Curriculum Structure for B. Tech. Computer Science & Engineering Programme

(In light of NEP 2020)

NCrF Level 6

(NEP_Version II)

For students admitted in 2023-24 onwards

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
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Structure for B. Tech. Programme in light of NEP 2020

For students admitted in 2023-24 onwards

Key Features of Curriculum

1. Multiple entry and exit option after every year.
2. Provision for Open Electives (OE), Vocational and Skill Enhancement Courses (VSE), Ability Enhancement Courses (AE), Indian Knowledge System (IKS), Value Education Courses (VE), Co-Curricular Courses (CC) in addition to program core courses.
3. Mandatory internship of one semester.
4. Credits for Value education courses, Ability Enhancement Courses, Co-Curricular, Curricular Activities.
5. Mandatory Non-Credit Courses.
6. Interdisciplinary and multidisciplinary education through single and double minors and open electives.
7. Skill based courses and multiple exit level.
8. Provision for learning in online mode through Swayam/ NPTEL etc courses
9. Provision for B.Tech. Honours with Research degree through research project.
10. Opportunity for learner to choose courses of their interest in all disciplines.
11. Provision of Skill Based Courses and internship/Field project/mini projects for exit options at each level.

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12. Flexibility for all types of learners i.e. Good, Normal and Exit

Good Students	Normal Students	Exit
B. Tech. Major with Multidisciplinary Minor	B. Tech. Major with Multidisciplinary Minor	Additional 08 credits in the form of skill-based courses / labs, internship, mini projects shall be offered in 8 weeks.
B. Tech. Honors and Multidisciplinary Minor	--	
B. Tech. Honors with Research and Multidisciplinary Minor	--	
B. Tech. with Double Minor (Multidisciplinary and Specialization Minor)	--	

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Credit Distribution for each year and Exit Option

NCrFLevel	Year / Semester	Exit Option	Credits	Additional Credits for exit students	Total Credits
4.5	Semester I & II	U. G. Certificate	43	08	51
5.0	Semester III & IV	U. G. Diploma	84	08	92
5.5	Semester V & VI	B. Vocational/B.Sc. Engg.	127	08	135
6.0	Semester VII & VIII	B. Tech.Major with Multidisciplinary Minor	167	--	167
		B. Tech. Honors and Multidisciplinary Minor	167+18=185	--	185
		B. Tech. Honors with Research and Multidisciplinary Minor	167+18=185	--	185
		B. Tech. with Double Minor (Multidisciplinary and Specialization Minor)	167+18=185	--	185

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Course Category-wise Credit Distribution

Course Category	As per NEP GR	GCOEA Credits	CC	As per NEP GR	GCOEA Credits
BSC/ESC	30	30	BS	14-18	18
			ES	16--12	12
Program Courses	64-76	67	PC	44-56	47
			PE	20	20
Multidisciplinary Courses	22	22	MM	14	14
			OE	8	8
Skill Courses	8	8	VSE	8	8
Humanities, Social Science & Management (HSSM)	14	14	AE	4	4
			EM	4	4
			IKS	2	2
			VE	4	4
Experiential Courses	22	22	RM	4	4
			FP	2	2
			PR	4	4
			IN/OJT	12	12
Liberal Learning Courses	4	4	CC	4	4
Total Credits	**160-176**	**167**		**160-176**	**167**

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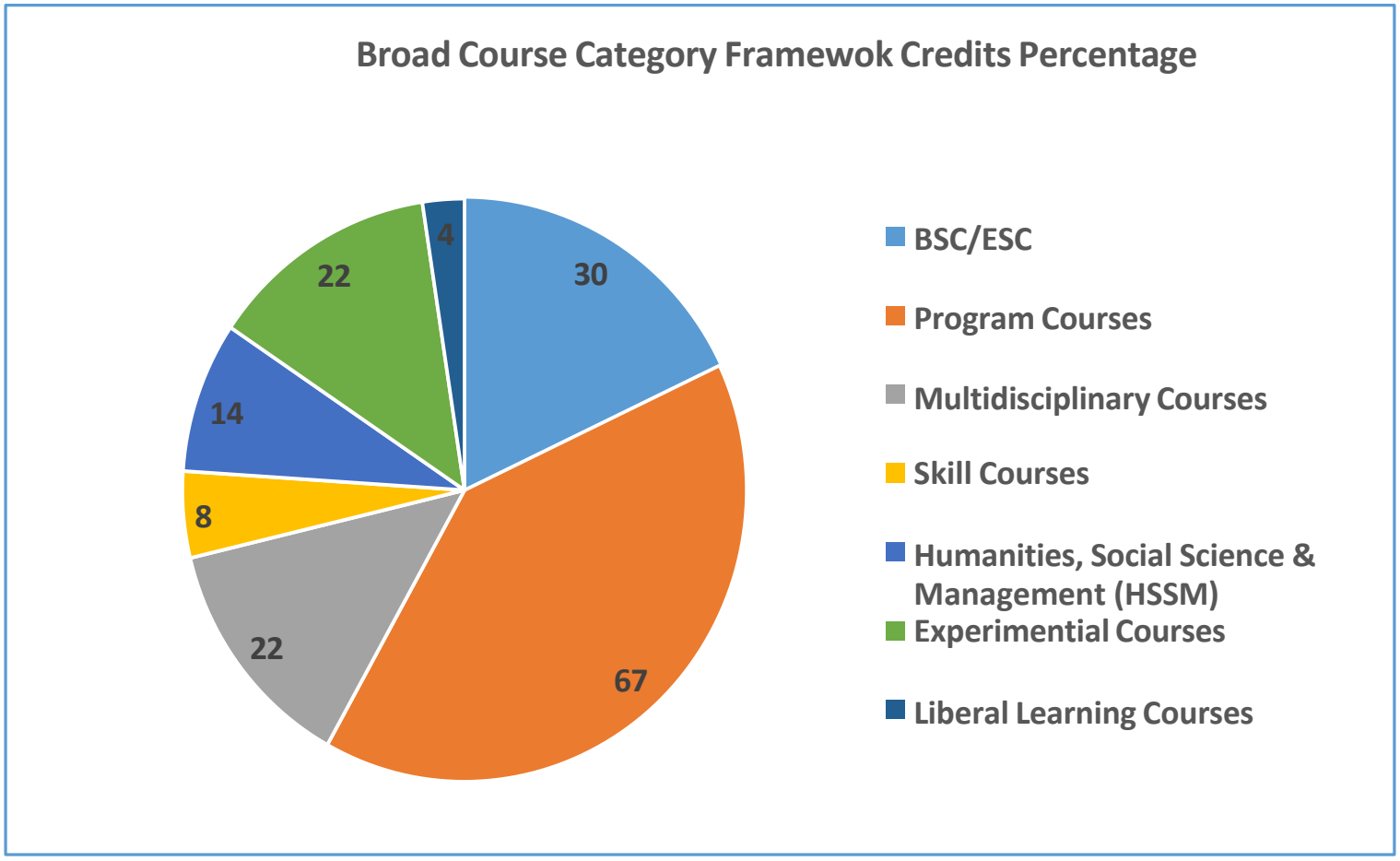

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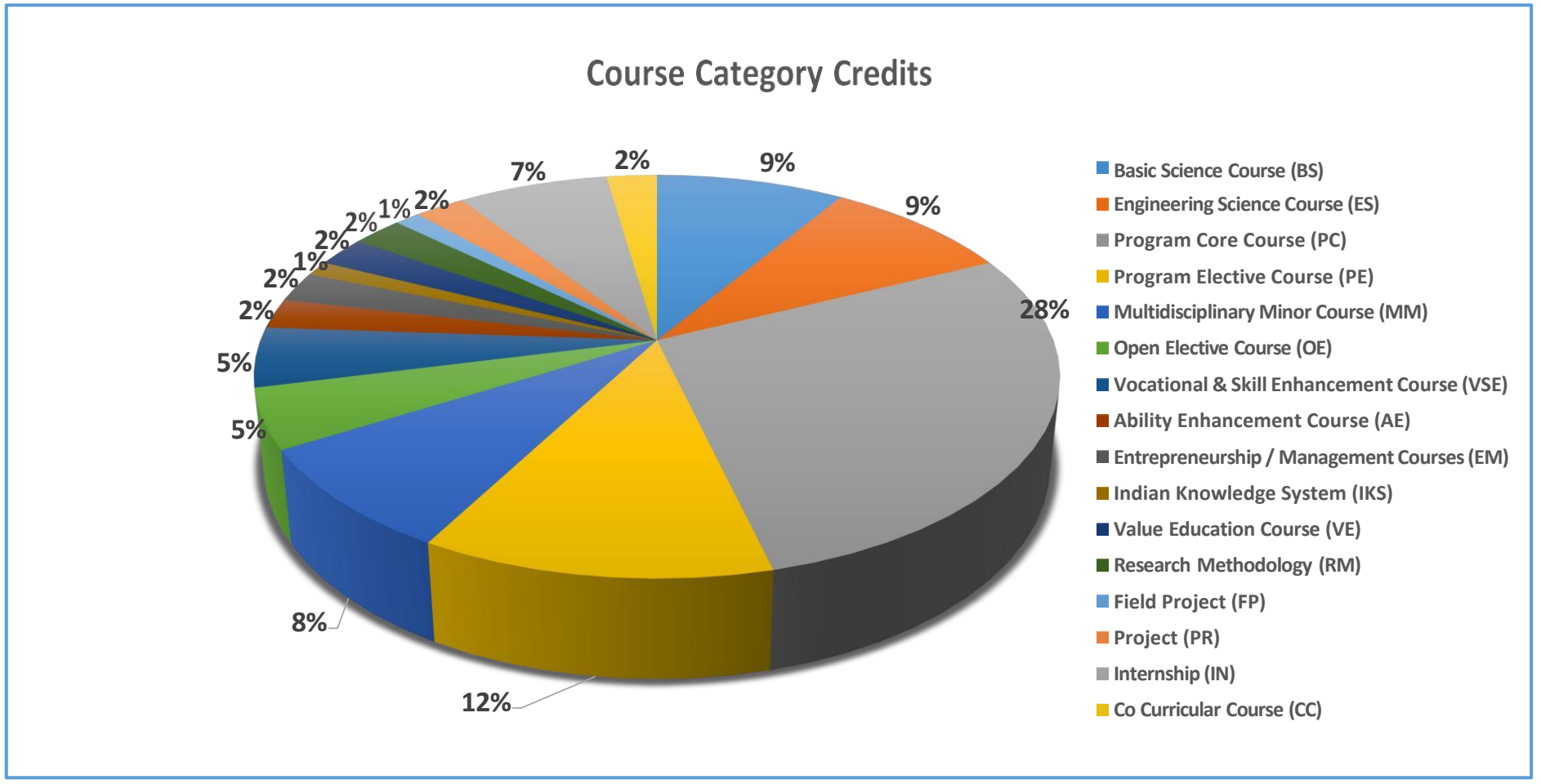

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Semester-wise Credit Distribution

Sr. No.	SEM	I	II	III	IV	V	VI	VII	VIII	Total Credits	NEP Requirement
1	Basic Science Course (BS)	8	7	3						18	14-18
2	Engineering Science Course (ES)	8	4							12	12-16
3	Program Core Course (PC)		6	11	12	9	6	3		47	44-56
4	Program Elective Course (PE)					4	8	8		20	20
5	Multidisciplinary Minor Course (MM)			3	3	3	3	2		14	14
6	Open Elective Course (OE)				3	3		2		8	8
7	Vocational & Skill Enhancement Course (VSE)			2	1	2	1	2		8	8
8	Ability Enhancement Course (AE)	1	3							4	4
9	Entrepreneurship / Management Courses (EM)			1					3	4	4
10	Indian Knowledge System (IKS)	2								2	2
11	Value Education Course (VE)	2	2							4	4
12	Research Methodology (RM)								4	4	4
13	Field Project (FP)						2			2	2
14	Project (PR)							4		4	4
15	Internship (IN)								12	12	12
16	Co Curricular Course (CC)				2	2				4	4
	Total Credits	**21**	**22**	**20**	**21**	**23**	**20**	**21**	**19**	**167**	160-176

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General Instructions:

(1) 10% content of syllabus of each theory course shall be completed by the students with self-study. The 10% portion of each course (for self-study) shall be declared by the concerned course-coordinator at the beginning of teaching of the course.

(2) Student can complete **any Course** or programme elective courses PE1 to PE5 in "online" mode, offered through SWAYAM/ NPTEL portal or equivalent platform which provides Evaluation mechanism with the permission of Departmental Faculty Board (DFB). In this case –

(i) Students can register and complete these online courses any time after beginning of third semester, however, the student must successfully complete and pass the course, and submit the score card/certificate before declaration of result of respective semester in which the course is being offered.

(ii) In case, if a student registers for a course in online mode but fails in the course, the student will have to register for the course offered by the institute in respective semester as per curriculum. In this case, the student will have to appear for all the examinations (CT1/CT2, TA, ICA, ESE etc) of the course, and successfully complete the course.

(3) In eighth semester, the students have to complete mandatory internship of one semester in the company/ organization approved by the DFB.

(4) In eighth semester during internship, the students have to complete the theory courses in any one of the two modes:

(i) **Online courses** offered through SWAYAM/ NPTEL or equivalent platform which provides Evaluation mechanism with the permission of DFB: In this case, students can register and complete these online courses any time after beginning of third semester and complete the course and submit the score card/ certificate before declaration of result of eighth semester.

In case if a student registers for a course in online mode but fails in the course, the student will have to register for the course offered by the institute as per curriculum. In this case, the student will have to appear for all the examinations (CT1/CT2, TA, ICA, ESE etc) of the course personally as per the schedule declared by the institute, and successfully complete the course.

(ii) **Self-study mode:** In this case the student will have to study the course offered by the institute of his/her own. The student shall appear for all the college assessments/ examinations (CT1/CT2, TA and ESE) personally as per the schedule declared by the institute and successfully complete the course.

(5) In addition to program specific courses, the students have to complete vocational skill courses, internship, field projects connected to **major degree**.

(6) Exit Option:

The exit option at the end of each year will be available to students after even semester. e. 2nd semester, 4th semester &6th semester and will commence from AY 2024-25 for UG Certificate, AY 2025-26 for UG Diploma, AY 2026-27 for B. Voc./B. Sc. Engineering degree.

(7) Students opting for exit at any level (after odd semesters or even semester) will have to earn additional eight credits before exit in skill based vocational courses and internship/apprenticeship/mini project to make them eligible to get UG certificate / UG Diploma or B. Voc./B. Sc. Engineering degree as per eligibility.

(8) Re Entry and Lateral Entry: Students opting for exit at any level after even semester, will have the option to re-enter the programme from where they left off in odd semesters within **four years of exit.** There shall be a gap of at least **one year** between exit and re-entry to UG programme.

(9) Students opting for exit after odd semester, i.e. 1st, 3rd, 5th or 7th semester will have the option to re-enter the programme from where they left off in even semesters only. There shall be a gap of at least **one year** between exit and re-entry to UG programme.

(10) Maximum period for completion of B. Tech. programme:

The student has to complete the degree programme within the stipulated **maximum period of eight years** from the date of admission to first year UG. The maximum duration of the programme includes the period of exit, withdrawal, absence and different kinds of leaves permissible to a student but it shall exclude the period of rustication of the student from the institute. However, genuine cases on confirmation of valid reasons may be referred to Academic Council for extending this limit by **additional one year**.

(11) Eligibility for admission to the UG Bachelor's Degree with Honours/ Research/Double Minor:

Students with minimum **CGPA of 7.5** without backlog courses at the end of fourth semester and should have earned 84 **credits** are eligible for admission to the UG Bachelor's Degree with Honours/ Research/ Double Minor.

