledge of commercial Real-Time Operating Systems (RTOS) and will understand real-time communication protocols and the design considerations for real-time databases, enabling them to apply these concepts in industry-relevant scenarios.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS407.1	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**3**
CS407.2	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**3**
CS407.3	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**3**
CS407.4	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**3**
CS407	3.00	3.00	3.00	2.00	3.00	1.00	1.00	1.00	2.00	2.00	1.00	2.00	3.00	2.00	3.00

SYLLABUS

No.	Content	Hours	COs
I	Introduction to Real time system, Modeling Timing constraints	**7**	**CS407.1**
II	Scheduling Real-Time Tasks: Types of Schedulers Table-driven scheduling Cyclic schedulers EDF RMA	**9**	**CS407.2**
III	Handling Resource sharing among realtime tasks, Scheduling Real-Time Tasks in Multiprocessor and Distributed systems, Commercial Real-time operating systems: General concepts Unix and Windows as RTOS	**12**	**CS407.3, CS407.4**
IV	Survey of commercial RTOS, Real-Time Communication, Real-Time Databases	**12**	**CS407.3, CS407.4**
	Total Hours	**40**	

Essential Readings

1. Rajib Mall, "Real-Time Systems: Theory and Practice," Pearson, 2008.
2. Jane W. Liu, "Real-Time Systems" Pearson Education, 2001.

Supplementary Readings

1. Krishna and Shin, "Real-TIme Systems," Tata McGraw Hill. 1999

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 409	**Ethical Hacking**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To Provide students with a comprehensive understanding of ethical hacking principles**	Course Outcomes	CS409.1	**Able to use tools NMAP, Nessus, Wireshark, and Burp Suite for information gathering, vulnerability scanning, and network analysis.**	Apply
	To equip students with practical skills in using advanced		CS409.2	**Able to gain a deep understanding of fundamental security concepts.**	Understand
	To introduce students to essential security concepts		CS409.3	**Able to ethically apply hacking techniques including system hacking (password cracking, privilege escalation), malware analysis, social engineering attacks, and network-based attacks mitigation.**	Apply
	To enable students to apply ethical hacking techniques ethically and legally		CS409.4	**Able to develop the ability to assess and identify security vulnerabilities in systems and networks, propose effective countermeasures, and contribute to enhancing cybersecurity resilience.**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS409.1	**3**	**3**	**3**	**2**	**3**	**2**	**1**	**3**	**2**	**2**	**1**	**3**	**1**	**1**	**1**
CS409.2	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**1**	**3**	**2**	**1**	**1**
CS409.3	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**2**	**1**	**1**
CS409.4	3	3	3	3	3	3	2	3	3	3	2	3	3	1	1
CS409	3.00	3.00	3.00	2.75	2.75	2.25	1.50	3.00	2.50	2.50	1.50	3.00	2.00	1.00	1.00

SYLLABUS

No.	Content	Hours	COs
I	Introduction to ethical hacking. Fundamentals of computer networking. TCP/IP protocol stack. IP addressing and routing. TCP and UDP. IP subnets. Routing protocols. IP version 6.	**8**	**CS409.1**
II	Installation of attacker and victim system. Information gathering using advanced google search, archive.org, netcraft, whois, host, dig, dnsenum and NMAP tool**.** Vulnerability scanning using NMAP and Nessus. Creating a secure hacking environment. System Hacking: password cracking, privilege escalation, application execution. Malware and Virus. ARP spoofing and MAC attack.	**10**	**CS409.1, CS409.2, CS409.3**
III	Introduction to cryptography, private-key encryption, public-key encryption. Cryptographic hash functions, digital signature and certificate, applications. Steganography, biometric authentication, network-based attacks, DNS and Email security.	**10**	**CS409.2, CS409.3**
IV	Packet sniffing using wireshark and burpsuite, password attack using burp suite. Social engineering attacks and Denial of service attacks. Elements of hardware security: side-channel attacks, physical inclinable functions, hardware trojans. Different types of attacks using Metasploit framework: password cracking, privilege escalation, remote code execution, etc.Attack on web servers: password attack, SQL injection, cross site scripting. Case studies: various attacks scenarios and their remedies.	**12**	**CS409.4**
	Total Hours	**40**	

Essential Readings

1. W. Stallings, "Data and Computer Communications" , 10th Edition, Pearson Education, 2017
2. B. A. Forouzan, "Data Communication and Networking", 4th Edition, McGraw Hill Education, 2017
3. B. A. Forouzan, "TCP/IP Protocol Suite", 4th Edition, McGraw Hill Education, 2017

Supplementary Readings

1. W. R. Stallings, "UNIX Network Programming", Addison-Wesley, 2003
2. C-H. Wu and J. D. Irwin, "Introduction to Computer Networks and Cybersecurity", 1st Edition, CRC Press Inc, 2013
3. W. Stallings, "Cryptography and Network Security: Principles and Practice", 8th Edition, Pearson, 2023