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Multiple exits: Following options are available for multiple exists:

Option	NCrF Level	Qualification Title	Additional credit requirement	Bridge courses
Exit-1	4.5	One year UG certificate course in Engg/Tech	8	2 Month Internship **OR** Online Two skill courses at ITI Level from NSQF/ESSC/ANY Other agency which provides certification / Evaluation @ **OR** Technical Project
Exit-2	5.0	Two year UG Diploma I Engg/Tech	8	2 Month Internship **OR** Online Two skill courses at Diploma Level from NSQF/ESSC/ANY Other agency which provides certification / Evaluation @ **OR** Technical Project
Exit-3	5.5	Three year Bachelor Degree in Vocation (B.Voc) orB.Sc. (Engg./Tech)	8	2 Month Internship **OR** Online Two skill courses at Degree Level from NSQF/ESSC/ANY Other agency which provides certification / Evaluation @ **OR** Technical Project

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SEMESTER –III														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
											Practical		Total	
			TH	TU	PR	Total	CT-1	CT-2	TA	ESE	ICA	ESE		
BS5	SH1301(A)	Linear Algebra and Statistical Methods	3			3	15	15	10	60			100	3
MM1	CS1315/16	Multidisciplinary Minor 1	3			3	15	15	10	60			100	3
PC3	CS1301	Fundamentals of Data Structure	3	1		4	15	15	10	60			100	4
PC4	CS1302	Object Oriented Methodology	3	1		4	15	15	10	60			100	4
PC5	CS1303	Discrete Mathematics	3			3	15	15	10	60			100	3
VSE1	CS1304	Data Structure Lab			2	2					25	25	50	1
VSE2	CS1305	Object Oriented Methodology Lab			2	2					50		50	1
EM1	CS1310	Idea Lab			2	2					50		50	1
Total			**15**	**2**	**6**	**23**	**75**	**75**	**50**	**300**	**125**	**25**	**650**	**20**

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SEMESTER –IV														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**							**Credits**
							Theory				**Practical**		**Total**	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM2	CS1415/16	Multidisciplinary Minor 2	3			3	15	15	10	60			100	3
PC6	CS1401	Design and Analysis of Algorithm	3	1		4	15	15	10	60			100	4
PC7	CS1402	Database Management System	3			3	15	15	10	60			100	3
PC8	CS1403	Computer Organization and Architecture	3			3	15	15	10	60			100	3
OE1	SH1401	Open Elective 1	3			3	15	15	10	60			100	3
PC9	CS1404	Design and Analysis of Algorithm Lab			2	2					50		50	1
PC10	CS1405	Computer Organization and Architecture Lab			2	2					50		50	1
VSE3	CS1406	Database Management System Lab			2	2					25	25	50	1
CC1	SH1402	Co-curricular Course			4	4			20				20	2
Total			**15**	**1**	**10**	**26**	**75**	**75**	**70**	**300**	**125**	**25**	**670**	**21**

Co-Curricular Course Activities minimum hours:2 hours per week or 24 hours Co-Curricular Course: Active Participation in Activities such as: Health and wellness, Sports, yoga education, Tech-fest, College Club Activity, University level/ college level cultural activities, Drama, painting, fine/ applied/ visual performing arts, annual day, department student's association/IE/ISTE/Any professional body, paper presentation, foreign language certificate, NCC, NSS etc. Co-Curricular Course Activities minimum hours: 2 hours per week or 24 hours."

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EXIT CRITERIA FOR U. G. DIPLOMA

Category	Course Code	Name of the Course @	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
EX2	CS1411	Mobile Application Development									50		50	4
EX2	CS1412	Computer Network and Internet Protocol									50		50	4
OR														
EX2	CS1413	**Internship / Technical Project**									100@		100	8

@ Based on seminar, Internship Report, Internship/ Project evaluation

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Equivalence Scheme

Programme Name:-B. Tech. Computer Science & Engineering

S. N.	Course code with Name of course (old) Revised Curriculum 2019-20			Course code with Name of course(NEW) (NEP Version-II)		
1.	Code	Name	Credit	Code	Name	Credit
2.	ETU331	Analog and Digital Integrated Circuit	3	←------No Equivalence ------→		
3.	SHU321B SHU322B	Transform and Linear Algebra Differential Equation and Transform	4	←------No Equivalence ------→		
4.		_____		SH1301 (B)	Engineering Mathematics- III	3
5.	CSU321	Data Structure & Algorithms	3	CS1302	Fundamentals of Data Structure	4
6.	CSU322	Discrete Mathematics	3	CS1304	Discrete Mathematics	3
7.	CSU421	Object Oriented Programming	3	CS1303	Object Oriented Methodology	4
8.	CSU323	Data Structure & Algorithms Lab	2	CS1305	Data Structure Lab	1

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9.	CSU 426	Object Oriented Programming Lab	2	CS1306	Object Oriented Methodology Lab	1
10.	CSU424	Design and Analysis of Algorithms	3	CS1402	Design and Analysis of Algorithm	4
11.	CSU521	Database Management System	3	CS1403	Database Management System	3
12.	CSU422	Computer Organization and Architecture	3	CS1404	Computer Organization and Architecture	3
13.	SHU323	Introduction to Constitution of India	0	SH1401	Open Elective 1	3
14.	SHU324	Effective Technical Communication	3	←------No Equivalence ----- →		
15.	ETU332	Analog and Digital Integrated Circuit Lab	2	←------No Equivalence ------→		
16.	CSU324	IT Workshop (Sci Lab/MATLAB)	3	←------No Equivalence ------→		
17.	CSU423	Operating System	3	CS1502	Operating System	4
18.	CSU428	Operating Systems Lab	3	CS1506	Operating System Lab	**1**
19.	CSU425	Organizational Behaviour	3	←------No Equivalence ------→		

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20.	SHU422	Environmental Sciences	0	←------No Equivalence ------→		
21.	←------No Equivalence ----- →			CS1405	Design and Analysis of Algorithm Lab	1
22.	CSU427	Computer Organization and Architecture Lab	2	CS1406	Computer Organization and Architecture Lab	1
23.	CSU527	Database Management System Lab	2	CS1407	Database Management System Lab	1

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SEMESTER –V														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**							**Credits**
								Theory			**Practical**		**Total**	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM3	CS1515/ CS1516	Multidisciplinary Minor 3	3			3	15	15	10	60			100	3
PC 11	CS1501	Introduction to Machine Learning	3			3	15	15	10	60			100	3
PC 12	CS1502	Operating System	3			3	15	15	10	60			100	3
PC 13	CS1503	Theory of Computation	3			3	15	15	10	60			100	3
PE1	CS1504	Program Elective 1	3			3	15	15	10	60			100	3
OE2	SH1501	Open Elective 2	3			3	15	15	10	60			100	3
VSE4	CS1505	Professional Software Lab			2	2					25	25	50	1
VSE5	CS1506	Operating System Lab			2	2					25	25	50	1
PE	CS1507	PE 1 Lab			2	2					25	25	50	1
CC2	SH1502	Co-curricular Course			4	4			20				20	2
MNC2	SH1503	Soft Skills	2			2			20				20	0
Total			**20**		**10**	**30**	**90**	**90**	**100**	**360**	**75**	**75**	**790**	**23**

Co-Curricular Course Activities minimum hours:2 hours per week or 24 hours Co-Curricular Course: Active Participation in Activities such as: Health and wellness, Sports, yoga education, Tech-fest, College Club Activity, University level/ college level cultural activities, Drama, painting, fine/ applied/ visual performing arts, annual day, department student's association/IE/ISTE/Any professional body, paper presentation, foreign language certificate, NCC, NSS etc. Co-Curricular Course Activities minimum hours: 2 hours per week or 24 hours."

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ADDITIONAL CRITERIA FOR HONORS

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			Theory Hrs /week	Tutorial Hrs/week	Practical Hrs/week	Total	CT1	CT2	TA	ESE	ICA	ESE		
PEH1	CS1521	Parallel Computer Architecture (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10			60	100	3
PEH2	CS1522	Introduction to Enterprise Resource Planning (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10			60	100	3
	Total													**6**

ADDITIONAL CRITERIA FOR HONORS WITH RESEARCH

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PER1	CS1531	Research Project Stage 1			08	08					100		100	4
Total					08	08					100		100	4

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ADDITIONAL CRITERIA FOR DOUBLE MINOR (SPECIALIZATION)

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MN1	CS1541	Computer Vision	3				15	15	10	60			100	3
MN2	CS1542	Business Intelligence & Analytics	3				15	15	10	60			100	3
	Total		6				30	30	20	120			200	6

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SEMESTER –VI														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**							**Credits**
							Theory				**Practical**		**Total**	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM4	CS1615/ CS1616	Multidisciplinary Minor 4	3			3	15	15	10	60			100	3
PC 14	CS1601	Computer Network	3			3	15	15	10	60			100	3
PC 15	CS1602	Software Engineering	4			4	15	15	10	60			100	4
PE2	CS1603	Program Elective 2	3			3	15	15	10	60			100	3
PE3	CS1604	Program Elective 3	3	1		4	15	15	10	60			100	4
VSE6	CS1605	Computer Network Lab			2	2					25	25	50	1
PE	CS 1606	Program Elective 2 Lab			2	2					25	25	50	1
FP	CS 1607	Minor Project			4	4					25	25	50	2
MNC3	CS 1608	Privacy and Security in Online Social Media	2			2	15	15	20				50	0
MNC4	SH1601	NCC/NSS/ Community service etc.							20				20	0
Total			**18**	**1**	**8**	**27**	**90**	**90**	**90**	**300**	**75**	**75**	**720**	**21**

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EXIT CRITERIA FOR EXIT CRITERIA FOR B. VOC.															
Category	Course Code	Name of the Course @	Teaching Scheme				Evaluation Scheme								Credits
							Theory				Practical		Total		
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE			
EX3	CS1611	User-Centric Mobile Computing									50		50		4
EX3	CS1612	Ethical Hacking									50		50		4
OR															
EX3	CS1613	Internship / Technical Project									100@		100		8

@ Based on seminar, Internship Report, Internship/ Project evaluation

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ADDITIONAL CRITERIA FOR HONORS

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PEH3	CS1621	Fundamentals of Information Retrieval (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10			60	100	3
PEH4	CS1622	Functional and Logical Programming (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10			60	100	3
	Total													**6**

ADDITIONAL CRITERIA FOR HONORS WITH RESEARCH

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PER2	CS1631	Research Project Stage 2			12	12					100	100	200	6

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ADDITIONAL CRITERIA FOR DOUBLE MINOR (SPECIALIZATION)

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			Theory Hrs /week	Tutorial Hrs/week	Practical Hrs/week	Total	CT1	CT2	TA	ESE	ICA	ESE		
MN3	CS1641	Natural Language Processing	3			3	15	15	10	60			100	3
MN4	CS1642	Affective Computing	3			3	15	15	10	60			100	3
	Total		6			6	30	30	20	120			200	6

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Equivalence Scheme

S N	Course code with Name of course (old) Revised Curriculum 2019-20			Course code with Name of course (NEW) (NEP Version-II)		
	Code	Name	Credit	Code	Name	Credit
1.	CSU521	Database management systems	3	CS1402	Database Management System	3
2.	CSU522	Formal Language and Automata Theory	4	CS1503	Theory of Computation	3
3.	CSU523	Java and Python Programming	3		No Equivalence	
4.	CSU524	Computer Networks	3	CS1601	Computer Network	3
5.	CSU525	(A)Graph Theory	3		No Equivalence	
6.		(B)System Analysis & Design	3		No Equivalence	
7.		(C) Artificial Intelligence	3	CS1504	(A) Artificial Intelligence	3
8.		(D) Electronic Design Automation	3		No Equivalence	
9.	CSU526	Database management systems Lab	2	CS1406	Database Management System Lab	1
10.	CSU527	Java and Python Programming Lab	2		No Equivalence	
11.	CSU528	Computer Networks Lab	2	CS1605	Computer Network Lab	1
12.	CSU621	Complier Design	3		No Equivalence	

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13.	CSU622	Software Engineering	3	CS1602	Software Engineering	4
14.	CSU623	(A)Advanced Algorithms	3		No Equivalence	
15.		(B) Distributed Systems	3		No Equivalence	
16.		(C) Machine Learning	3	CS1501	Introduction to Machine Learning	3
17.		(D) Computer Graphics			No Equivalence	
18.	CSU624	(A) Parallel and Distributed Algorithms	3		No Equivalence	
19.		(B) Embedded Systems	3		No Equivalence	
20.		(C) Data Mining		CS1604	(C) Data Warehousing and Data mining	4
21.		(D) Cloud Computing			No Equivalence	
22.	CSU633	Web Designing	3	CS1504	(D) Full Stack Development	3
23.		Data structure and Algorithm	3	CS1301	Fundamentals of Data Structure	4
24.	CSU626	Complier Design Lab	2		No Equivalence	
25.	CSU627	Minor Project	3	CS1607	Minor Project	2

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SEMESTER –VII														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM5	CS1715/16	Multidisciplinary Minor 5	2			2	15	15	10	60			100	2
PC 16	CS1701	Cryptography and Cyber Security	3			3	15	15	10	60			100	3
PE4	CS1702	Program Elective 4	3	1		4	15	15	10	60			100	4
PE5	CS1703	Program Elective 5	4			4	15	15	10	60			100	4
OE3	SH1701	Open Elective 3	2			2	15	15	10	60			100	2
VSE7	CS1704	PE4 Lab			2	2					25	25	50	1
VSE8	CS1705	PE5 Lab			2	2					25	25	50	1
PR	CS1706	Project			8	8					50	50	100	4
MNC5	CS1707	Principles of Instrumentation	2			2	15	15	20				50	0
Total			**16**	**1**	**12**	**29**	**90**	**90**	**70**	**300**	**100**	**100**	**750**	**21**

Note: Project Guide Teaching load: 8 hrs/week

Students can register for the elective in seventh semester under Multidisciplinary Minor 4 using **SWAYAM/NPTEL** etc. portal. Courses will be of completely student's choice but approved by DFB of concerned department (other than MM1 to MM3) and should be **at least of 12 weeks** including tutorials, which will be considered as **4 credit course**.

Students can register and complete online courses for Multidisciplinary Minor 4 any time after completion of semester IV, however, the student must successfully complete and pass the course, and submit the score card/certificate before declaration of result of VII th semester.

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ADDITIONAL CRITERIA FOR HONORS

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Thoery				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PEH5	CS1721	Distributed System (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10			60	100	3
PEH6	CS1722	Advanced Computer Architecture (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10			60	100	3
	Total													**6**

ADDITIONAL CRITERIA FOR HONORS WITH RESEARCH

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PER3	CS1731	Research Project Stage 3			16	16					100	200	300	8

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ADDITIONAL CRITERIA FOR DOUBLE MINOR (SPECIALIZATION)

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MN5	CS1741	Digital Forensics	3				15	15	10	60			100	3
MN6	CS1741	Automatic Speech Recognition	3				15	15	10	60			100	3
	Total		6				30	30	20	120			200	6

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SEMESTER –VIII															
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**								**Credits**
								Theory			**Practical**		**Total**		
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE	Total		
RM	SH1801	Research Methodology (Online through SWAYAM/NPTEL)	4			4	15	15	10	60			100		4
EM2	CS1802	Engineering Management	3			3	15	15	10	60			100		3
IN	CS1803	Internship (Online reviews - one in each month)									100	200	300		12
		Total	7			7	30	30	20	120	100	200	500		19

Note: Internship Guide Teaching load: 4 hrs/week

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LIST OF PROGRAM ELECTIVES					
	PE1 CS1504	**PE2 CS1603**	**PE3 CS1604**	**PE4 CS1703**	**PE5 CS1705**
A	Artificial Intelligence	Advanced Machine Learning and Deep Learning	Computer Vision	Cloud Computing	Introduction to Quantum Computing
B	Big Data Analytics	Internet of Things	Software Project Management	Block chain and Application	Advance System Security
C	Image Processing	High Processing Computing	Data Warehousing and Data mining	Human Computer Interaction	Mobile App Development
D	Full Stack Development	Augmented and Virtual Reality	Social Network Analysis	Geographic Information System and Spatial Database	Generative AI with Large Language Model
	SWAYAM/NPTEL etc related to vertical approved by DFB	**SWAYAM/NPTEL**etc related to vertical approved by DFB	**SWAYAM/NPTEL**etc related to vertical approved by DFB	**SWAYAM/NPTEL**/etc related to vertical approved by DFB	**SWAYAM/NPTEL**etc related to vertical approved by DFB

SWAYAM/NPTEL etc. portal. Courses for PE1 to PE5 should be related to concerned vertical approved by DFB and should be **at least of 12 weeks** including tutorials.

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LIST OF MULTIDICIPLINARY MINOR COURSES:

Sr No.	Offering Department	Name of Programme /Minor Course	Students from Department who can register
1	CSE	Data Science	CE,ME,EE,ENTC,INST
		Artificial Intelligence	CE,ME,EE,ENTC,INSTR
2	IT	Machine Learning	CE,ME,EE,ENTC,INST
		Software Engineering	CE,ME,EE,ENTC,INST
3	ENTC	IOT	CE,ME,EE,CSE,IT,INST
		Electronics and Telecommunication Engg.	CE,ME,EE,CSE,IT,INST
4	ME	Mechanical Engineering	CE,EE,ENTC,CSE,IT,INS
		Automation & Robotics	CE,EE,ENTC,CSE,IT,INS
		Industrial Management	ME,CE,ENTC,CSE,IT,EE,INST
5	CE	Building Construction and Management	ME,EE,ENTC,CSE,IT,INST
		Business Economics	ME,EE,ENTC,CSE,IT,INST,CE
6	EE	Energy Engineering	ME,CE,ENTC,CSE,IT,INST
		Electrical Motors & Drives	ME,CE,ENTC,CSE,IT,INST
7	INST	Instrumentation and Control	ME,CE,ENTC,CSE,IT,EE
		Banking and Finance	ME,CE,ENTC,CSE,IT,EE,INST

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Name of Programme /Minor Course	Course Code	Civil Engineering		Mechanical Engineering			Electrical Engineering	
		Building Technology (TRACK-I)	**Business Economics (TRACK-II)**	**Mechanical Engineering (TRACK-I)**	**Automation & Robotics (TRACK-II)**	**Industrial Management (TRACK-III)**	**Energy Engineering(TRACK-I)**	**Electrical Motors & Drives (TRACK-II)**
MinorCourse-1	XX1315/16/17	CE1315 Basics of Civil Engineering	CE1316 Principles of Macroeconomics	ME1315 Production Technology	ME1316 Hydraulics and Pneumatics	ME1317 Organizational Behaviour	EE1315 Introduction to Renewable Energy	EE 1316 Electrical Motors
MinorCourse-2	XX1415/16/17	CE1415 Building Construction	CE1416 Principles of Microeconomics	ME1415 New and Renewable Energy Sources	ME1416 Automation in Manufacturing	ME1417 Human Resource Management	EE1415 Energy Resources, Environment and Economics	EE 1416 Special Electrical Machines
MinorCourse-3	XX1515/16/17	CE1515 Building Planning & Drawing	CE1516 Business Statistics	ME1515 Automobile Engineering	ME1516 Mechatronic Systems	ME1517 Material Management	EE1515 Energy Efficiency in Electrical Utilities	EE 1516 Power Electronics
MinorCourse-4	XX1615/16/17	CE1615 Building Estimates & Tendering	CE1616 Financial Accounting	ME1615 Basic of Product Design	ME1616 Industrial Robotics	ME1617 Marketing Management	EE1615 Energy Management	EE 1616 Electrical Drives and Control
MinorCourse-5	XX1715/16/17	CE1715 Construction Management	CE1716 Minor Project	ME1715 Industrial Management and Quality Control	ME1716 Computer Integrated Manufacturing	ME1717 Corporate Financial Reporting and Analysis	EE1715 Project	EE 1716 Project

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Name of Programme /Minor Course	Course Code	Electronics Engineering		Computer Engineering		Information Technology		Instrumentation Engineering	
		Internet of Things (TRACK-I)	Electronics and Telecommunication Engg. (TRACK-II)	Data Science (TRACK-I)	AI (TRACK-II)	Machine Learning (TRACK-I)	Software Engineering (TRACK-II)	Instrumentation and Control (TRACK-I)	Banking and Finance(TRACK-II)
MinorCourse-1	XX1315/16	ET1315 Introduction to internet of things	ET1316 Digital Circuits	CS1315 Fundamentals of data science	CS1316 Introduction to Artificial Intelligence	IT1315 Essential math for machine learning	IT1316 Data Structure & Algorithms	IN1315 Industrial Measurement I	IN1316 Bank operations Management
MinorCourse-2	XX1415/16	ET1415 IoT Architecture & Protocols	ET1416 Communication Engineering	CS1415 Computational Data Analytics	CS1416 Data Mining	IT1415 Artificial Intelligence	IT1416 Software Engineering	IN1415 Industrial Measurement II	IN1416 Strategic management and innovation in banking
MinorCourse-3	XX1515/16	ET1515 Programming with Arduino and Raspberry-Pi	ET1516 Microprocessor &Embedded System	CS1515 Introduction to Database System	CS1516 Machine Learning	IT1515 Machine learning Foundation	IT1516 Object Oriented Design & Programming	IN1515 Control system Engineering	IN1516 Security analysis and portfolio management
MinorCourse-4	XX1615/16	ET1615 Industrial Internet of Things	ET1616 Wireless Communication	CS1615 Machine Learning	CS1616 Deep Learning	IT1615 Fundamentals Deep Learning	IT1616 Software Testing	IN1615 Industrial Automation	IN1616 Spreadsheet based data analysis
MinorCourse-5	XX1715/16/17	ET1715 Project	ET1716 Project	CS1715 Advance Machine Learning and Deep Learning	CS1716 Generative AI with Large Language Model	IT1715 Minor Project	IT1716 Minor Project	IN1715 Programming for PLAC,DCS & SCADA	IN1716 IT operations &Management

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	LIST OF OPEN ELECTIVE COURSES		
	OE-I	**OE-II**	**OE-III**
Course Code	SH1401	SH1501	SH1701
A	**Appreciating Indian Music**	**Environmental law**	**Operational Research**
B	**Introduction to Human Psychology**	**Cyber law**	**Digital Marketing**
C	**Nanotechnology, Science and Application**	**Introduction to Mass Communication**	**Biology for Engineers**
D	**Introduction to Exercise Physiology & Sports Performance**	**Foreign Language Japanese (N5) /German (A1)**	**Foreign Language Japanese(N4) /German(A2)**
	SWAYAM/NPTEL https://onlinecourses.nptel.ac.in/noc22_hs57/preview https://onlinecourses.nptel.ac.in/noc24_hs39/preview https://onlinecourses.nptel.ac.in/noc19_mm21/preview https://onlinecourses.nptel.ac.in/noc24_hs86/preview	**SWAYAM/NPTEL**	**SWAYAM/NPTEL**

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LIST OF PROGRAM ELECTIVES HONOR'S COURSES (Swayam/NPTEL)	
COURSE CODE	**<Computer System >**
CS1521	Parallel Computer Architecture
CS1522	Introduction to Enterprise Resource Planning
CS1621	Fundamentals of Information Retrieval
CS1622	Functional and Logical Programming
CS1721	Distributed System
CS1722	Advanced Computer Architecture

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LIST OF MINOR COURSES FOR DOUBLE MINOR (SPECIALIZATION)							
COURSE CODE	**Civil Engineering**	**Mechanical Engineering**	**Electrical Engineering**	**Electronics Engineering**	**Computer Engineering**	**Information Technology**	**Instrumentation Engineering**
CS1541	CE1541/ABC				Computer Vision		
CS1542					Business Intelligence & Analytics		
CS1641					Natural Language Processing		
CS1642					Affective Computing		
CS1741					Digital Forensics		
CS1742					Automatic Speech Recognition		

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Sample Guidelines for the Honour with Research Project

The purpose of this course is to introduce students to the process of conducting research projects/work. The students will be helped to conceptualise, design and execute a research project by a teacher guide.

Stage-1:

- Student have to complete online course related to topic/perquisite course prescribed by the assigned guide/BOS
  OR
- The focus will be on discussions and analysis of assignments. Learners will be encouraged to read books and research journals related to his/her research topic (literature review, theory and hypotheses etc) and share them in the seminars and evaluated by two member Team of department and same to be enter in ICA format.

Stage-2:

Sample steps:

- Research design/Methodology
- Sampling tool of data collection
- data processing and analysis
- Plan of research report
- Publish review paper in peer view journal/Scopus indexed journal and seminar on it
- The faculty supervisor will assess the method and procedures used by the learner
- At end evaluated by two member Team of department

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Stage-3:

- If applicable initiate Actual implementation
- Data Analysis and Interpretation: The outcome of the research is presented in tabular form with the help of statistical procedures. The data are analysed and interpreted and presented in the form of a research report and presenatation/seminar.
- Report writing
- Publish paper on findings in peer view journal/Scopus indexed journal.
- Two member Team of department will assess the Findings method and procedures
- The faculty supervisor will assess the presentation of major findings depending on the methodology used, presentation of results, interpretation of the results with discussion, summary of the proposed research problem and conclusion.
- Two member Team of department (may evaluated by Guide and external expert) will assess the Findings method and procedures etc

Note : Guide Teaching load : 4 Hrs per student in Research stage -1 /2/3

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SEMESTER – III

Course Code	SH1301A							Course category			BS05
Course Name	LINEAR ALGEBRA AND STATISTICAL METHODS										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives:

1. To introduce the basic concept of statistics for analysing experimental data
2. To familiarize the students with concepts of probability and probability distribution.
3. To study about the mathematical tool like Z-transform, Laplace transform and its properties.
4. To introduce the concept of Vector spaces
5. To learn inner product spaces

Basic Statistics:

Measures of Central Tendency: Moments, Skewness and Kurtosis, Correlation and Regression, Probability distributions: Binomial, Poisson and Normal.

Random Variables and Probability Distributions:

Random variables, Discrete and Continuous random variables, Distribution functions, Probability distribution of continuous random variable. Joint distribution of discrete and continuous random variables, Conditional distribution, Mathematical expectation, Mean, moments and variance. Variance for joint distribution and Covariance.

Z-transform:

Definition, Properties of Z-transform, Inverse Z-transform by using properties, Partial fraction method, Residue method, Convolution theorem and power series method

Vector Spaces I:

Vector spaces and Subspaces, Linear dependence and Independence of vectors, Bases and dimensions, Coordinate vectors, Linear transformation, Algebra of linear transformation,

Vector Spaces II:

Representation of linear transformation of matrices relative to basis, Inner product, Inner Product Spaces, Norm and Orthogonality, Orthogonal and orthonormal basis, Gram-Schmidt orthogonalisation process

Text Books:

1. A text book of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2010.

2. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 44th edition, 2020.

3. Higher Engineering Mathematics, H.K.Das, S.Chand & Company Pvt.Ltd, 2014

Reference Books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Introduction to Probability Theory, P. G. Hoel, S. C. Port and C. J. Stone, Universal Book Stall, 2003 (Reprint).
3. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India, 2002.
4. An Introduction to Probability Theory and its Applications, W. Feller, Vol. 1, 3rd Ed., Wiley, 1968.
5. Advanced Engineering mathematics, Reena Garg, Khanna book publishing company, 2021
6. Engineering Mathematics (for semester III), Veerarajan T., Tata McGraw-Hill, New Delhi, 2010

Course Outcomes:

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

SH1301(A).1. Apply the basic concept of statistics for analysing experimental data.

SH1301(A).2. Familiarize the students with concepts of probability and probability distributions.

SH1301(A).3. Study about the mathematical tool like Z-transform, Laplace transform and its properties.

SH1301(A).4. Apply the knowledge of Vector spaces for solving engineering problems

SH1301(A).5. Use inner product spaces concept to deal problems

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
SH1301(A).1	3	3	3	3	3	-	-	-	-	-	-	-	2	-	-
SH1301(A).2	3	3	3	3	3	-	-	-	-	-	-	-	2	-	-
SH1301(A).3	3	3	3	3	3	-	-	-	-	-	-	-	2	-	-
SH1301(A).4	3	3	3	3	3	-		-	-	-	-	-	2	-	-
SH1301(A).5	3	3	3	3	3	-	-	-	-	-	-	-	2	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**CS1301**	**Course category**	PC3
Course Name	**FUNDAMENTLAS OF DATA STRUCTURE**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	01	00	03	15	15	10	60	**2**hr 30 min	00	00	100	04

Course Objective:

1. To impart the knowledge of data structures and algorithms.
2. To analyse the algorithm with respect to time and space which will prove the efficiency of algorithm.
3. To assess how the choice of data structures and algorithm design methods impacts the performance of programs
4. To convert algorithms into efficient programs

Basic of Data Structure and Algorithm: Understanding the concept of Problem Solving, Design of Algorithms and Data Structures. Basic Terminologies: Elementary Data Organizations, Data Structures Operations and Types, Abstract Data Type (ADT),Writing Algorithms, Mathematical Notations and Functions, Algorithmic Notation, Introduction to Searching Algorithms: Linear and Binary Search, Analysis of an Algorithm: Complexity and Rate of Growth, Asymptotic Notations, Time-Space Trade-Off, Dictionaries, Introduction to Sorting Algorithms: Bubble, Selection, Insertion, Quick, Merge, Radix
Note: In this unit all the algorithms are implemented through a basic data structure called Array

Linked List: Introduction to Linked List, Types of Linked List, Representation of Linked List in Memory**,** Algorithms of several operation on Linked List and there analysis**,** String Processing: Storing Strings, String Operations, Word/Text Processing, String Pattern Matching Algorithms.

Stack and Queue: Introduction to Stack, Representation of Stack in Memory using Array and Linked List, Arithmetic Expression, Polish Notation, Application of Stack, Tower of Hanoi Problem, Recursion, Introduction to Queue, Representation of Queue in Memory using Array and Linked List, Types of Queues, Application of Queues.

Tree: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree, Red Black Tree**,** Tree operations on each of the trees and their algorithms with complexity analysis**,** Applications of Binary Trees**,** Introduction to B Tree (Disk Based Data Structure)**,** Heap Sort.

Graph: Graph: Basic Terminologies and Representations**,** Graph search and traversal algorithms and complexity analysis, Minimum Spanning Tree Algorithms (Kruskal and Prim), Single Source Shortest Path (Dijkstra's) and Shortest Path Algorithms (Warshalls)**,** Hashing in Data Structures.

Text Book

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al. 2nd edition Computer Science Press

Course Outcomes

CS1301.1 Understand basic terminology of data organization with the available data structures and their behaviour.
CS1301.2 Analysing and understanding, the implementation of data structures on computer memory so that, one must able to choose appropriate data structure for a given specific problem.
CS1301.3 After implementation a student must be capable of doing quantitative analysis of algorithm.
CS1301.4 Demonstrate ability to devise an efficient algorithm and transform into efficient code.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1301.1	0	3	3	2	2	2	0	2	3	3	3	1	1	2	3
CS1301.2	1	2	2	1	3	1	2	1	0	1	2	2	1	1	3
CS1301.3	2	1	3	1	0	2	2		2	1	0	2	2	0	0
CS1301.4	3	2	3	1	2	0	1	2	1	3	1	2	0	3	2

0-Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlate

Course Code	**CS1302**	**Course category**	PC4
Course Name	**OBJECT ORIENTED METHODOLOGY**		

Teaching Scheme				Examination Scheme								
Th	Tu	Pr	Total	Theory					Practical		Total	Credits
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	01	00	04	15	15	10	60	2hr 30 min	00	00	100	04

Course Objective:

1. Learn basic terminology, formal logic, proofs, sets, relations, functions, recursion
2. Use formal logic proof and logical reasoning to solve problems
3. Relate the ideas of mathematical induction to recursion and recursively defined structures
4. Learning graphs, trees and related algorithms ,Relate, interpret and apply these concepts to various areas of computer science

Course Content

Principles of Objective Oriented Programming
Object Oriented Programming Paradigm, Basic Concepts of Object Oriented Programming, Benefits of Object Oriented Programming, Object Oriented Languages, Applications of Object Oriented Programming.

Token Expressions & Control Structures
Tokens, Keywords, Identifiers and Constants, Data Types, Type Compatibility, Variables, Operators, Implicit Conversions, Operator Overloading, Operator Precedence, Control Structures.

Functions, Classes & Objects.
The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Function Overloading, Friend and Virtual Functions. Specifying a class, Member Functions, Arrays within a class, Static Member Functions, Arrays of Objects, and Friendly Functions.

Constructors & Destructors, Operator Overloading, Inheritance
Constructors, Parameterized Constructors, Copy Constructors, Dynamic Constructors, Destructors, Defining Operator Overloading, Overloading Operators, Rules for Overloading Operators, Type Conversions

Pointers, Virtual Functions & Polymorphism, Working with Files, Exception handling Pointers, Pointers to Objects, this pointer, Pointer to Derived Classes, Virtual

Functions, Classes for File Stream Operations, Opening and Closing a File, File Modes, File Pointers, Input Output Operations, Updating a File.
An Object Oriented Approach in Real Life Problems Object Orientation O Development O Themes, Modelling, Abstraction Models.