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 411	**Computer Vision and Image Processing**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To understand digital image representation, including pixel intensity and color spaces.**	Course Outcomes	CS411.1	**Able to understand computer vision goals, image formation concepts including radiometry and geometric transformations**	Understand
	To learn fundamental image processing operations		CS411.2	**Able to develop a solid understanding of digital image representation and fundamental image processing techniques**	Analyse
	To gain skills in extracting features from images, such as edges and corners.		CS411.3	**Able to acquire skills in extracting meaningful features from images, enabling analysis and interpretation.**	Analyse
	To understand computer vision algorithms using neural networks.		CS411.4	**Able to apply common computer vision algorithms using deep learning.**	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS411.1	1	1	2	2	3	2			1					**1**	**1**
CS411.2	**1**	**1**		**3**		**1**								**1**	**1**
CS411.3	**1**	**2**	**3**	**1**	**2**								**1**		**1**
CS411.4			**1**	**2**	**2**	**3**	**1**						**1**	**1**	**3**
CS411	1.00	1.33	2.00	2.00	2.33	2.00	1.00		1.00				1.00	1.00	1.50

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Computer Vision and Basic Concepts of Image Formation: Goals of Computer Vision and Image Processing, Image Formation Concepts.** **Fundamental Concepts of Image Formation: Radiometry, Geometric Transformations, Geometric Camera Models, Camera Calibration, Image Formation in a Stereo Vision Setup, Image Reconstruction from a Series of Projections.**	**7**	**CS411.1**
II	**Image Processing Concepts: Image Transforms, Image Enhancement, Image Filtering, Colour Image Processing, Image Segmentation** **Image Descriptors and Features: Texture Descriptors, Colour Features, Edges/Boundaries, Object Boundary and Shape Representations, Interest or Corner Point Detectors, Histogram of Oriented Gradients, Scale Invariant Feature Transform, Speeded up Robust Features, Saliency**	**13**	**CS411.2, CS411.3**
III	**Fundamentals of Machine Learning: Linear Regression, Basic Concepts of Decision Functions, Elementary Statistical Decision Theory, Parameter Estimation, Clustering for Knowledge Representation, Dimension Reduction, Linear Discriminant Analysis.**	**10**	**CS411.1, CS411.3**
IV	**Applications of Computer Vision: Artificial Neural Network for Pattern Classification, Convolutional Neural Networks, Autoencoders, Gesture Recognition, Motion Estimation and Object Tracking, Programming Assignments.**	**10**	**CS411.4**
	Total Hours	**40**	

Essential Readings

1. M.K. Bhuyan , " Computer Vision and Image Processing: Fundamentals and Applications", 1st Edition, CRC Press, USA, 2019
2. R. Szeleski, "Computer Vision: Algorithms & Applications", Springer, 2010
3. Forsyth and Ponce, "Computer vision: A modern approach", 2nd Edition, Pearson Education India, 2015.

Supplementary Readings

1. R. Hartley and A. Zisserman, "Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press, 2004.

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Department	**Computer Science and Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 413	**Bandit Algorithm**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To develop a solid understanding of bandit algorithms, spanning from batch learning to online settings, and their transition across different environments.**	Course Outcomes	CS413.1	**Able to design and analyze bandit algorithms across different settings**	Analyse
	To delve into adversarial settings with both full and bandit information, studying algorithms		CS413.2	**Able to develop the ability to evaluate the performance of bandit algorithms and will be able to compare algorithms based on their theoretical guarantees and practical performance metrics.**	Evaluate
	To analyze regret lower bounds in adversarial settings and explore various regret notions in stochastic settings, applying concentration inequalities for performance evaluation.		CS413.3	**Able to gain practical experience in applying bandit algorithms to solve real-world decision-making problems**	Apply
	To gain practical insights into contextual bandit algorithms and explore algorithms designed for pure exploration scenarios, distinguishing between fixed confidence and budget constraints.		CS413.4	**Able to enhance their critical thinking and problem-solving skills through exploration of advanced topics and will be able to propose and implement appropriate bandit algorithms to optimize decision-making under uncertainty.**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS413.1	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**3**	**3**	**3**
CS413.2	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**3**	**3**	**3**
CS413.3	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**
CS413.4	3	3	3	3	3	3	2	3	3	3	2	3	3	3	3
CS413	3.00	3.00	3.00	3.00	3.00	2.50	2.00	2.50	2.50	2.50	1.50	3.00	3.00	3.00	3.00

SYLLABUS

No.	Content	Hours	COs
I	Introduction to Bandit Algorithms. From Batch to Online Setting, Adversarial Setting with Full information (Halving, WM Algorithm), Adversarial Setting with Bandit Information, Regret lower bounds for adversarial Setting	**12**	**CS413.1**
II	Introduction to Stochastic Setting and various regret notions, A primer on Concentration inequalities, Stochastic Bandit Algorithms UCB, KL-UCB, Lower bounds for stochastic Bandits	**10**	**CS413.1, CS413.2**
III	Introductions to contextual bandits, Overview of contextual bandit algorithms	**9**	**CS413.3**
IV	Introduction to pure exploration setups (fixed confidence vs budget), Algorithms for pure explorations (LUCB, KL-LUCB, lil'UCB)	**9**	**CS413.4**
	Total Hours	**40**	

Essential Readings

1. Sébastien Bubeck and Nicolo Cesa-Bianchi, "Regret analysis of stochastic and nonstochastic multi-armed bandit problems. Foundations and Trends in Machine Learning", now publishers Inc, 2012.