Text Books:

1. Object Oriented Design by Rumbaugh (Pearson publication)

2. Object-oriented programming in Turbo C++ By Robert Lafore,Galgotia Publication.

3. Object-oriented programming with C++ by E.Balagurusamy, 2nd Edition, TMH.

Course Outcomes:

On successful completion of the course, the student will:

CS1302.1 Master the fundamental principles of OO programming
CS1302.2 Master key principles in OO analysis, design and development.
CS1302.3 Master common patterns in OO design and implement them,
CS1302.4 Be familiar with alternative development processes,
CS1302.5 Be familiar with group/team projects and presentations.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1302.1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CS1302.2	2	3	1	2	--	-	-	-	-	-	-	-	3	-	-
CS1302.3	3	2	1	2	--	-	-	-	-	-	-	-	2	-	-
CS1302.4	3	2	1	-	-	-	1	-	-	-	-	-	3	-	-
CS1302.5	3	2	1	-	-	-	1	-	-	-	-	-	3	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	**CS1303**	**Course category**	PC5
Course Name	**DISCRETE MATHEMATICS**		

Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr 30 min	00	00	100	03

Course Objective:

1. Learn basic terminology, formal logic, proofs, sets, relations,
2. Use formal logic proof and logical reasoning to solve problems
3. Relate the mathematical induction to functions with recursively defined structures and analyse various counting techniques
4. Evaluate Boolean functions to simplify expression and study the algebraic structures
5. Interpret graphs, trees and related algorithms inorder to apply these concepts in various areas of computer science

Set Theory: Set, types of set, operations on set, properties, cardinality, cartesian product, venn diagrams; **Relation:** reflexivity, symmetry, antisymmetry, transitivity, equivalence relations, partial orders, equivalence of relation, binary relation, partial ordering relation.

Propositional Logic: syntax, semantics, validity and satisfiability, basic connectives and truth tables, logical equivalence, logical Implication, rules of inference, Quantifiers; **Proof Techniques**: Terminology, mathematical proofs of implication, double implication, equivalence, converse, inverse, contrapositive, negation, and contradiction.

Functions: Domain, target, range, surjections, injections, bijections, inverses, composition, sum and product of functions, recursion, division algorithm: prime numbers, Greatest common divisor: Euclidean algorithm; **Basic counting techniques:** inclusion and exclusion, pigeonhole principle, permutation and combination, modular arithmetic.

Boolean algebra: ldentities, posets, lattices, hasse diagrams, duality, representation and minimization of boolean function, conjunctive and disjunctive normal form; **Algebraic structures:** Groups, semigroups, monoids, rings and fields.

Graphs: Degree, connectivity, path, cycle, sub graph, properties, types, bipartite, isomorphism, Eulerian and hamiltonian walk, graph coloring, planar graphs, perfect graph; **Trees**: Properties, Traversal strategies, Spanning trees, Shortest distances, Bi-connected component and Articulation Points.

Text Books:

l. Kenneth H. Rosen. Discrete Mathematics and its Applications, Tata McGraw Hill
2. Susanna S. Epp, Discrete Mathematics with Applications,4th edition, Wadsworth Publishing Co. Inc.
3. C t. Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach. 3rd Edition by. Tata McGraw - Hill.

Reference Books:

1. J.P. Trernblay and R. Manohar, Discrete Mathematical Structure and It's Application to
2. Conrputer Science". TMG Edition, TataMcgraw-Hill
3. Nonnan L. Biggs. Discrete Mathematics,2nd Edition, oxfbrd universitl, press. Schaum's
4. Outlines Series. Seymour Lipschutz, Marc Lipson,
5. Discrete Mathematics. Tata Mccraw – Hill

Course Outcomes:

After completing the course, the students will be able to:

CS1303.1	Analyse sets with operations to identify their structure and show reasoning about the relations based on their observations
CS1303.2	Use logical notation to define and reason mathematically about the fundamentals of logics and proof techniques.
CS1303.3	Identify and Apply the definitions and conclusions of functions with recursive structures and identify reasoning of various counting techniques
CS1303.4	Comprehend and Evaluate the Boolean algebra with minimization of expression and know the structures of algebraic nature.
CS1303.5	Gain the knowledge of graphs and trees in order to identify model and solve real world problems related to them.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1303.1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CS1303.2	2	3	1	2	--	-	-	-	-	-	-	-	3	-	-
CS1303.3	3	2	1	2	--	-	-	-	-	-	-	-	2	-	-
CS1303.4	3	2	1	-	-	-	1	-	-	-	-	-	3	-	-
CS1303.5	3	2	1	-	-	-	1	-	-	-	-	-	3	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	**CS1304**	**Course category**	VSE1
Course Name	DATA STRUCTURE LABORATORY		

Teaching Scheme				Examination Scheme								
Th	Tu	Pr	Total	Theory					Practical		Total	Credits
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	02	02	00	00	00	00	---	25	25	50	01

Course Objective:

1. To impart the knowledge of data structures and algorithms.
2. To analyse the algorithm with respect to time and space which will prove the efficiency of algorithm.
3. To assess how the choice of data structures and algorithm design methods impacts the performance of programs
4. To convert algorithms into efficient programs

Sample List of Practical

Project 1 will be comprised of static sized array data structure involving sorting, searching, ADT such as dictionaries.

Project 2 will be comprised of linked list different types and string pattern matching algorithms

Project 3 will comprise of applications of stack and queue

Project 4 will comprise of Graph algorithm and its applications

Project 5 will comprise of Tree algorithms and its application

Project 6 will be a major application comprises most of the required contents of syllabus.

Note: Project 1 to 5 can be completed individually or group of two students and Project 6 containing at least 4 different modules which can be completed in the group of 3 to 4 students

Course Outcomes

CS1304.1 Understand basic terminology of data organization with the available data structures and their behaviour

CS1304.2 Analysing and understanding, the implementation of data structures on computer memory so that, one must able to choose appropriate data structure for a given specific problem.

CS1304.3 After implementation a student must be capable of doing quantitative analysis of algorithm.

CS1304.4 Demonstrate ability to devise an efficient algorithm and transform into efficient code.

CS1304.5 Implement the algorithms to solve real time problems.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1304.1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CS1304.2	2	3	1	2	--	-	-	-	-	-	-	-	3	-	-
CS1304.3	3	2	1	2	--	-	-	-	-	-	-	-	2	-	-
CS1304.4	3	2	1	-	-	-	1	-	-	-	-	-	3	-	-
CS1304.5	3	2	1	-	-	-	1	-	-	-	-	-	3	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

ICA – Internal Continuous Assessment shall be based on the practical record and knowledge/ skills acquired. The performance shall be assessed experiment wise using continuous assessment formats, A and B.

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Course Code	**CS1305**							**Course category**			VSE2
Course Name	OBJECT ORIENTED METHODOLGY LABORATORY										
Teaching Scheme				Examination Scheme							Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	02	02	00	00	00	00	---	50	00	50	01

Course Objectives:

To make the students aware and understand:

1. Allow programmers to think in terms of the structure of the problem rather than in terms of the structure of the computer.
2. Decompose the problem into a set of objects
3. Objects interact with each other to solve the problem
4. Create new type of objects to model elements from the problem space

Course Contents:

Minimum eight to ten experiments related to the course contents of Course (**OBJECT ORIENTED METHODOLOGY)** are to be performed.

List of experiments:

1. Understanding Data Types, Identifiers, and Constants in Object-Oriented Programming
2. WAP to change a variable's data type from one to another by using type casting.
3. Write a program to understand different operators in OOP.
4. Write a Program to Demonstrate the i) Operator Overloading. ii) Function Overloading.
5. Write a program to understand different control statements used in OOP
6. a) Write a Program Containing a Possible Exception. Use a Try Block to Throw it and a Catch Block to Handle it Properly. b) Write a Program to Demonstrate the Catching of All Exceptions.
7. WAP to swap two numbers by using call by reference & call by value functions.
8. Write a program that illustrates the order of execution of constructors and destructors when new class is derived from more than one base class.

9. Write programs that illustrate how the following forms of inheritance are supported: a)Single inheritance b)Multiple inheritance c)Multi level inheritance d)Hierarchical inheritance
10. Program to open a file whose name is passed as command line argument and display its contents on output device and find the size of file in bytes

On successful completion of the course, the student will:

CS1305.1	Master the fundamental principles of OO programming
CS1305.2	Master key principles in OO analysis, design and development.
CS1305.3	Master common patterns in OO design and implement them,

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1305.1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CS1305.2	2	3	1	2	--	-	-	-	-	-	-	-	3	-	-
CS1305.3	3	2	1	2	--	-	-	-	-	-	-	-	2	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

ICA – Internal Continuous Assessment shall be based on the practical record and knowledge/ skills acquired. The performance shall be assessed experiment wise using continuous assessment formats, A and B.

Course Code	CS1310						Course category		EM1
Course Name	IDEA LABORATORY								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
-	-	02	02	-	-	-	-	-	50	-	50	01

Course Objectives:

1. Understand design thinking and innovation concepts and approaches.
2. Understand the problems faced by society.
3. Identify new and unaddressed social needs.
4. Design and development of Small project based on Laboratory equipment like Machine hardware, Electronic hardware and software etc.

Students are expected to complete work in group of max.three students in pertaining to following aspects under the supervision of course coordinator/teacher.

1. Demonstration of modern manufacturing facilities available at the institute
2. Demonstration of automation and programming tools.
3. Active Sessions on brainstorming, creativity, idea generation, problem-solving techniques and new product development.
4. Visit social sites for the identification of social needs and community problems. The report on this visit is to be submitted.
5. Identification of product problems through customer surveys.
6. The minor project based on hardware (along with software if desire).
7. Building prototype and identifying modifications.
8. Write a project report.
9. The Course Coordinator/Teacher may arrange demonstration with poster presentation of all minor projects developed by the students at the end of semester.

Course Outcomes:

CS1310.1 Gain knowledge of design thinking and innovation with the modern machines and devices available in the idea lab.
CS1310.2 Generate different ideas for innovative products through ideation and brainstorming.
CS1310.3 Identify, discuss and justify the technical aspects of the chosen idea with a comprehensive and systematic approach.
CS1310.4 Design and develop innovative products for specific problems considering user- centric perspective and market.
CS1310.5 Communicate and report effectively project related activities.

References Books:

1. Ulrich, Karl T., Steven D. Eppinger, and Maria C. Yang. Product design and development Vol. 4. Boston: McGraw-Hill higher education, 2008.
2. Mueller-Roterberg, Christian. "Handbook of design thinking." Independently publish 2018 (2018).
3. Koh, Joyce Hwee Ling, et al. Design thinking and education. Springer Singapore, 2015.
4. Uebernickel, Falk, et al. Design thinking: The handbook. World Scientific, 2020.
5. Woolery, Eli. Design thinking handbook. In Vision, 2019.

Web Resource:

1. https://www.coursera.org/learn/uva-darden-design-thinking-innovation?action=enroll
2. https://www.mygreatlearning.com/academy/learn-for-free/courses/design-thinking

Note:-

ICA – The Internal Continues Assessment shall be based on project development and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1310.1															
CS1310.2															
CS1310.3															
CS1310.4															
CS1310.5															

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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SEMESTER IV

Course Code	**CS1401**	**Course category**	PC
Course Name	**DESIGN AND ANALYSIS OF ALGORITHM**		

Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	01	00	04	15	15	10	60	2hr 30 min	00	00	100	04

Course Objectives

1. To write rigorous correctness proofs for algorithms designed using different algorithm.
2. Synthesize efficient algorithms in common engineering design situations.
3. To emphasize the relationship between algorithms and programming
4. To demonstrate familiarity with NP-Complete problems.
5. To design techniques and understand there efficiency using different analysis methods.

Algorithms: Algorithms as Technology, Algorithm Design Techniques, Asymptotic notations of analysis of algorithms, analysing control structures, complexity, worst case and average case analysis. **Mathematical foundations**: summation of arithmetic and geometric series, bounding summations using integration, recurrence relations.

Sorting Algorithms: Sorting Algorithms and there analysis using incremental approach such as insertion sort, bubble sort, selection sort, sorting in linear time.

Greedy method: basic strategy, application to job sequencing with deadlines problem, Elements of Greedy Methods.

Divide and conquer: Divide and conquer basic strategy, Recurrences, binary search, quick sort, merge sort. Maximum sub array and matrix multiplication problem.

Dynamic programming: basic strategy, Rod Cutting Problem, Elements of Dynamic Programming.

Graph and Tree Algorithms: Elementary Graph Algorithms, DFS, BFS, minimum cost spanning trees, single source shortest path, Network Flow, Topological Sorting

Backtracking basic strategy, 8- Queen's problem, graph colouring, Hamiltonian cycles etc.

Advance Topics: Basic Concepts of NP-hard and NP-complete problems, non-deterministic algorithms, Randomization Algorithms and Approximation Algorithms, RSA Cryptography Algorithm, Compression.

Text Books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.

2. Fundamentals of Algorithms – E. Horowitz et al. Computer Science Press

Reference Books

1. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.

2. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.

3. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

Course Outcomes

CS1401.1 Students will be analyse the asymptotic performance of algorithms.
CS1401.2 Students will be understood the rigorous correctness proofs for algorithms.
CS1401.3 Students will be Demonstrate a familiarity with major algorithms and data structures.
CS1401.4 Students will be Apply important algorithmic design paradigms and methods of analysis.
CS1401.5 Students will be able to write the proof for correctness of algorithm.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1401.1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CS1401.2	2	3	1	2	--	-	-	-	-	-	-	-	3	-	-
CS1401.3	3	2	1	2	--	-	-	-	-	-	-	-	2	-	-
CS1401.4	3	2	1	-	-	-	1	-	-	-	-	-	3	-	-
CS1401.5	3	2	1	-	-	-	1	-	-	-	-	-	3	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	**CS1402**	**Course category**	PC
Course Name	DATABASE MANAGEMNT SYSTEM		

Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr 30 min	00	00	100	03

Course Objectives:

1. To Understand the basic concepts of DBMS
2. To learn data models, conceptualize and depict a database system using ER diagram.
3. To understand the internal storage structures in a physical DB design.
4. To know the fundamental concepts of transaction processing techniques.

Introduction: Database System Applications, Purpose of Database System, Views of data, data models, Database Languages, database architecture and components of DBMS, Database System Applications, Database Users and Administrators, Database System Structure, History of Database Systems. Entity-Relationship Model, Basic Concepts, Design Issues, Entity-Relationship Diagram, ER Model, notations, examples.

Relational Model: Relational Data Model, Concept of relations, schema-instance distinction, referential integrity constraints, keys, referential integrity and foreign keys, relational algebra operators, Extended Relational-Algebra Operations SQL: Introduction, data definition in SQL, table, key and foreign key definitions, update behaviours. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses, embedded SQL. Domain Constraints, Referential Integrity, Assertions, Triggers, Security and Authorization, Authorization in SQL, Encryption and Authentication.

Relational Database Design: Dependencies and Normal forms, dependency theory, functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF.

Query processing and optimization Evaluation of relational algebra expressions, query equivalence, join strategies, query optimization algorithms. **Storage strategies** Indices, B-trees, hashing.

Transactions: Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods.

Advanced topics Object-oriented and object relational databases, logical databases, web databases, distributed databases, data warehousing and data mining.

Text Books:

1. Silberschatz Abraham, Korth Henry F., and Sudharshan S., "Database System Concepts", 6th edition Tata McGraw Hill, Sixth Edition, 2017.
2. Elmasri Ramez and Navathe Shamkant B., "Fundamentals of Database Systems", Pearson Education, Seventh Edition, 2017.

Reference Books:

1. Date C. J., Kannan A. and Swamynathan S., "An Introduction to Database Systems", Pearson Education, Eighth Edition, 2006

2. Chodorow Kristina, "MongoDB: The Definitive Guide", 2 nd edition, O'Reilly, 2013

Course Outcomes:

CS1402.1 Ability to install, configure and interact with a relational database management system.
CS1402.2 Ability to master the basics of SQL and construct queries using SQL.
CS1402.3 Ability to obtain sound knowledge in the theory, principles and applications of database management system.
CS1402.4 Ability to identify issues in data storage, transaction, and concurrency control of DBMS.

CO/PO Mappings:

CO	PO / PSO														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CS1402.1	3	1	0	0	0	0	0	2	0	0	0	0	0	0	0
CS1402.2	3	1	2	0	3	0	0	2	0	0	0	2	3	0	0
CS1402.3	2	3	3	2	3	2	2	0	0	2	2	2	3	2	3
CS1402.4	3	3	0	0	2	0	2	0	2	3	2	2	2	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Course Code	**CS1403**							**Course category**			PC
Course Name	COMPTER ORGANIZATION AND ARCHITECTURE										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr 30 min	00	00	100	03

Course Objective

1. To understand the basic of computer peripherals which computers work
2. To impart the knowledge on micro programming.
3. To analyse how I/O devices are accessed and its principles.
4. To understand the concept of pipelining techniques.