Supplementary Readings

1. Csaba Szepesvári and Tor Lattimore. http://banditalgs.com/. Blog posts on bandit theory1.
2. Nicolo Cesa-Bianchi and Gábor Lugosi, "Prediction, learning, and games" Cambridge university press, 2006.

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Department	**Computer Science and Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 415	**Blockchain and its Applications**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	This course explains the need and working principle of blockchain systems, cryptocurrency, cryptographic primitives.	Course Outcomes	CS415.1	Able to explain the need of Blockchain system and demonstrate the fundamentals of cryptocurrency, cryptographic primitives.	Understand
	This course describes the in-depth knowledge and concept of recent technologies, tools, and implementation strategies.		CS415.2	Able to demonstrate the tools, Nakamoto consensus and demonstrate the working principals of payment verification protocol	Understand
	This course provides the validation and verification techniques of transaction through miners and Consensus Algorithms.		CS415.3	Able to describe and analyse the various consensus algorithm as per the application requirements.	Analyse
	This course provides the mechanism for the development of smart contract using solidity language for distributed applications.		CS415.4	Able to design and develop the communication model for sending and receiving the messages in transaction.	Create
			CS415.5	Able to design, develop and analyse the real time distributed real time applications.	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS415.1	3	3							2				3		3
CS415.2	3	3	3	1	2				1				2	3	2
CS415.3	1	2	3	3	2	2							2	3	3
CS415.4	1	2	3	3	3	2	3		2			1	2	3	2
CS415.5	2	3	3	2	2	3	2		2			1	3	3	3
CS415	2.00	2.60	3.00	2.25	2.25	2.33	2.50		1.75			1.00	2.40	3.00	2.60

SYLLABUS

No.	Content	Hours	COs
I	Introduction to Blockchain Technology and its Importance	**5**	**CS415.1**
II	Basic Crypto Primitives Cryptographic Hash, Digital Signature Evolution of the Blockchain Technology Elements of a Blockchain	**10**	**CS415.2**
III	Blockchain Consensus Permissionless Models, Permissioned Models Smart Contract Hands On – Ethereum Smart Contracts (Permissionless Model), Hyperledger Fabric (Permissioned Mode)	**13**	**CS415.3, CS415.4**
IV	Decentralized Identity Management Blockchain Interoperability Blockchain Applications	**12**	**CS415.4, CS415.5**
	Total Hours	**40**	

Essential Readings

1. Imran Bashir, "Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more", 3rd Edition, Packt Publishing, 2020, ISBN: 9781839213199, book website: https://www.packtpub.com/product/mastering-blockchain-third-edition/9781839213199

2. Imran Bashir, "Mastering Blockchain", 1st Edition,Packt, 2017.

3. Melanie Swan, "Blockchain: Blueprint for New Economy", 1st Edition, O'Reilly Media, 2015.

4. Sam Goundar, "Blockchain Technologies, Applications And Cryptocurrencies: Current Practice And Future Trends", 1st Edition Word Scientific, 2020

Supplementary Readings

1. Hyperledger Tutorials - https://www.hyperledger.org/use/tutorials

2. Ethereum Development Resources - https://ethereum.org/en/developers

3. Alan T. Norman, "Blockchain Technology Explained: The Ultimate Beginner's Guide About Blockchain Wallet, Mining, Bitcoin, Ethereum, Litecoin, Zcash, Monero, Ripple, Dash, IOTA and Smart Contracts", 1st Edition, 2017

4. Jan Veuger, "Blockchain Technology and Applications", 1st Edition, Nova Publisher,2019

5. Andreas Bolfing, "Cryptographic Primitives in Blockchain Technology : A Mathematical Introduction", 1st Edition, Oxford University Press, 2020.

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Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 417	**High Performance Computing**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	**COB1:** To develop the student's ability to understand the concept of reduced and complex instruction set architecture and its performance.	CS417.1	Able to understand the computer architectural design principles and performance enhancement strategies	Understand
	COB2: To develop the student's ability to understand the fundamentals of pipelining, identify the cause of hazards and apply different approaches for possible hazard free solutions.	CS417.2	Able to understand the multiprocessor architecture, distributed memory architecture and distributed systems.	Understand
	COB3: To provide the students with some knowledge and analysis skills associated with the principles of superscalar technique and speculative execution			
	COB4: To develop the student's ability to understand the concept of shared- memory, distributed-memory, cache coherence problem and multiprocessor architecture.	CS417.3	Able to solve the performance related problems of pipeline structures, interconnect networks and memory.	Evaluate
	COB5: To provide the students with some basic knowledge of distributed system with its design principles.	CS417.4	Able to analyze the performance differences of computing evolution on pipeline structures, interconnect networks, memory and distributed memory architecture	Analyse

Course Outcomes

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS417.1	3	1	1					1	1			2		1	
CS417.2	3	3	2	2	2			1	1			2	1	1	
CS417.3	3	3	3	2	2			2	2			2	2	2	
CS417.4	3	3	3	2	2			2	2			2	2	2	
CS417	3.00	2.5	2.25	2.00	2.00			1.5	1.5			2.00	1.67	1.5	