Introduction: Computer components and its functions, Processing unit, bus architecture, execution of a complete instruction, sequencing of control signals, Computer peripherals, I/O devices such as video terminals, video displays, graphic input devices, printers, magnetic disk, magnetic tape, CDROM systems, Threading and Multithreading .

Addressing modes, their application in implementation of HLL constructs and data structures, instruction formats, expanding op-code method, Micro programmed control, microinstruction format, microinstruction sequencing, bit slice concept.

Arithmetic, number representations and their operations, design of fast address, signed multiplication, Booth's Algorithm, bit-pair recording, division , floating point numbers and operations, guard bits and rounding.

Main memory organization, various technologies used in memory design, higher order memory design, multi module memories and interleaving, cache memory, concept of cache memory, mapping functions, replacement algorithms.

External devices: I/O modules, Programmed I/O, Interrupt I/O, I/O channels

Input-output organization, I/O mapped I/O and memory mapped I/O, Direct Memory Access (DMA), interrupts and interrupt handling mechanisms, device identification, vectored interrupts, interrupt nesting, I/O interfaces, synchronous vs. asynchronous data transfer, I/O channels.

RISC philosophy, pipelining, basic concepts in pipelining, delayed branch, branch prediction, data dependency, influence of pipelining on instruction set design, multiple execution units, performance considerations, basic concepts in parallel processing & classification of parallel architectures. Introduction of Superscalar and vector superscalar.

TextBooks:

1. Computer Organization & Architecture By Stalling W, 6th Edition , Pearson Education 2003
2. Computer Organization , Hamacher, Carl V. et al, McGraw Hill

References:

1. Computer Organization & Design, the Hardware/ Software Interface, Patterson D. A, Hennessy J. L.
2. Structured Computer Organization , Tanenbaum A.S, Prentice Hall of India Ltd

Course Outcomes:

CS1403.1 Students will learn the fundamentals of computer organization and its relevance to classical and modern problems of computer design.

CS1403.2 Students will be able to identify where, when and how enhancements of computer performance can be accomplished.

CS1403.3 Students will learn the sufficient background necessary to read more advance texts as well as journal articles on the field.

CS1403.4 Student will see how to use concepts of computer organization in real-life settings using various PC performance improvements.

CO/PO Mappings:

CO	PO / PSO														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CS1403.1	3	1	0	0	0	0	0	2	0	0	0	0	0	0	0
CS1403.2	3	1	2	0	3	0	0	2	0	0	0	2	3	0	0
CS1403.3	2	3	3	2	3	2	2	0	0	2	2	2	3	2	3
CS1403.4	3	3	0	0	2	0	2	0	2	3	2	2	2	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Course Code	**CS1404**	**Course category**	PC
Course Name	DESIGN AND ANALYSIS OF ALGORITHM LABORATORY		

Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	02	02	00	00	00	00	---	50	00	50	01

Course Objectives

1. To write rigorous correctness proofs for algorithms designed using different algorithm design techniques and understand there efficiency using different analysis methods.
2. Synthesize efficient algorithms in common engineering design situations.
3. To emphasize the relationship between algorithms and programming

Sample list of experiments-

- Write a program to implement searching algorithm with time complexity.
- Write a program to implement sorting algorithm.
- Implement 0/1 Knapsack problem using Dynamic Programming.
- From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
- Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.
- Print all the nodes reachable from a given starting node in a digraph using BFS method.
- Check whether a given graph is connected or not using DFS method.
- Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.
- Implement N Queen's problem using Back Tracking.
- Case study on real world application.

Course Outcomes

CS1404.1 Students will analyse the asymptotic performance of algorithms.
CS1404.2 Students will understood the rigorous correctness proofs for algorithms.
CS1404.3 Students will demonstrate a familiarity with major algorithms and data structures.

CO-PO-PSO Mappings:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1404.1	3	1	0	0	0	0	0	2	0	0	0	0	0	0	0
CS1404.2	3	2	2	0	3	0	0	2	0	0	0	2	3	0	0
CS1404.3	2	3	2	1	3	2	2	0	0	2	2	2	3	2	3

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Course Code	**CS1405**	**Course category**	PC
Course Name	COMPUTER ORGANIZATION AND ARCHITECTURE LABORATORY		

Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	02	02	00	00	00	00	---	50	00	50	01

Course Objectives

1. To understand the basic of computer peripherals which computers work
2. To impart the knowledge on micro programming.
3. To analyse how I/O devices are accessed and its principles.

Following is the sample list of practical based on syllabus

1. Study of peripherals, components of a Computer System.
2. Study of GNUSim simulator for 8085
3. Design an assembly program for Binary Addition
4. Design an assembly program for Binary Multiplication
5. Study of Logisim Tool.
6. Design of half-adder circuit using basic gates.
7. Design of full-adder circuit using basic gates.
8. Design Ripple Carry adder.

Course Outcomes

CS1405.1 Students will learn the fundamentals of computer organization and its relevance to classical and modern problems of computer design.

CS1405.2 Students will be able to identify where, when and how enhancements of computer performance can be accomplished.

CS1405.3 Students will learn the sufficient background necessary to read more advance texts as well as journal articles on the field.

CO/PO Mappings:

CO	PO / PSO														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CS1405.1	1	2	3	0	2	0	1	1	0	0	0	0	2	0	0
CS1405.2	2	3	3	0	0	0	1	0	0	0	0	0	3	2	0
CS1405.3	3	2	0	0	0	0	0	0	0	0	0	0	3	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1406**	**Course category**	PC
Course Name	DATABASE MANAGEMENT SYSTEM LABORATORY		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
00	00	02	02	00	00	00	00	---	25	25	50	01

Course Objectives:

1. To give a good formal foundation on the relational model of data.
2. To present SQL and procedural interfaces to SQL comprehensively.
3. To design database using normalization

The sample list of programs based on ORACLE or MY SQL is given below. This list can be used as guideline for problem statements but the scope of the laboratory should not be limited to the same. Aim of the list is to achieve the minimum expected outcomes.

List of Experiments:

1. SQL and installation of SQL server/oracle.
2. Data Definition Language (DDL) commands in RDBMS
3. Data Manipulation Language (DML) and Data Control Language (DCL)
4. Data types and create a database and write the program to carry out the following operation.
5. Create tables department and employee with required constraints.
6. Working with null values, matching the pattern from the table.
7. Aggregate functions: grouping the result of a query.
8. Set operators, Nested Queries, Joins and Sequences.
9. Views, indexes, database security and privileges: Grant and Revoke commands, Commit and Rollback commands.
10. PL/SQL Architecture, Assignments and Expressions, Writing PL/SQL Code, Referencing Non-SQL parameters.
11. Triggers and Cursor Management in PL/SQL.
12. Procedures and Functions
13. Automatic Backup of Files and Recovery of Files.
14. As a designer identify the views that may have to be supported and create views.
15. Mini Project Using Oracle 9i or MY SQL

ICA – The Internal Continuous Assessment shall be based on practical record and knowledge or skills acquired. The performance shall be assessed experiment wise by using continuous assessment format, A & B.

ESE – The End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

Lab Outcomes:

CS1406.1 Ability to design and implement a database schema for a given problem-domain.

CS1406.2 Ability to normalize a database.

CS1406.3 Populate and query a database using SQL DML/DDL commands.

CO/PO/ Mappings:

CO	PO / PSO														
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CS1406.1	0	0	3	0	3	0	0	0	0	0	3	2	0	3	0
CS1406.2	0	3	3	0	2	0	0	0	0	0	1	0	2	3	0
CS1406.3	1	1	3	0	3	1	0	0	0	0	0	0	2	1	3

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	SH1401A							Course Category			OE1
Course Name	Appreciating Indian Music										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-1	Ct-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	30	2 hrs 30 min	-	-	100	03

Course Objectives:

1. To familiarize students with the historical and cultural context of Indian Classical Music.
2. To introduce students to the fundamental concepts of raga, tala, and improvisation.
3. To develop students' listening skills through analysis and appreciation of classical music recordings.
4. To provide students with practical training in basic vocal or instrumental techniques.
5. To encourage critical thinking and reflection on the aesthetic and philosophical aspects of Indian Classical Music.

Course Contents:

Introduction to Indian Music:
Historical overview: origins, evolution, and major developments, definitions (sangeet, swar and its types, saptak and its types, aroha, aavaroha, pakad, alankar, wadi swar, sanvadi swar,varjit swar, sthayi and antara) Regional variations and prominent classical music traditions (Hindustani and Carnatic). Influence of spirituality, mythology, and philosophy on Indian Classical Music.

Fundamentals of Raga:
Understanding the concept of raga (melodic framework) and its elements, Notation systems and the role of improvisation within the framework of raga (Paluskar and Bhatkhande lipi), Different THAATs and their brief information, Definition of Raga, Sargam geet, the concept of Khyal , aalap and tana, Raga and Time Association, Basic ragas (Bhupali, Yaman, Bhimpalasi and Kedar) along with Aaroha, avaroha, pakad and sargam geet and khyal.

Introduction to Taala:
Understanding the components of a tala cycle (Defining- Taal, Lay and its types, matras, theaka, sum,tali, kaal, avartan).
Study of common talas (Teental, Rupak, Kehrarva, Dadra and Bhajni Theaka)
Practical exercises in clapping and counting rhythms to internalize talas.

Introduction to Musical Instruments:
Classification of Indian Musical Instruments (String, wind, percussion and Solid Instruments), components parts of Indian classical instruments along with neat sketch
Biography- Ustad Zakir Husen (Tabla), Pandit Appa Jalgaokar (Harmonium)
Pandit Ravi Shankar (Sitar), Pandit Hari Prasad Chaurasiya (Flute), Dr. N Rajam (Violin)

Textbooks:

1. Indian Classical Music By Ravi S. Prasanna
2. Appreciating Indian Music By Emmons E. White
3. Fundamental of Indian Music By. S. Sharma.

References:

4. Indian Music By Dr. Thakur J. Sing
5. Finding the Raga By Amit Choudhari.
6. History of Indian Music By B. A. Pingle
7. Raga Harmony By L. Subramaniam

Course Outcomes:
After successful completion of this course student will be able to

SH1401A.1: Students will demonstrate an understanding of the historical development and cultural significance of various genres and styles of Indian music.
SH1401A.2: Students will understanding classical, folk, and contemporary forms, by discussing key historical milestones and movements.
SH1401A.3: Students will be able to applying knowledge of musical elements such as raga, tala, swara, and laya to identify stylistic features, structural patterns, and aesthetic qualities.
SH1401A.4: Students will develop skills and competencies relevant to careers in music education. SH1401A.5: Students will develop skills and competencies relevant to research, arts administration, cultural advocacy, or related fields, preparing them for further academic pursuits or professional endeavors in the music industry.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
SH1401A.1	1	0	0	0	0	1	2	2	3	0	0	0	1	0	2
SH1401A.2	1	0	0	0	0	1	2	2	3	0	0	0	1	0	2
SH1401A.3	1	0	0	0	0	1	2	2	3	0	0	0	1	0	2
SH1401A.4	1	0	0	0	0	1	2	2	3	0	0	0	1	0	2
SH1401A.5	1	0	0	0	0	1	2	2	3	0	0	0	1	0	2

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

BoS Member Secretary BoS Chairman Dean Academic Principal

Course Code	SH1401B							Course Category			OE1
Course Name	Introduction to Human Psychology										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs 30 min	-	-	100	03

Course Objectives:

To make the students will be able to:

1. Understand the human behaviour.
2. Helps humans in exerting more control over situations
3. Basic cognitive processes that guide human behaviours.
4. Tackling everyday problems and attaining optimal solutions
5. Knowledge about human cognitive systems in designing sophisticated Artificial Intelligence (AI) systems.

Course Contain:

Introduction to Cognitive Psychology:

- History,
- Theory
- Research in Human Cognition

Basic Cognitive Processes:

- Object Perception and Recognition
- Attentional Processes and cognition
- Memory Introduction
- Long Term Memory

Organizational Knowledge:

- Memory of general knowledge.
- Concept Formation
- Visual and Spatial Memory

The Use of Knowledge:

- Human language skills.
- Thought process and Problem Solving
- Reasoning
- Decision Making

Textbooks:

1. Kathleen Galotti, Cognitive Psychology, Cengage Learning.
2. Robert Stenberg, Applied Cognitive Psychology, Cengage Learning.

References:

1. Bridger Riegler, Cognitive Psychology, Pearson Press
2. Stephen Kosslyn, Cognitive Psychology, PHI Press

Course Outcomes:

At the end of this course, students will demonstrate the ability to
SH1401B.1: To learn history of Human Psychology.
SH1401B.2: To understand, theory and research in Human Psychology.
SH1401B.3: To learn the Basic Cognitive Processes.
SH1401B.4: To understand about Organizational Knowledge.
SH1401B. 5: Apply the knowledge of human Psychology to developed process of problem solving, reasoning, decision making.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
SH1401B.1	2	3	0	0	0	0	0	1	2	0	0	0	3	1	2
SH1401B.2	2	0	0	0	0	0	0	1	2	0	0	0	2	1	1
SH1401B.3	2	2	0	0	0	0	0	1	2	0	0	0	2	1	1
SH1401B.4	2	0	0	0	0	0	0	1	2	0	0	0	2	1	1
SH1401B.5	2	2	0	0	0	0	0	1	2	0	0	0	2	1	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

BoS Member Secretary BoS Chairman Dean Academic Principal

Course Code	**SH1401C**	**Course Category**	**OE1**
Course Name	**Nanotechnology, Science and Application**		

Teaching Scheme				**Examination Scheme**								**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-1	Ct-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	20	00

Course Objectives:

Students will be able to:

1. To understand the history, background and nature of Nano science and nanotechnology as well as the quantum and Nano sized scale effect on materials.
2. To acquire theoretical understanding of different types of nanostructure
3. To understand the synthesis technique and its types.
4. To learn the different methods of characterization.
5. Aim to approach towards advance research and application of nanoparticals.

Course Contents:

Basics of Nanoscience:

Introduction, Effect of reduction of dimensions on physical properties, History of Nanotechnology, Quantum size effect,

Different classes of Nanomaterial's:

Classification based on dimensionality-Quantum Dots, Wells and Wires, preparation of quantum nanostructures, conduction electrons and dimensionality, Fermi gas and density of states, potential wells, partial confinement, properties dependent on density of states, exitons, single electron tunnelling.

Material Synthesis Method:

Nanostructures of one dimension: Crystalline growth, Template based synthesis. Nanostructures of two dimensions: Fundamentals of thin film growth, physical vapour deposition, chemical vapour deposition, atomic layer deposition, self-assembly, Sol-Gel films, and electrochemical deposition.

Material Characterization Methods:

UV visible microscopy, Scanning electron microscopy (SEM), Transmission electron microscope (TEM), x-ray diffraction (XRD). Atomic Force Microscope (AFM)

Application of Nanomaterial's:

Agriculture field, Medical field, Space Technology, Food Technology, Water Treatment, Energy Sector, Automobile, Electronics Field, Textile Field, Cosmetic.

Textbooks:

1. Introduction to Nanotechnology by C.P. Poole Jr. and F.J. Oweus, Wiley Interscience
2. Nano-Technology by Gregory Timp (Editior), AIP Press, Springer.
3. Pradeep T., "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd.

Reference Books and website links:

1. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press
2. Graphene: Synthesis and applications, edited by Wonbong Choi and Jo-won Lee.
3. Semiconductor Nanostructures and Nanodevices Vol 1-5-A. A. Balandin, K. L.Wang.
4. Springer Handbook of Nanotechnology: Bharat Bhushan
5. Nanofabrication towards biomedical application: Techniques, tools, Application and impact: Ed. Challa S., S. R. Kumar, J. H. Carola
6. A. S. Edelstein and R. C. Cammarata, "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Pub., 1998.
7. G. Cao, Nanostructures & Nanomaterials: Synthesis, Properties & Applications , Imperial College Press, 2004.
8. G.A. Ozin and A.C. Arsenault, "Nano chemistry : A chemical approach to nanomaterials", Royal Society of Chemistry, 2005.

9. Joel I. Gersten, "The Physics and Chemistry of Materials", Wiley, 2001.
10. K.W. Kolasinski, "Surface Science: Foundations of Catalysis and Nanoscience", Wiley, 2002.
11. Physical Chemistry – Atkins Peter, Paula Julio.
12. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications.