SYLLABUS

No.	Content	Hours	COs
I	Program execution: Program, Compilation, Object files, Function call and return, Address space, Data and its representation Computer organization: Memory, Registers, Instruction set architecture, Instruction processing	**10**	**CS417.1**
II	Pipelined processors: Pipelining, Structural, data and control hazards, Impact on programming Virtual memory: Use of memory by programs, Address translation, Paging	**10**	**CS417.2, CS417.3**
III	Cache memory: Organization, impact on programming, virtual caches Operating systems: Processes and system calls, Process management	**10**	**CS417.3, CS417.4**
IV	Program profiling, File systems: Disk management, Name management, Protection, Parallel architecture: Inter-process communication, Synchronization, Mutual exclusion, Basics of parallel architecture, Parallel programming with message passing using MPI	**12**	**CS417.2, CS417.4**
	Total Hours	**42**	

Essential Readings

1. J. L. Hennessy and D. A. Patterson, "Computer Architecture: A Quantitative Approach", 6th Edition, Morgan Kaufmann, 2017.
2. A. Silberschatz, P. B. Galvin, G. Gagne, "Operating System Concepts", 9th Edition, John Wiley, 2013.
3. R. E. Bryant and D. R. O'Hallaron, "Computer Systems: A Programmer's Perspective", 3rd Edition, Prentice Hall, 2015

Supplementary Readings

4. Hwang, Kai, "Advanced Computer Architecture with Parallel Programming", 3rd Edition, McGraw-Hill, 2017.
5. "Intel® 64 and IA-32 Architectures Optimization Reference Manual", http://www.intel.com/content/www/us/en/architecture-and-technology/64-ia-32-architectures-optimizationmanual.html
6. "Intel® 64 and IA-32 Architectures Software Developer Manuals", http://www.intel.com/content/www/us/en/processors/architectures-software-developermanuals.html
7. Nvidia Kepler Compute Architecture White Paper", http://www.nvidia.com/object/nvidia-kepler.html

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Department	**Computer Science and Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 419	**Pattern Recognition and Applications**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To introduce the fundamentals of pattern recognition and its relevance to classical and modern problems	Course Outcomes	CS419.1	Able to explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.	Understand
	To introduce the knowledge about state-of-the-art algorithms used in pattern recognition research		CS419.2	Able to summarize, analyze, and relate research in the pattern recognition area	Analyze
	To introduce Understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis.		CS419.3	Able to apply performance evaluation methods for pattern recognition, and critique comparisons of techniques made in the research literature.	Apply
	To provide an understanding of pattern recognition techniques in practical problems and a main objective is to be able to identify where, when and how pattern recognition can be applied.		CS419.4	Able to apply pattern recognition techniques to real world problems	Apply
	To provide knowledge regarding various application of pattern recognition using machine learning model.		CS419.5	Able to Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS419.1		1	2	2	3	2			1					**1**	
CS419.2	**2**	**1**		**3**		**1**							**2**	**1**	
CS419.3	**1**	**2**	**3**	**1**	**2**								**1**		**1**
CS419.4	**1**		**1**	**2**	**2**	**3**	**1**						**1**	**1**	
CS419.5	**1**	**1**	**1**	**3**	**3**	**1**							**1**	**1**	
CS419	1.25	1.25	1.75	2.20	2.50	1.75	1.00		1.00				1.25	1.00	1.00

SYLLABUS

No.	Content	Hours	COs
I	Overview of Pattern classification and regression: Introduction to Statistical Pattern Recognition Overview of Pattern Classifiers: Bayesian decision making and Bayes Classifier, The Bayes Classifier for minimizing Risk, Estimating Bayes Error; Minimax and Neymann-Pearson classifiers	**6**	**CS419.1**
II	**Parametric Estimation of Densities**: Implementing Bayes Classifier; Estimation of Class Conditional, Maximum Likelihood estimation of different densities, Bayesian estimation of parameters of density functions, MAP estimates, Bayesian Estimation examples, the exponential family of densities and ML estimates, Sufficient Statistics; Recursive formulation of ML and Bayesian estimates **Mixture Densities and EM Algorithm**: Mixture Densities, MLestimation and EM algorithm, Convergence of EM algorithm; overview of Nonparametric density estimation **Nonparametric density estimation**: Convergence of EM algorithm; overview of Nonparametric density estimation, Nonparametric estimation,Parzen Windows, nearest neighbour methods	**8**	**CS419.2**
III	**Linear models for classification and regression**: Linear Discriminant Functions;Perceptron -- Learning Algorithm and convergence proof, Linear Least Squares Regression; LMS algorithm, AdaLinE and LMS algorithm; General nonliner least-squares regression, Logistic Regression;Statistics of least squares method; Regularized Least Squares, Fisher Linear Discriminant, Linear Discriminant functions for multi-class case; multi-class logistic regression **Overview of statistical learning theory, Empirical Risk Minimization and VC-Dimension**: Learning and Generalization;PAC learning framework, Overview of Statistical Learning Theory;Empirical Risk Minimization, Consistency of Empirical Risk Minimization, Consistency of Empirical Risk Minimization; VCDimension, Complexity of Learning problems and VC Dimension, VC-Dimension Examples; VC-Dimension of hyperplanes	**10**	**CS419.3, CS419.4**
IV	**Artificial Neural Networks for Classification and regression**: Overview of Artificial Neural, Multilayer Feedforward Neural networks with Sigmoidal activation functions; Backpropagation Algorithm; Representational abilities of feedforward networks; Feedforward networks for Classification and Regression; Backpropagation in Practice; Radial Basis Function Networks; Gaussian RBF networks; Learning Weights in RBF networks; K-means clustering algorithm **Support Vector Machines and Kernel based methods**: Support Vector Machines -- Introduction, obtaining the optimal hyperplane; SVM formulation with slack variables; nonlinear SVM classifiers; Kernel Functions for nonlinear SVMs; Mercer and positive definite Kernels; Support Vector Regression and ε-insensitive Loss function, examples of SVM learning; Overview of SMO and other algorithms for SVM; v -SVM and v-SVR;SVM as a risk minimizer; Positive Definite Kernels; RKHS; Representer Theorem	**10**	**CO3, CO4, CO5**
V	**Feature Selection, Model assessment and cross-validation**: Feature Selection and Dimensionality Reduction; Principal ComponentAnalysis; No Free Lunch Theorem; Model selection and model estimation;Bias-variance trade-off; Assessing Learnt classifiers; Cross Validation; **Boosting and Classifier ensembles** Bootstrap,Bagging and Boosting; Classifier Ensembles;AdaBoost, Risk minimization view ofAdaBoost	**6**	**CS419.3, CS419.4, CS419.5**

Total Hours	**40**	
Essential Readings		
1. R.O.Duda,P.E.Hart and D.G.Stork, “Pattern Classification”, John Wiley, 2002.		
2. C.M.Bishop, “Neural Networks and Pattern Recognition”, Oxford University Press (Indian Edition), 2003.		
Supplementary Readings		
1. C.M.Bishop,"Pattern Recognition and Machine Learning",Springer, 2006.		

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Department	**Computer Science and Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 471	**Cyber Physical System**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To gain a solid understanding of foundational concepts in CPS, including real-time sensing, communication, task scheduling, and dynamical system modeling.	Course Outcomes	CS471.1	Able to demonstrate a deep understanding of fundamental concepts in CPS	Understand
	To apply hybrid automata modeling and reachability analysis techniques to analyze and predict the behavior of CPS under various operational scenarios		CS471.2	Able to apply advanced modeling techniques	Apply
	To develop skills in designing safe and efficient CPS controllers using techniques		CS471.3	Able to design and implement robust CPS controllers and design neural network-based control approaches to optimize system performance and ensure safety.	Create
	To explore methods for detecting and mitigating cyber-attacks in CPS through state estimation		CS471.4	Able to gain practical skills in implementing cybersecurity measures for CPS	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS471.1	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**1**	**1**
CS471.2	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**1**	**1**
CS471.3	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**3**	**1**	**1**
CS471.4	3	3	3	3	3	3	2	3	3	3	2	3	2	1	1
CS471	3.00	3.00	3.00	2.75	3.00	2.25	2.00	3.00	2.50	2.25	1.50	2.50	2.50	1.00	1.00

SYLLABUS

No.	Content	Hours	COs
I	Cyber— Physical Systems (CPS) in the real world: Industry 4.0, Automotive, Building Automation, Medical CPS Low power compute platforms for CPS Real time sensing and communication for CPS: i. Sensors, Actuators ii. CAN protocol in automotive systems	**4**	**CS471.1**
II	Real time task scheduling for CPS Worst Case Execution Time, Response time analysis of CPS software Dynamical System modeling for CPS Different notions of stability	**8**	**CS471.2**
III	Controller Design (using pole placement), Delay aware Controller Design Stability and Control Performance in presence of Platform uncertainties	**4**	**CS471.2**
IV	Lyapunov Stability, Barrier Functions Quadratic Program based Controller Design ensuring Safety and Stability	**4**	**CS471.3**
V	Neural Network (NN) Based Controllers in CPS Safety of NN enabled CPS: switching between NN and conventional controllers State Estimation using Kalman Filter and other techniques False Data Injection (FDI) Attack detection in CPS, Attack Mitigation in C	**8**	**CS471.4**
	Total Hours	**28**	

Essential Readings

1. Rajeev Alur and Stanley Bak, "Cyber-Physical Systems: A Computational Perspective", Cambridge University Press, 2023
2. Houbing Song, Danda B. Rawat, Sabina Jeschke, and Christian Brecher, "Cyber-Physical Systems: Foundations, Principles and Applications", 1st Edition, Academic Press, 2016

Supplementary Readings

1. Edward Ashford Lee and Sanjit Arunkumar Seshia , "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", 2nd Edition, Lee & Seshia, 2017
2. Danda B. Rawat, Joel J.P.C. Rodrigues, Ivan Stojmenovic, "Cyber-Physical Systems: From Theory to Practice", 1st Edition, CRC Press, 2015