Course Outcomes:

On completion of the course, students will be able to:

SH1401C.1: To learn basic of Nano science with special, emphasize on nanomaterial's.
SH1401C.2: Correlate physical behavior of materials at the Nano scale.
SH1401C.3: Understand the physical, chemical and other important methods for synthesis of nanoparticles.
SH1401C.4: Understand the various characterization techniques of Nano materials.
SH1401C.5 Apply the knowledge gained to suggest different applications of Nano science and technology.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
SH1401C.1	2	0	2	0	0	0	0	0	1	2	2	3	2	2	1
SH1401C.2	3	2	3	0	2	0	2	0	0	3	2	3	2	2	1
SH1401C.3	3	2	3	2	0	0	3	3	1	3	3	3	2	2	1
SH1401C.4	3	2	3	2	2	0	2	0	0	3	3	3	2	2	1
SH1401C.5	3	2	3	2	2	0	3	1	0	3	3	3	2	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**CS1**411							**Course category**			EX1
Course Name	**MOBILE APPLICATION DEVELOPMENT**										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT	TA	ESE	ESE Duration	ICA	ESE		
00	00	00	02	00	00	00	----	50	00	50	04

Course Objective: The students will

1. Understand the basics of android and its tools.
2. Understand the android operating system and development tool kit.
3. Analyse the requirements for developing the android applications.
4. Implement the UI components and layout.
5. Design secure android application.

Course Content:

Android and its tools: Introduction to Android, open handset alliance, Android Ecosystem, need of Android, Features of Android, Tools and software required for developing android application.

Installation and Configuration of Android: introduction of operating system, Android development tool kit, Dalvik Virtual Machine, Difference between JVM and DVM. Steps to install and configure Android Studio and SDK

UI Components and Layout: Control flow, Directory Structure, Components of a screen, fundamentals of UI design, Linear layout, absolute layout, frame layout, table layout, Relative Layout.

Designing User Interface with View: Text view- edit text, button, image, toggle button, radio button and radio group. List view- grid view, image view, scroll view

Security and Application Deployment: Location based services- creating the project, getting the maps API key, displaying the map, navigation, getting location data monitoring location.

Text Book:

1. Android by Dixit, Prasanna Kumar, Vikas Publications, New Delhi 2014, ISBN: 9789325977884

2. Pro Android 5 by Maclean David, Koatineni Satya, Allen Grant, Apress Publication, 2015, ISBN: 978-1-4302-4680-0

Reference Book:

1. Android Programming for Beginners by Hortan John Packet Publication, 2015, ISBN: 978-1-78588-326-2

Course Outcomes:

CS1411.1. Interpret features of Android operating system.
CS1411.2. Configure Android environment and development tools.
CS1411.3. Develop rich Interface by using layout and controls.
CS1411.4. Use User Interface components for android application development.
CS1411.5. Publish android applications.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1411.1	2	0	2	0	0	0	0	0	1	2	2	3	2	2	1
CS1411.2	3	2	3	0	2	0	2	0	0	3	2	3	2	2	1
CS1411.3	3	2	3	2	0	0	3	3	1	3	3	3	2	2	1
CS1411.4	3	2	3	2	2	0	2	0	0	3	3	3	2	2	1
CS1411.5	3	2	3	2	2	0	3	1	0	3	3	3	2	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**CS1**412							**Course category**			EX2
Course Name	**COMPUTER NETWORK AND INTERNET PROTOCOL**										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT	TA	ESE	ESE Duration	ICA	ESE		
00	00	00	02	00	00	00	----	50	00	50	04

Course objective:

1. Describe and analyse the most common application architectures in the Internet
2. Understand the most important application-layer protocols work and the service they provide
3. Analyse and explain important design considerations at the transport layer, including describing how TCP's flow control and congestion control works
4. Motivate and explain how routing and forwarding is implemented on the Internet, including describing how IP addressing and fragmentation works
5. Describe and explain different link-layer technologies and how they work

Course Content:

Introduction to Computer Network: A brief history, data networks from Circuit Switching Network to packet Switching Network, Network Protocol Stack, Services at different layers of the protocol stack.

Application Layer: Domain name system, The Web, Hypertext Transfer Protocol (HTTP), Internet Mail Transfer (IMT), File Transfer Protocol (FTP)

Transport Layer Primitives: Connection Establishment and Closure, Flow Control and Congestion Control at the Transport Layer. Transmission Control Protocol – Basic Features, TCP Congestion Control.

Network Layer Primitives – IP Addressing, IP Routing – Intra Domain Routing Protocols, Inter Domain Routing Protocols (BGP), IP Services – SNMP, ARP

Data Link Layer Service Primitives – Forwarding, Flow Control, Error Control, Media Access Control - Channel Access Protocols, Framing, End to End Principles of Computer Networks.

Text Book:

1. Kurose, J. F. & Ross, K. W. (2017), Computer networking: a top-down approach. Seventh Edition. Pearson.

2. Computer Networks by Bhushan Trivedi, Oxford University Press

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Course Outcome: After completion of course student will be able to

CS1412.1. Explain, describe, and analyse a typical network architecture, including the importance of network layers and encapsulation.

CS1412.2. Explain the different basic types of protocols, communication channels, and network types.

CS1412.3. Analyse network traces containing the most common Internet protocols

CS1412.4. Apply the communication protocol for network.

CS1412.5. Analyse, specify and design the topological and routing strategies for an IP based networking infrastructure

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1412.1	2	0	2	0	0	0	0	0	1	2	2	2	1	2	1
CS1412.2	3	2	3	0	2	0	2	0	0	3	2	1	2	2	1
CS1412.3	3	2	3	2	0	0	3	3	1	3	3	2	3	2	1
CS1412.4	3	2	3	2	2	0	2	0	0	3	3	2	2	2	1
CS1412.5	3	2	3	2	2	0	3	1	0	3	3	3	3	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

BoS Member Secretary BoS Chairman Dean Academic Principal

Course Code	**CS1501**	**Course category**	PC
Course Name	**INTRODUCTION TO MACHINE LEARNING**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Required Knowledge: Calculus & Linear Algebra; Programming language

Course Objectives

Aim of the course is

I. To explore supervised, unsupervised and reinforcement learning paradigms of machine learning.
II. To design and implement machine learning solutions to classification, regression, and clustering problems.
III. To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
IV. To learn to apply machine learning algorithms on real world problems.

Course Content

Introduction to Machine Learning: Introduction to Machine Learning: Definition of Machine Learning, Definition of learning. Classification of Machine Learning: Supervised learning, unsupervised learning, Reinforcement learning, Semi-supervised learning. Categorizing based on required Output: Classification, Regression, and Clustering. Difference in ML and Traditional Programming, Definition of Data, Information and Knowledge. Split data in Machine Learning: Training Data, Validation Data and Testing Data. Machine Learning: Application

Machine Learning - Performance Metrics: Performance Metrics for Classification Problems- Confusion Matrix, Classification Accuracy, Classification Report- Precision, Recall or Sensitivity, Support, F1 Score, AUC (Area Under ROC curve). Performance Metrics for Regression Problems- Mean Absolute Error (MAE), Mean Square Error (MSE), R Squared (R2)

Computational Learning Theory: Probably approximately correct (PAC) learning. Sample complexity. Computational complexity of training.

Supervised Learning: Linear and Logistic Regression, Assessing performance of Regression- Error measures, Over-fitting- Catalysts for Over-fitting, Case study of Polynomial Regression. Gradient Descent, Support Vector Machines, Decision Trees, ML and MAP Estimates, K-Nearest Neighbour, Naive Bayes. Binary Classification- Assessing Classification performance, Multiclass Classification.

Unsupervised learning algorithms: K-Means clustering, Expectation Maximization, Gaussian Mixture Models. PAC Learnability, Learning with Partially Observable Data (EM). Dimensionality Reduction and Principal Component Analysis (PCA). Bias Variance Trade-off. Model Selection and Feature Selection. Regularization. Learning Theory. Introduction to Markov Decision Processes.

Reinforcement Learning: Non-associative learning, Markov decision processes**,** Ensemble learning-Boosting, Bagging, Random forests and some application areas of machine learning e.g. applications on the web mining, Image recognition, text and speech recognition.

Text Book:

1. "Machine Learning", Tom Mitchell, McGraw-Hill, 1997.
2. "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Peter Flach, Cambridge University Press, Edition 2012.
3. "Introduction to Statistical Machine Learning with Applications in R", Hastie, Tibshirani, Friedman, Springer, 2nd Edition-2012.

Reference Books:

1. Ethem Alpaydin : Introduction to Machine Learning, PHI 2nd Edition-2013.
2. Parag Kulkarni: Reinforcement and Systematic Machine Learning for Decision Making, Wiley IEEE Press, Edition July 2012.

Course Outcomes:

After completion of this course student will be able to

CS1501.1 Understand fundamental issues and challenges of machine learning, data model selection and model complexity.
CS1501.2 Analyze the strengths and weaknesses of many popular machine learning approaches.
CS1501.3 Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
CS1501.4 Design and implement various machine learning algorithm in a range of real-world applications.
CS1501.5 Approach an unstructured problem with structural thinking

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1501.1	3	1	1	0	2	0	0	0	0	0	0	1	3	1	1
CS1501.2	3	2	1	1	2	0	0	0	0	0	0	1	3	1	1
CS1501.3	3	2	1	1	2	0	0	0	0	0	0	1	3	1	1
CS1501.4	3	2	1	1	2	0	0	0	0	0	0	1	3	1	1
CS1501.5	3	2	1	1	2	0	0	0	0	0	0	1	3	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1501.1	3	1	1	0	2	0	0	0	0	0	1	3	1	1
CS1501.2	3	2	1	1	2	0	0	0	0	0	1	3	1	1
CS1501.3	3	2	1	1	2	0	0	0	0	0	1	3	1	1
CS1501.4	3	2	1	1	2	0	0	0	0	0	1	3	1	1
CS1501.5	3	2	1	1	2	0	0	0	0	0	1	3	1	1

Course Code	**CS1502**	**Course category**	PC
Course Name	**OPERATING SYSTEM**		

Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Objectives:
Aim of the course is

I. To learn how Operating System is Important for Computer System and To make aware of different types of Operating System and their services
II. To learn the mechanisms involved in Process management and scheduling of process in contemporary OS to achieve better performance of a computer system.
III. To gain knowledge on operating system concepts that includes Mutual exclusion algorithms, deadlock detection and avoidance algorithms.
IV. To know the aspects of memory management and concepts of virtual memory.
V. Study of various mechanisms involved in File management and Securities in Unix OS.

Course Content

Introduction: Concept of Operating Systems, Goals of Operating System, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Overview of Operating system, multiprogramming, time sharing, real time and distributed operating systems, Concept of Virtual Machine.

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching **Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, **Process Scheduling:** Foundation and Scheduling objectives, Types of Schedulers, Scheduling Criteria, Scheduling algorithms.

Inter-process Communication and Process Synchronization: Critical Section, Race Conditions, Mutual Exclusion, Semaphores, Classical IPC Problems, **Deadlocks :** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation, fragmentation and Paging, **Virtual Memory**: Hardware and control structures, Page fault, Page Replacement algorithms.

File Management: Access methods, File operation, Directory structure, File System structure, Allocation methods, File Protection. **Case study of UNIX :** Protection and security: Illustrations of security model of UNIX. Examples of attacks, **Advanced topics**: Introduction to distributed OS, multimedia OS, embedded OS

Text Books:

1. Operating System concepts and principles, A. Silberschatz & P.B. Galvin, 8th Edition Wiley India, 2009.

2. Modern Operating System, Tanenbaum, 3rd Edition, Prentice Hall India, ,2003.

References:

1. Operating Systems: Internals and design Principle, W. Stallings, 6thEdition, Pearson Education(LPE) , 2009.
2. Design of Linux Operating system, M.J. Bach, 3rd Edition, Prentice Hall, 2004.
3. www.nptel.iitm.ac.in
4. www.nptel.iitkgp.ac.in

Course Outcomes:

After completion of this course student will be able to

CS1502.1 Understand, Describe, contrast and compare the different structures for operating systems and basics of operating system
CS1502.2 Analyse the process management policies, scheduling of processes by CPU and Thread
CS1502.3 Evaluate the requirement for Process communication and synchronization and apply deadlock detection and avoidance in real life application.
CS1502.4 Compare and contrast various memory management schemes.
CS1502.5 Illustrate the various concept of file management and security in UNIXs

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1502.1	3	3	3	1	2	2	0	0	0	0	0	2	3	2	1
CS1502.2	3	3	3	1	2	1	0	0	0	0	0	2	3	2	1
CS1502.3	3	3	2	1	2	2	0	0	0	0	0	2	3	2	1
CS1502.4	3	2	2	1	2	2	0	0	0	0	0	2	3	2	1
CS1502.5	3	2	2	1	2	2	0	0	0	0	0	2	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1502.1	3	3	3	1	2	2	0	0	0	0	2	3	2	1
CS1502.2	3	3	3	1	2	1	0	0	0	0	2	3	2	1
CS1502.3	3	3	2	1	2	2	0	0	0	0	2	3	2	1
CS1502.4	3	2	2	1	2	2	0	0	0	0	2	3	2	1
CS1502.5	3	2	2	1	2	2	0	0	0	0	2	3	2	1

1- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1503**	**Course category**	PC
Course Name	**THEORY OF COMPUTATION**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Course Objectives:

Aim of the course is

I. To develop a formal notation for strings, languages and machines.
II. To design finite automata to accept a set of strings of a language
III. To prove that a given language is regular and apply the closure properties of languages.
IV. To design context free grammars to generate strings from a context free language and convert them into normal forms.
V. To prove equivalence of languages accepted by Push Down Automata and languages generated by context free grammars

Course Content

Introduction to the Theory of Computation: Mathematical Preliminaries and Notation, Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.

Regular languages and finite automata*:* Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata.

Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context free languages, deterministic pushdown automata, closure properties of CFLs. Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.

Turing machines: The basic model for Turing machines (TM), Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages.

Text Books:

1. "Introduction to Automata Theory, Languages, and Computation", John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Pearson Education Asia.
2. "An Introduction to Formal Languages and Automata", by Peter Linz, 5th edition, Jones & Bartlett Learning

Reference Books:

1. "Elements of the Theory of Computation", Harry R. Lewis and Christos H. Papadimitriou, Pearson Education Asia.
2. "Automata and Computability, Undergraduate Texts in Computer Science", Dexter C. Kozen, Springer.
3. "Introduction to the Theory of Computation", Michael Sipser, PWS Publishing.
4. "Introduction to Languages and The Theory of Computation", John Martin, Tata McGraw Hill

Course Outcomes:

After completion of this course student will be able to

CS1503.1 Write a formal notation for strings, languages and machines.
CS1503.2 Design finite automata to accept a set of strings of a language.
CS1503.3 Determine whether the given language is regular or not.
CS1503.4 Design context free grammars to generate strings of context free language.
CS1503.5 Identify the associations between language classes and machine models.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1503.1	3	1	2	0	2	0	0	0	0	0	0	1	3	1	1
CS1503.2	3	2	2	1	2	0	0	0	0	0	0	1	3	1	1
CS1503.3	3	2	2	1	2	0	0	0	0	0	0	1	3	1	1
CS1503.4	3	2	2	1	2	0	0	0	0	0	0	1	3	1	1
CS1503.5	3	2	2	1	2	0	0	0	0	0	0	1	3	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1503.1	3	1	2	0	2	0	0	0	0	0	1	3	1	1
CS1503.2	3	2	2	1	2	0	0	0	0	0	1	3	1	1
CS1503.3	3	2	2	1	2	0	0	0	0	0	1	3	1	1
CS1503.4	3	2	2	1	2	0	0	0	0	0	1	3	1	1
CS1503.5	3	2	2	1	2	0	0	0	0	0	1	3	1	1

Course Code	**CS1504(A)**	**Course category**	PE
Course Name	**ARTIFICIAL INTELLIGENCE**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Objectives:

Aim of the course is

I. To gain a historical perspective of AI and its foundations.
II. To become familiar with basic principles of AI toward problem solving, perception, knowledge representation, and learning.
III. To investigate applications of AI techniques in intelligent agents, artificial neural networks and other models.
IV. To explore the current scope, potential, limitations, and implications of intelligent systems.