Eighth Semester Courses

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Department	**Computer Science and Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 402	**Cloud Computing**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**This course introduces the concept of cloud computing and background technologies.**	Course Outcomes	CS402.1	**Able to acquire knowledge about cloud computing, its vision, and history, characteristics.**	Understand
	This course summarizes the background cryptographic mathematics which will be applied in Cloud computing		CS402.2	**Able to acquire knowledge about the background technologies and cryptographic mathematics of Cloud Computing.**	Understand
	This course explain about architecture, types and the security flaws in Cloud computing.		CS402.3	**Able to acquire knowledge about the Cloud architecture, Cloud types and its various services.**	Understand
	This course describes the concept of various cloud computing platform available.		CS402.4	**Able to analyse the security of cloud computing.**	Analyse
			CS402.5	**Able to analyse the various cloud platform available.**	Analyse

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS402.1	3	2											2		3
CS402.2	3	2				1			2				2	3	2
CS402.3	3	3	3	1		1	2		2				3	3	2
CS402.4	2	3	3	1	2	2	3		2			1	3	2	2
CS402.5	2	3	3		2	2	3		2			1	3	3	3
CS402	2.60	2.60	3.00	1.00	2.00	1.50	2.67		2.00			1.00	2.60	2.75	2.40

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Clouds, Cloud Computing architecture, Virtualization and Virtual Machine, service management in cloud computing**	**8**	**CS402.1, CS402.2, CS402.3**
II	**Data Management in Cloud computing, resource management in cloud, Cloud security**	**10**	**CS402.1, CS402.2**
III	**Open source and commercial clouds, cloud simulators, research trend in cloud computing, fog computing, VM resource allocation, management and monitoring, Cloud-Fog-Edge enabled analytics**	**12**	**CS402.3, CS402.4**
IV	**Serverless computing and FaaS Model, Case Studies and recent Advancements**	**10**	**CS402.5**
	Total Hours	**40**	

Essential Readings

1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", 1st Edition, Wiley, 2013
2. Gautam Shroff, "Enterprise Cloud Computing - Technology, Architecture, Applications", 1st Edition, Cambridge University Press, 2010
3. Barrie Sosinsky, "Cloud Computing Bible", 1st Edition, Wiley-India, 2011
4. Ronald L. Krutz, Russell Dean Vines, "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", 1st Edition, Wiley- India,2010

Supplementary Readings

1. Nancy Lynch, "Distributed Algorithms", Morgan Kaufmann Publishers In, 1996
2. Kai Hwang, Jack Dongarra, Geoffrey Fox, "Distributed and Cloud Computing From Parallel Processing to the Internet of Things", 1st Edition, Morgan Kaufmann, 2013
3. Nikos Antonopoulos, Lee Gillam, "Cloud Computing: Principles, Systems and Applications", Springer, 2012

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Department	**Computer Science and Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 404	**Design and Implementation of Human Computer Interface**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**This course introduces the concept of human computer interaction.**	Course Outcomes	CS404.1	**Able to acquire knowledge about the basic concept on human computer interaction.**	Understand
	This course illustrates the various software process and design of human computer interaction.		CS404.2	**Able to acquire knowledge about the design of human computer interaction and its software process.**	Understand
	This course describes the various existing models of interacting human with computer.		CS404.3	**Able to acquire knowledge about the various models and theories on human computer interaction.**	Understand
	This course explains the designing of human computer interaction using mobile and web interface.		CS404.4	**Able to design the human computer interaction using the mobile platforms.**	Create
			CS404.5	**Able to design the human computer interaction in web interface.**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS404.1	**3**														**1**
CS404.2	**3**	**3**							**2**				**3**	**3**	**1**
CS404.3	**3**	**3**	**2**	**1**	**1**	**1**			**2**				**3**	**3**	**2**
CS404.4	**3**	**3**	**2**	**2**	**1**	**2**	**2**		**2**			**1**	**3**	**3**	**2**
CS404.5	**3**	**3**	**2**	**2**	**1**	**2**	**2**		**2**			**1**	**3**	**3**	**3**
CS404	3.00	3.00	2.00	1.67	1.00	1.67	2.00		2.00			1.00	3.00	3.00	1.80

SYLLABUS

No.	Content	Hours	COs
I	Introduction, Identification of usability requirements I, Identification of usability requirements II	**6**	**CS404.1**
II	Usable interface design Rapid usability evaluation	**8**	**CS404.2**
III	Converting design to system I Converting design to system II	**10**	**CS404.3**
IV	System implementation I System implementation II System implementation III	**10**	**CS404.4**
V	Empirical usability evaluation Conclusion	**6**	**CS404.5**
	Total Hours	**40**	

Essential Readings

1. Samit Bhattacharya, "*Human-Computer Interaction*: *User-Centric Computing for Design"*, 1st Edition, McGraw Hill Education, 2019.
2. Bruce R Maxim & Roger S Pressman, "Software Engineering: A Practitioner's Approach", 8th Edition, McGraw Hill Education, 2019
3. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004
4. Brian Fling, "Mobile Design and Development", 1st Edition , O'Reilly Media Inc., 2009
5. Bill Scott and Theresa Neil, "Designing Web Interfaces", 1st Edition, O'Reilly, 2009