Course Content

Introduction: – Agents and Objects – Evaluation of Agents – Agent Design Philosophies - Multiagent System – Mobile Agents – Agent Communication – Knowledge query and Manipulation Language – Case Study. What is AI? , The Foundations of Artificial Intelligence; - INTELLIGENT AGENTS – Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents;

Search Techniques: Problem-Solving Agents, formulating problems, Searching for Solutions, Uninformed Search Strategies, Breadth-first search, Depth-first search, Searching with Partial Information, Informed (Heuristic) Search Strategies, Greedy best-first search, A* Search: Minimizing the total estimated solution cost, Heuristic Functions, Local Search Algorithms and Optimization Problems, Online Search Agents and Unknown Environments;

Adversarial SEARCH : Games, the minimax algorithm, Optimal decisions in multiplayer games, Alpha-Beta Pruning, Evaluation functions, cutting off search, Games that Include an Element of Chance; - LOGICAL AGENTS – Knowledge-Based agents, The Wumpus World

Propositional Logic: A Very Simple Logic, Reasoning Patterns in Propositional Logic, Resolution, Forward and Backward chaining; - FIRST ORDER LOGIC – Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic; - INFERENCE IN FIRST ORDER LOGIC – Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution;

Learning: Overview of different forms of learning, Learnability theory, Representing Knowledge in an Uncertain Domain, Learning Decision Trees, Neural Networks, Biological Analogy, Historical development; ANN terminology; network structure; basis functions; activation functions; advantages of ANN; application areas of ANN. rule based.

Text Books:

1. "Artificial Intelligence: A Modern Approach", Stuart Russell and Peter Norvig, PrenticeHall.
2. "Artificial Intelligence: A New Sythesis", Nils J. Nilsson, Morgan-Kaufmann.
3. "AI: Strcutures and Strategies for Complex problem solving", George F.Luger and William A. Stubblefield, 2nd edition, Benjamin Cummings Publishers, 1997.

Reference Books:

1. "Artificial Intelligence", Winston P.H., 3rd edition, Addison Wesley, 1995.

2. "Artificial Intelligence", Shivshankar B Nair, E. Rich and K.Knight, Tata McGraw Hill,1992.

3. "Artificial Intelligence", E. Charniack and D. McDermott, Addison Wesley, 1987.

4. "Artificial Intelligence and Machine Learning", Chandra S.S. & H.S. Anand, PHI Publications

Web Resources:

1. https://nptel.ac.in/courses/106/105/106105077/

Course outcomes:

After completion of this course student will be able to:

CS1504(A).1 Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
CS1504(A).2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
CS1504(A).3 Apply difficult real life problems in a state space representation so as to solve them using AI techniques like searching and game playing.
CS1504(A).4 Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, artificial neural networks.
CS1504(A).5 Demonstrate ability to share in discussions of AI, its current scope and limitations, and societal Implications

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1504(A).1	2	2	1	0	0	0	0	0	0	0	0	2	2	1	0
CS1504(A).2	2	2	1	0	0	0	0	0	0	0	0	2	2	1	0
CS1504(A).3	2	2	1	0	0	0	0	0	0	0	0	2	2	1	0
CS1504(A).4	2	2	1	0	0	0	0	0	0	0	0	2	2	1	0
CS1504(A).5	2	2	1	0	0	0	0	0	0	0	0	2	2	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1504(A).1	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(A).2	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(A).3	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(A).4	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(A).5	2	2	1	0	0	0	0	0	0	0	2	2	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1504(B)**	**Course category**	PE
Course Name	**BIG DATA ANALYTICS**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Course Objectives:

Aim of the course is

I. To understand the Big Data Platform and its Use cases
II. To provide an overview of Apache Hadoop
III. To provide HDFS Concepts and Interfacing with HDFS
IV. To understand Map Reduce Jobs
V. To apply analytics on Structured, Unstructured Data.

Course Content

Introduction to Big Data Introduction: Big Data - Characteristics of Big Data - Big data management architecture - Examining Big Data Types - Big Data Technology Components - Big data analytics - Big data analytics examples - Web Data Overview - Web Data in Action.

Hadoop Introduction: History of Hadoop - Hadoop Ecosystem - Analyzing data with Hadoop - Hadoop Distributed File System - Design - HDFS concepts - Hadoop filesystem - Data flow - Hadoop I / O - Data integrity - Serialization - Setting up a Hadoop cluster - Cluster specification - cluster setup and installation - YARN. UNIT

MapReduce Introduction: Understanding MapReduce functions - Scaling out - Anatomy of a MapReduce Job Run - Failures - Shuffle and sort - MapReduce types and formats - features - counters - sorting - MapReduce Applications –Configuring and setting the environment - Unit test with MR unit - local test.

Spark: Installing spark - Spark applications - Jobs - Stages and Tasks - Resilient Distributed databases - Anatomy of a Spark Job Run - Spark on YARN - SCALA: Introduction - Classes and objects - Basic types and operators - built-in control structures - functions and closures - inheritance.

NoSQL: Databases Introduction to NoSQL - MongoDB: Introduction - Data types - Creating - Updating and deleing documents - Querying - Introduction to indexing - Capped collections - Hbase: Concepts - Hbase Vs RDBMS - Creating records - Accessing data - Updating and deleting data - Modifying data - exporting and importing data. USE CASES: Call detail log analysis - Credit fraud alert - Weather forecast.

Text Books:

1. EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley Publishers, 2015.
2. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
3. Aven Jeffrey, Data Analytics with Spark Using Python | Big Data | First Edition | Pearson Paperback, November 2018

4. Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Wiley, 2014

References Books:

1. Dirk Deroos et al., Hadoop for Dummies, Dreamtech Press, 2014.
2. Chuck Lam, Hadoop in Action, December, 2010.
3. Leskovec, Rajaraman, Ullman, Mining of Massive Datasets, Cambridge University Press.
4. I.H. Witten and E. Frank, Data Mining: Practical Machine learning tools and techniques.
5. Erik Brynjolfsson et al., The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies, W. W. Norton & Company, 2014.
6. Chris Eaton, Dirk Deroos et al., "Understanding Big data", McGraw Hill, 2012.

Course outcomes:

After completion of this course student will be able to:

CS1504(B).1 Identify Big Data and its Business Implications. .
CS1504(B).2. Access and Process Data on Distributed File System
CS1504(B).3 Manage Job Execution in Hadoop Environment
CS1504(B).4 Develop Big Data Solutions using Hadoop Eco System
CS1504(B).5 Analyze Infosphere BigInsights Big Data Recommendations

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1504(B).1	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1504(B).2	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1504(B).3	3	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1504(B).4	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1504(B).5	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1504(B).1	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(B).2	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(B).3	3	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(B).4	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(B).5	2	2	1	0	0	0	0	0	0	0	2	2	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1504(C)**	**Course category**	PE
Course Name	**IMAGE PROCESSING**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Course Objective:

Aim of the course is

I. To introduce the concepts of image processing and basic analytical methods to be used in image processing.
II. To familiarize students with image enhancement and restoration techniques,
III. To explain different image compression techniques
IV. To introduce segmentation and morphological processing techniques.

Course Content

Introduction: Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and quantization.

Spatial Domain Filtering: Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian.

Image Restoration: Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Restoration from projections.

Image Compression: Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, LZW coding, Sub-image size selection, Run length coding, Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding

Morphological Image Processing and Image Segmentation: Preliminaries, dilation, erosion, open and closing, basic morphologic algorithm , Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Iterative thresholding, Moving averages, Multivariable thresholding, Region based segmentation, Use of motion in segmentation

Text Books:

1. Digital Image Processing, 3rd Edition, by Rafael C Gonzalez and Richard E Woods, Publisher: Pearson Education.
2. Digital Image Processing using MATLAB, R C Ganzalez, R E Woods & S L Eddins, 2 nd Edition

Reference Books:

1. Digital Image Processing, R C Gonzalez & R E Woods, 3 rd /4 th Ed, PHI
2. Image Processing, Analysis, and Machine Vision, Milan Sonka, Vaclav Hlavac and Roger Boyle, Second Edition, Thomson Learning

Web Resources:

1. https://nptel.ac.in/courses/117/105/117105135/

Course Outcomes:

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

CS1504(C). 1 Analyse the different types of digital images.

CS1504(C). 2 Perform image enhancement techniques in spatial and frequency domain.

CS1504(C). 3 Elucidate the mathematical modelling of image restoration and compression

CS1504(C). 4 Apply the concept of image segmentation.

CS1504(C). 5 Analyse object detection and recognition techniques

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1504(C).1	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1504(C).2	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1504(C).3	3	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1504(C).4	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1504(C).5	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1504(C).1	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(C).2	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(C).3	3	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(C).4	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(C).5	2	2	1	0	0	0	0	0	0	0	2	2	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1504(D)**	**Course category**	PE
Course Name	**FULL STACK DEVELOPMENT**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Course Objective:

Aim of the course is

I. To become knowledgeable about the most recent web development technologies.
II. Idea for creating two tier and three tier architectural web applications.
III. Design and Analyse real time web applications.
IV. Constructing suitable client and server-side applications.
V. To learn core concept of both front end and back-end programming.

Web Development Basics: Web development Basics - HTML & Web servers Shell - UNIX CLI Version control - Git &Github HTML, CSS

Frontend Development: Javascript basics OOPS Aspects of JavaScript Memory usage and Functions in JS AJAX for data exchange with server jQuery Framework jQuery events, UI components etc. JSON data format.

REACT JS: Introduction to React React Router and Single Page Applications React Forms, Flow Architecture and Introduction to Redux More Redux and Client-Server Communication

Java Web Development: JAVA PROGRAMMING BASICS, Model View Controller (MVC) Pattern MVC Architecture using Spring RESTful API using Spring Framework Building an application usingMaven

Databases & Deployment: Relational schemas and normalization Structured Query Language (SQL) Data persistence using Spring JDBC Agile development principles and deploying application in Cloud

Text Books:

1. Web Design with HTML, CSS, JavaScript and JQuery Set Book by Jon Duckett Professional JavaScript for Web Developers Book by Nicholas C. Zakas
2. Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-byStep Guide to Creating Dynamic Websites by Robin Nixon
3. Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB. Copyright © 2015 BYAZAT MARDAN

Reference Books:

1. Full-Stack JavaScript Development by Eric Bush.

2. Mastering Full Stack React Web Development Paperback – April 28, 2017 by TomaszDyl , Kamil Przeorski , Maciej Czarnecki

Course Outcomes:

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

CS1504(D). 1 Understand the basics of full stack web development

CS1504(D). 2 Develop responsive web pages using HTML and CSS

CS1504(D). 3 Implement client-side scripting using JavaScript

CS1504(D). 4 Build interactive web pages using React JS.

CS1504(D). 5 Develop real-world web applications using various technologies learned in the course

CO – PO – PSO Mapping:

CO															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1504(D).1	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1504(D).2	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1504(D).3	3	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1504(D).4	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1504(D).5	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1504(C).1	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(C).2	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(C).3	3	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(C).4	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1504(C).5	2	2	1	0	0	0	0	0	0	0	2	2	0	0

0-Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	SH1501 A								Course Category			OE
Course Name	ENVIRONMENTAL LAW											
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	100	3

Course Objectives:

To make the student aware and understand:

1. To introduce students to the basic concepts of environment, environmental studies, and the scope of environmental law.
2. To analyze how these principles are incorporated into Indian environmental legislation and upheld by the judiciary
3. To study the evolution of environmental protection from ancient, medieval, and modern India.
4. To analyze the role of the Indian Constitution in protecting the environment.
5. To critically analyze the role of the judiciary in interpreting and enforcing environmental laws.

Course Contents:

Introduction: Introduction to Environment and Environmental Law, Scope and Importance of Environmental Studies, Important Case Laws on Environmental Law.

Fundamental Principles of Environmental Law: Important Principles of Environmental Law, All about Public Trust Doctrine, incorporation of Precautionary Principle in Environmental Legislation, Application of Polluter Pays Principle In Indian Legal Jurisprudence, Role of Indian Judiciary in Upholding International Principles of Environmental Law, Sustainable Development.

History and Development of Environmental Law in India: History of Environment Protection Ancient, Medieval and Modern India, Efficacy of Environment Protection Act, 1986, Efficacy of Water Legislation in India,Efficacy of Air Legislation in India, Efficacy of Wildlife Protection Laws in India. Efficacy of Forest Legislation in India, Protection of Tribal Rights: An Effort through Environmental Legislation, A Critique on Criminal Law Provisions on Environment Protection.

Protection of Environment under the Indian Constitution: Protection of Environment under the Indian Constitution, Right to Clean and Healthy Environment under Indian Constitution: An Analysis.

Environment and the Judiciary: Section 133 CrPC: A Critical Analysis, Role of National Green Tribunal in Environment Protection, Role of Judiciary in Environment Protection, Role of Public Interest

Litigation in Environmental Protection, Nature and Scope of Environmental Torts in India, The emergence of Noise Pollution Jurisprudence in India,Role of Judiciary in Preventing Noise Pollution, Role of Judiciary in Preventing Air Pollution.

Text Books:

1. Environmental Law by DrNishthaJaswal Dr. P S Jaswal
2. EBC Environmental Law S.C Shastri.
3. Introduction To Environmental Law by S. Shantakumar

Reference Books:

1. Lectures on Environmental Law by Rega Surya Rao
2. Environmental Laws Bare Act with Amendments
3. Universal's Environment Laws bare act (all acts)

Course Outcomes:

After successful completion of this course student will be able to:

SH1501A.1. Understand the basic Environmental law
SH1501A.2. Demonstrate a thorough understanding of the principles, laws, and policies governing Environmental protection in India.
SH1501A.3. Critically analyze the role of the judiciary, legislature, and other institutions in upholding environmental laws.
SH1501A.4. Apply legal principles to contemporary environmental issues and propose solutions.
SH1501A.5. Develop a nuanced perspective on the intersection of environmental law with constitutional rights, tribal rights, and criminal law.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1501A.1	0	0	0	0	0	2	2	2	2	0	2	0
SH1501A.2	0	0	0	0	0	2	2	2	2	0	2	0
SH1501A.3	0	0	0	0	0	2	2	2	2	0	2	0
SH1501A.4	0	0	0	0	0	2	2	2	2	0	2	0
SH1501A.5	0	0	0	0	0	2	2	2	2	0	2	0

CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1501A.1	0	0	0	0	0	2	2	2	0	2	1
SH1501A.2	0	0	0	0	0	2	2	2	0	2	1
SH1501A.3	0	0	0	0	0	2	2	2	0	2	1
SH1501A.4	0	0	0	0	0	2	2	2	0	2	1
SH1501A.5	0	0	0	0	0	2	2	2	0	2	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	SH1501 B								Course Category			OE
Course Name	CYBER LAW											
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	100	3

Course Objectives:

To make the student aware and understand:

1. To introduce students to the legal and regulatory frameworks governing cyberspace.
2. To familiarize students with key concepts such as cybercrime, data protection, intellectual property, and digital privacy.
3. To explore the ethical implications of technology and its impact on society.
4. To understand the role of national and international laws in addressing cyber threats and challenges.
5. To equip students with the knowledge to identify and mitigate legal risks in the development and deployment of technology.

Course Contents:

Introduction to Cyber Law

- Overview of Cyberspace and Cyber Law: Definition, scope, and importance.
- Evolution of Cyber Law: Historical development and global perspectives.
- Key Concepts: Jurisdiction, sovereignty, and challenges in cyberspace.
- Introduction to Cyber Ethics: Ethical issues in technology and digital behavior.

Cybercrime and Legal Frameworks

- Types of Cybercrimes: Hacking, phishing, identity theft, cyber terrorism, etc.
- Legal Frameworks for Cybercrime:
  Indian Context: Information Technology Act, 2000 (IT Act) and amendments.
  International Context: Budapest Convention on Cybercrime.
- Case Studies: Landmark cybercrime cases and their legal implications.
- Role of Law Enforcement Agencies: Cyber cells, CERT-In, and Interpol.

Data Protection and Privacy Laws

- Concept of Data Privacy: Importance and challenges.
- Data Protection Laws:
  Indian Context: Personal Data Protection Bill (PDPB), IT Act provisions. Global Context: GDPR (General Data Protection Regulation), CCPA.
- Right to Privacy: Judicial interpretations and constitutional perspectives.
- Data Breaches and Legal Liabilities: Case studies and mitigation strategies.

Cybersecurity Laws and Regulations:

- Importance of Cybersecurity: Threats, vulnerabilities, and risk management.
- Legal Frameworks for Cybersecurity:
  Indian Context: National Cybersecurity Policy, IT Act provisions.
  Global Context: NIST Framework, EU Cybersecurity Act.
- Role of Organizations: CERT-In, NCIIPC, and international cybersecurity agencies.
- Compliance and Best Practices: Implementing cybersecurity measures in organizations.

Text Books:

1. "Cyber Law in India" by S. S. Jaswal.
2. "Information Technology Law and Practice" by Vakul Sharma.
3. "Cyber Law and Cyber Crimes" by Nandan Kamath.