Supplementary Readings

1. K. Meena and R. Sivakumar, "Human-Computer Interaction",Prentice Hall India, 1 st Edition,2014
2. Mike van Drongelen, Adam Dennis, Richard Garabedian, Alberto Gonzalez, Aravind Krishnaswamy "Lean Mobile App Development", O'Reilly 1 st Edition, 2017.
3. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interfaces", O'Reilly Media, Inc., 3 rd Edition, 2020

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 406	**Reinforcement Learning**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To develop a deep understanding of foundational RL algorithms**	Course Outcomes	CS406.1	**Able to demonstrate proficiency in foundational RL algorithms and to understand their theoretical basis and practical implementation.**	Understand
	To gain proficiency in core RL concepts and Learn how these methods contribute to optimizing decision-making processes and improving policy learning in dynamic environments.		CS406.2	**Able to gain practical experience in applying advanced RL techniques and actor-critic architectures to solve complex decision-making tasks.**	Evaluate
	To apply advanced RL techniques and Gain practical experience in implementing algorithms		CS406.3	**Able to develop the ability to analyze and evaluate RL algorithms using performance metrics**	Analyze
	To Explore hierarchical RL strategies and their role in managing decision-making hierarchies effectively and Understand the challenges and applications		CS406.4	**Able to design and implement RL solutions for real-world applications**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS406.1		**1**	**2**	**2**	**3**	**2**	**1**							**1**	
CS406.2	**1**		**1**		**2**	**2**							**2**	**1**	
CS406.3	**1**	**2**	**3**	**1**	**2**								**1**		**1**
CS406.4		**1**	**1**	**3**		**1**	**2**						**1**	**1**	**2**
CS406	1.00	1.33	1.75	2.00	2.33	1.67	1.50						1.33	1.00	1.50

SYLLABUS

No.	Content	Hours	COs
I	Introduction to Reinforcement Learning, Bandit algorithms – UCB, PAC, Median Elimination, Policy Gradient	**8**	**CS406.1**
II	Full RL & MDPs Bellman Optimality Dynamic Programming & TD Methods	**12**	**CS406.1, CS406.2**
III	Eligibility Traces Function Approximation Least Squares Methods	**12**	**CS406.3**
IV	Fitted Q, DQN & Policy Gradient for Full RL Hierarchical RL POMDPs	**8**	**CS406.4**
Total Hours		**40**	

Essential Readings

1. R. S. Sutton and A. G. Barto, "Reinforcement Learning - An Introduction" MIT Press. 2nd Edition, 2018
2. "Reinforcement Learning: State-of-the-Art", Editors: Marco Wiering and Martijn van Otterlo, Springer, 2nd Edition, 2012

Supplementary Readings

1. Maxim Lapan , "Deep Reinforcement Learning Hands-On", Packt Publishing, 2nd Edition, 2020
2. Csaba Szepesvári , "Algorithms for Reinforcement Learning", Morgan & Claypool Publishers, 2nd Edition, 2021

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 408	**GPU Architecture and Programming**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To understand the principles of traditional computer architecture, focusing on the five-stage RISC pipeline, cache memory organization, register file management, and SIMD instructions.**	Course Outcomes	CS408.1	**Able to gain a comprehensive understanding of traditional computer architecture principles, including the five-stage RISC pipeline, cache memory, register file organization, and SIMD instructions.**	Understand
	To gain proficiency in GPU architectures, specifically understanding Streaming Multiprocessors (SM), cache hierarchy designs, and the graphics pipeline.		CS408.2	**Able to develop proficiency in GPU architectures, focusing on concepts, Streaming Multiprocessors (SM), cache hierarchies, and the graphics pipeline.**	Understand
	To develop practical skills in CUDA programming, including multi-dimensional data space mapping, effective synchronization methods, warp scheduling strategies, and handling thread divergence.		CS408.3	**Able to acquire practical skills in CUDA programming, including multi-dimensional mapping of data space, synchronization mechanisms, warp scheduling strategies, and handling thread divergence.**	Apply
	To introduce the basics of OpenCL programming and its application in heterogeneous computing environments.		CS408.4	**Able to discuss OpenCL basics and its role in heterogeneous computing environments.**	Analyse

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS408.1	**1**	**1**		**1**	**3**	**2**			**1**					**1**	
CS408.2		**1**		**1**		**1**	**2**							**1**	
CS408.3	**1**	**2**	**3**	**1**	**2**								**1**		
CS408.4			**1**	**2**		**3**	**1**		**1**				**1**	**1**	
CS408	1.00	1.33	2.00	1.25	2.50	2.00	1.50		1.00				1.00	1.00	

SYLLABUS

No.	Content	Hours	COs
I	Review of Traditional Computer Architecture – Basic five stage RISC Pipeline, Cache Memory, Register File, SIMD instructions. GPU architectures - Streaming Multi Processors, Cache Hierarchy,The Graphics Pipeline	**6**	**CS408.1**
II	Introduction to CUDA programming, Multi-dimensional mapping of dataspace, Synchronization, Warp Scheduling, Divergence	**12**	**CS408.2, CS408.3**
III	Memory Access Coalescing, Optimization examples : optimizing Reduction Kernels, Optimization examples : Kernel Fusion, Thread and Block	**10**	**CS408.3**
IV	OpenCL basics, OpenCL for Heterogeneous Computing, Application Design : Efficient Neural Network Training/Inferencing	**12**	**CS408.4**
	Total Hours	**40**	

Essential Readings

1. John L.Hennessy and David A. Patterson, "Computer Architecture -- A Quantitative Approach", 6th Edition, Morgan Kaufmann Publishers In, 2017
2. David Kirk and Wen-mei Hwu, "Programming Massively Parallel Processors", 2nd Edition, Morgan Kaufmann Publishers In, 2012
3. Benedict Gaster,Lee Howes, David R. Kaeli, "Heterogeneous Computing with OpenCL", 1st Edition, Morgan Kaufmann, 2011

Supplementary Readings

1. Dirk Deroos et al., "Hadoop for Dummies", Dreamtech Press, 2014.
2. Chuck Lam, "Hadoop in Action", Dreamtech Press, 2011
3. Leskovec, Rajaraman, Ullman, "Mining of Massive Datasets", 2nd Edition, Cambridge University Press, 2014.
4. I.H. Witten and E. Frank, "Data Mining: Practical Machine learning tools and techniques", 4th Edition, Morgan Kaufmann, 2016
5. Erik Brynjolfsson et al., "The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies", W. W. Norton & Company, 2014.

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS 410	**Cyber Security and Privacy**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To gain a thorough understanding of the CIA triad (Confidentiality, Integrity, Availability) and its application in cybersecurity to ensure data protection.**	Course Outcomes	CS410.1	**Able to articulate and apply the principles of confidentiality, integrity, and availability (CIA triad) to assess and enhance the security posture of digital systems.**	Apply
	To implement effective security management practices using GRC frameworks and industry standards to mitigate risks and ensure regulatory compliance.		CS410.2	**Able to develop and implement security policies, leveraging governance, risk management, and compliance (GRC) frameworks to mitigate risks and ensure organizational resilience.**	Create
	To acquire skills in incident response, disaster recovery planning, and business continuity to minimize downtime and recover from cybersecurity incidents effectively.		CS410.3	**Able to execute incident response plans effectively, manage disasters, and implement business continuity measures to minimize operational disruption and restore normalcy in the event of cyber incidents.**	Evaluate
	To explore foundational concepts of information privacy, analyze privacy theories, and comprehend global privacy regulations		CS410.4	**Able to understand and apply global privacy regulations, GDPR, DPDP, and regional privacy laws, ensuring organizational compliance and safeguarding individual privacy rights in data management**	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS410.1	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**3**	**2**	**3**	**1**	**3**	**2**	**1**	**1**
CS410.2	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
CS410.3	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
CS410.4	3	3	3	3	2	3	2	3	3	3	2	3	3	2	2
CS410	3.00	3.00	3.00	3.00	2.00	2.75	1.75	3.00	2.75	3.00	2.25	3.00	2.75	1.75	1.75

SYLLABUS

No.	Content	Hours	COs
I	Introduction - Introduction to cyber security, Confidentiality, integrity, and availability. Foundations - Fundamental concepts, CIA, CIA triangle, data breach at target.	**8**	**CS410.1**
II	Security management, Governance, risk, and compliance (GRC)- GRC framework, security standards. Contingency planning - Incidence response, Disaster Recovery, BCP. Cyber security policy - ESSP, ISSP, SYSSP.	**10**	**CS410.2**
III	Risk Management - Cyber Risk Identification, Assessment, and Control. Cyber security: Industry perspective - Defense Technologies, Attack, Exploits. Cyber security technologies - Access control, Encryption, Standards.	**10**	**CS410.3**
IV	Foundations of privacy - Information privacy, Measurement, Theories. Privacy regulation - Privacy, Anonymity, Regulation, Data Breach. Privacy regulation in Europe, Privacy: The Indian Way - Data Protection, GDPR, DPDP, Aadhar. Information privacy: Economics and strategy, Economic value of privacy, privacy valuation, WTA and WTC, Business strategy and privacy, espionage, Privacy vs safety.	**12**	**CS410.4**
Total Hours		**40**	

Essential Readings

1. Michael E. Whitman, Herbert J. Mattord, (2018). Principles of Information Security, 6th edition, Cenage Learning, N. Delhi.
2. Darktrace, "Technology" https://www.darktrace.com/en/technology/#machine-learning, accessed November 2018.
3. Van Kessel, P. Is cyber security about more than protection? EY Global Information Security Survey 2018-2019.
4. Johnston, A.C. and Warkentin, M. Fear appeals and information security behaviors: An empirical study. MIS Quarterly, 2010.

Supplementary Readings

1. Arce I. et al. "Avoiding the top 10 software security design flaws", IEEE Computer Society Center for Secure Design (CSD), 2014.
2. Smith, H. J., Dinev, T., & Xu, H. "Information privacy research: an interdisciplinary review" MIS Quarterly, 2011.
3. Subramanian R. Security, "Privacy and politics in India: a historical review", Journal of Information Systems Security (JISSec), 2010.
4. Acquisti, A., John, L. K., & Loewenstein, G. "What is privacy worth?", The Journal of Legal Studies, 2013

5. Xu H., Luo X.R., Carroll J.M., Rosson M.B. “The personalization privacy paradox: An exploratory study of decision making process for location-aware marketing”, Decision Support Systems, 2011.