Reference Books:

1. Information Technology Act, 2000 (India).
2. General Data Protection Regulation (GDPR).
3. "Cybersecurity and Cyber Law" by Nina Godbole.
4. "The Law of Cybercrimes and Their Investigations" by George Curtis.

Course Outcomes:

After successful completion of this course student will be able to:

SH1501B.1 Understand the legal and ethical dimensions of cyberspace.
SH1501B.2 Identify and analyze cybercrimes and their legal consequences.
SH1501B.3 Apply cyber law principles to real-world scenarios in technology development and usage.
SH1501B.4 Evaluate the impact of cyber security laws on businesses and individuals.
SH1501B.5 Develop strategies to comply with data protection and privacy regulations.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1501B.1	2	2	2	2	2	2	0	2	2	2	1	1
SH1501B.2	2	2	2	2	2	2	0	2	2	2	1	0
SH1501B.3	2	2	2	2	2	2	0	2	2	2	1	2
SH1501B.4	2	2	2	2	2	2	0	2	2	2	1	2
SH1501B.5	2	2	2	2	2	2	0	2	2	2	1	2

CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1501B.1	2	2	2	2	2	2	2	2	2	2	1
SH1501B.2	2	2	2	2	2	2	2	2	2	2	1
SH1501B.3	2	2	2	2	2	2	2	2	2	2	1
SH1501B.4	2	2	2	2	2	2	2	2	2	2	1
SH1501B.5	2	2	2	2	2	2	2	2	2	2	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	SH1501 C								Course Category			OE
Course Name	INTRODUCTION TO MASS COMMUNICATION											
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	100	3

Course Objectives:

To make the student aware and understand:

1. To introduce students to the basic concepts, theories, and models of mass communication.
2. To explore the role of mass media in shaping public opinion, culture, and society.
3. To familiarize students with the various forms of mass media (print, electronic, digital, and social media).
4. To examine the ethical and legal issues in mass communication.
5. To develop critical thinking and analytical skills in evaluating media content and provide hands-on experience in creating basic media content.

Course Contents:

Introduction to Mass Communication

- Definition and Scope: What is mass communication?
- Elements of Mass Communication: Sender, message, channel, receiver, feedback, and noise.
- Functions of Mass Media: Information, education, entertainment, and persuasion.
- Theories of Mass Communication: Hypodermic Needle Theory, Two-Step Flow Theory, Agenda-Setting Theory, and Uses and Gratifications Theory.

Forms of Mass Media

- Print Media: Newspapers, magazines, and books.
- Electronic Media: Radio, television, and cinema.
- Digital Media: Internet, websites, and blogs.
- Social Media: Platforms, trends, and impact.
- Comparative Analysis: Strengths and limitations of each medium.

Role of Mass Media in Society

- Media and Public Opinion: Shaping perceptions and attitudes.
- Media and Culture: Influence on language, traditions, and values.
- Media and Democracy: Role in elections, governance, and accountability.
- Media and Globalization: Cross-cultural communication and global trends.

Media Ethics and Laws

- Ethical Issues in Mass Communication: Bias, sensationalism, and privacy concerns.
- Media Laws and Regulations: Freedom of speech, censorship, and regulatory bodies.
- Case Studies: Ethical dilemmas and legal controversies in media.

Technology and Mass Communication

- Impact of Technology on Media: Digital transformation and convergence.
- Emerging Trends: Artificial Intelligence, Virtual Reality, and Augmented Reality in media.
- Social Media Algorithms: How they shape content consumption.
- Fake News and Misinformation: Challenges and solutions.

Text Books:

1. "Mass Communication in India" by Keval J. Kumar.
2. "Introduction to Mass Communication" by Stanley J. Baran.
3. "Media and Communication Studies: An Introduction" by James Watson and Anne Hill.

Reference Books:

1. "Understanding Media: The Extensions of Man" by Marshall McLuhan.
2. "Media and Society: Power, Platforms, and Participation" by Nicholas Carah.
3. "The Elements of Journalism" by Bill Kovach and Tom Rosenstiel.

Course Outcomes:

After successful completion of this course student will be able to:

SH1501C.1 Understand the fundamentals of mass communication and its role in society.
SH1501C.2 Analyze the impact of mass media on individuals, communities, and cultures. SH1501C.3 Identify the strengths and limitations of different forms of mass media.
SH1501C.4 Critically evaluate media content for bias, accuracy, and ethical considerations.
SH1501C.5 Create basic media content using simple tools and techniques and appreciate the intersection of technology and mass communication.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1501C.1	1	0	0	1	1	0	0	0	1	0	0	1
SH1501C.2	0	1	1	0	2	0	0	0	1	0	0	1
SH1501C.3	1	1	1	0	1	0	0	0	0	0	0	1
SH1501C.4	1	0	1	1	0	0	0	0	1	0	0	1
SH1501C.5	1	0	1	1	3	0	0	0	1	0	0	1

CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1501C.1	1	0	0	1	0	0	0	0	1	0	1
SH1501C.2	0	1	1	0	0	0	0	0	2	0	1
SH1501C.3	1	1	1	0	0	0	0	0	1	0	1
SH1501C.4	1	0	1	1	0	0	0	0	0	0	1
SH1501C.5	1	0	1	1	0	0	0	0	3	0	1

0 - Not correlated 1 – Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	SH1501 D								Course Category			OE
Course Name	BASIC GERMAN LANGUAGE A1											
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	100	3

Course Objectives:

To make the student aware and understand:

1. To introduce students to the basics of the German language, including pronunciation, grammar, and vocabulary.
2. To develop basic communication skills in German for everyday situations.
3. To familiarize students with German culture, traditions, and etiquette.
4. To prepare students for further language learning and potential opportunities in German- speaking countries.
5. To enhance students' global competence and intercultural communication skills.

Course Contents:

Introduction to German Language and Culture

- Alphabet and Pronunciation: German alphabet, sounds, and basic pronunciation rules.
- Greetings and Introductions: Common greetings, introducing oneself, and basic polite expressions.
- Numbers and Dates: Counting, telling time, and discussing dates.
- Cultural Insights: Overview of German-speaking countries, traditions, and etiquette.

Basic Grammar and Sentence Structure

- Articles and Gender: Definite and indefinite articles (der, die, das).
- Nouns and Plurals: Basic noun forms and pluralization rules.
- Pronouns: Personal pronouns (ich, du, er/sie/es, etc.).
- Basic Sentence Structure: Subject-verb-object order and forming simple sentences.

Everyday Communication

- Asking for Directions: Common phrases for navigating and understanding directions.
- Shopping and Ordering: Vocabulary for shopping, ordering food, and making payments.
- Daily Activities: Talking about daily routines, hobbies, and free time.
- Role-Playing: Simulating real-life situations (e.g., at a café, market, or train station).

Vocabulary Building

- Family and Friends: Vocabulary for describing family members and relationships.
- Food and Drink: Common food items, meals, and dining vocabulary.

- Travel and Transportation: Vocabulary for travel, public transport, and booking tickets.
- Practice Sessions: Interactive activities to reinforce vocabulary

Reading and Writing in German

- Reading Simple Texts: Short dialogues, signs, and advertisements.
- Writing Practice: Filling out forms, writing short messages, and emails.
- Listening Comprehension: Understanding slow and clear spoken German.
- Speaking Practice: Participating in simple conversations and role-plays.

Cultural Immersion and Practical Applications

- German Culture: Festivals, traditions, and cultural norms.
- Engineering and Technology in Germany: Overview of Germany's role in engineering and innovation.
- Opportunities in German-Speaking Countries: Study, work, and internship opportunities.
- Final Project: Presenting a short dialogue or skit in German.

Text Books:

1. "Netzwerk A1" by Stefanie Dengler et al.
2. "Menschen A1" by Sandra Evans et al.
3. "Schritte International A1" by Daniela Niebisch et al.

Reference Books:

1. "German for Dummies" by Paulina Christensen et al.
2. "Practice Makes Perfect: Basic German" by Jolene Wochenske.
3. "Langenscheidt German-English Dictionary".

Course Outcomes:

After successful completion of this course student will be able to:

SH1501D.1 Understand and use familiar everyday expressions and basic phrases.
SH1501D.2 Introduce themselves and others, and ask and answer questions about personal details. SH1501D.3 Interact in a simple way, provided the other person speaks slowly and clearly.
SH1501D.4 Read and write simple texts in German.
SH1501D.5 Appreciate German culture and its relevance in a global context.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1501D.1	1	0	0	0	0	0	1	0	3	0	0	0
SH1501D.2	0	1	1	0	0	0	1	0	3	0	0	0
SH1501D.3	1	1	1	0	0	0	1	0	3	0	0	0
SH1501D.4	1	0	1	0	0	0	1	0	0	0	0	0
SH1501D.5	1	0	1	0	0	0	1	0	3	0	0	0

CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1501D.1	1	0	0	1	0	0	0	0	0	0	0
SH1501D.2	0	1	1	0	0	0	0	0	0	0	0
SH1501D.3	1	1	1	0	0	0	0	0	0	0	0
SH1501D.4	1	0	1	1	0	0	0	0	0	0	0
SH1501D.5	1	0	1	1	0	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	CS1505	Course category	VSE
Course Name	PROFESSIONAL SOFTWARE LAB		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
00	00	02	02	00	00	00	00	--	25	25	50	01

Course Objectives

Aim of the course is

I. To understand the software development process
II. To prepare students to become familiar with Object Oriented Programming through JAVA language.
III. To understand the professional software development using core and advance java features.
IV. To analyse the problem statement and develop the corresponding software application.

Minimum eight experiments shall be performed and the list given is just a guideline. However, course coordinator may prepare their own list

1. Understand the professional software development processes
2. Understand different available IDE platforms
3. Programs based on OOP concepts
4. Program based on Multithreading
5. Java Collection
6. Applets and Swings
7. Database connection through JDBC
8. Servlets for web development
9. Application Development

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge or skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of Experiments and may be followed by sample questions.

Reference: http://vlabs.iitkgp.ac.in/se/

Course outcomes:

After completion of this course student will be able to:

CS1505 .1 Able to analyse the necessity for Object Oriented Programming paradigm

CS1505 .2 Able to design and develop java efficient java programs for any given computational problem.

CS1505.3 Demonstrate an ability to implement professional software development process for application development.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1505.1	2	2	1	0	0	0	0	0	2	2	1	2	3	3	2
CS1505.2	2	2	1	0	2	0	0	0	2	2	1	2	3	3	2
CS1505.3	3	2	1	0	2	0	0	0	2	0	1	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1505.1	2	2	1	0	0	0	0	2	2	1	2	3	3	2
CS1505.2	2	2	1	0	2	0	0	2	2	1	2	3	3	2
CS1505.3	3	2	1	0	2	0	0	2	0	1	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1506**	**Course category**	VSE
Course Name	**OPERATING SYSTEM LAB**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
00	00	02	02	00	0	00	00	--	25	25	50	01

Course Objectives:
Aim of the course is

I. To make aware of different types of operating system and their services
II. To learn the mechanisms involved in process management and scheduling of process in contemporary OS to achieve better performance of a computer system.
III. To gain knowledge on operating system concepts that includes Mutual exclusion algorithms, deadlock detection, avoidance algorithms and memory management.

Minimum eight experiments shall be performed and the list given is just a guideline. However, course coordinator may prepare their own list

List of Practical's

1. To study the basic concept of operating system
2. Implementation of CPU Scheduling. (i) FCFS, (ii) SJF, (iii) Shortest Remaining Time First and (iv) Priority based
3. Implementation of CPU Scheduling: (i) Round Robin (ii) Longest Job First and (iii) Longest Remaining Time First (LRTF)
4. Basics of UNIX commands and Implementation of Shell Programming
5. Implementation of Process and thread (Life cycle of process): (i) Process creation and Termination; (ii) Thread creation and Termination
6. Write a C program to simulate producer-consumer problem using Semaphores
7. Write a C program to simulate the concept of Dining-philosophers problem
8. Producer-Consumer Problem using Semaphores and Reader Writer Problem
9. Simulate algorithm for deadlock prevention and detection
10. Simulate the algorithm for deadlock avoidance and study about deadlock recovery
11. Write a C program to simulate the following contiguous memory allocation Techniques a) Worst fit b) Best fit c) First fit.
12. Simulate page replacement algorithms: FIFO, LRU and Optimal
13. Project

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge or skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.
ESE - The End Semester Exam for practical shall be based on performance in one of Experiments and may be followed by sample questions.

Text Books:

1. Operating System concepts and principles, A. Silberschatz & P.B. Galvin, 8th Edition Wiley India, 2009.
2. Modern Operating System, Tanenbaum, 3rd Edition, Prentice Hall India, ,2003.

Reference Books:

1. Operating Systems: Internals and design Principle, W. Stallings, 6thEdition, Pearson Education(LPE) , 2009.
2. Design of Linux Operating system, M.J. Bach, 3rd Edition, Prentice Hall, 2004.

Web Resources:

1. www.nptel.iitm.ac.in
2. www.nptel.iitkgp.ac.in

Course outcomes:

After completion of this course student will be able to:

CS1506.1 Understand, Describe, contrast and compare the different structures for operating systems and basics of operating system
CS1506.2 Analise the process management policies, scheduling of processes by CPU and Thread
CS1506.3 Illustrate the various concept of file management, memory management, deadlock and security in OS

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1506.1	2	2	2	3	2	0	2	0	2	2	2	2	3	3	2
CS1506.2	2	2	3	3	2	0	2	0	0	2	2	1	3	3	2
CS1506.3	2	2	2	3	2	0	2	0	0	2	2	0	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1506.1	2	2	1	0	0	0	0	2	2	1	2	3	3	2
CS1506.2	2	2	1	0	2	0	0	2	2	1	2	3	3	2
CS1506.3	3	2	1	0	2	0	0	2	0	1	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1507(A)**	**Course category**	PE
Course Name	**ARTIFICIAL INTELLIGENCE LAB**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	
00	00	02	02	00	0	00	00	--	25	25	50	01

Course Objectives:

Aim of the course is

I. To explore the methods of implementing algorithms using artificial intelligence techniques
II. To illustrate search algorithms
III. To demonstrate building of intelligent agents

Minimum eight experiments shall be performed and the list given is just a guideline. However, course coordinator may prepare their own list

1. Write a program to implement DFS
2. Write a program to implement BFS
3. Write a Program to find the solution for travelling salesman Problem
4. Write a program to implement Simulated Annealing Algorithm
5. Write a program to find the solution for wampus world problem
6. Write a program to implement 8 puzzle problem
7. Write a program to implement Towers of Hanoi problem
8. Write a program to implement A* Algorithm
9. Write a program to implement Hill Climbing Algorithm
10. Build a bot which provides all the information related to you in college.
11. Build a virtual assistant for Wikipedia using Wolfram Alpha and Python

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge or skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of Experiments and may be followed by sample questions.

Course outcomes:

After completion of this course student will be able to:

CS1507(A).1. Implement search algorithms

CS1507(A).2. Solve Artificial intelligence problems

CS1507(A).3. Design chatbot and virtual assistant

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1507(A).1	2	2	1	0	0	0	0	0	2	2	1	2	3	3	2
CS1507(A).2	2	2	1	0	2	0	0	0	2	2	1	2	3	3	2
CS1507(A).3	3	2	1	0	2	0	0	0	2	0	1	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1507(A).1	2	2	1	0	0	0	0	2	2	1	2	3	3	2
CS1507(A).2	2	2	1	0	2	0	0	2	2	1	2	3	3	2
CS1507(A).3	3	2	1	0	2	0	0	2	0	1	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	CS1507(B)	Course category	PE
Course Name	BIG DATA ANALYTICS LAB		

Teaching Scheme				Examination Scheme								
				Theory					Practical			Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	
00	00	02	02	00	0	00	00	--	25	25	50	01

Course Objectives:

Aim of the course is

I. To implement MapReduce programs for processing big data.
II. To realize storage of big data using MongoDB.
III. To analyze big data using machine learning techniques such as Decision tree classification and clustering.

Minimum eight experiments shall be performed and the list given is just a guideline. However, course coordinator may prepare their own list

1. Install, configure and run python, numPy and Pandas.
2. Install, configure and run Hadoop and HDFS.
3. Visualize data using basic plotting techniques in Python.
4. Implement NoSQL Database Operations: CRUD operations, Arrays using MongoDB.
5. Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB.
6. Implement word count / frequency programs using MapReduce.
7. Implement a MapReduce program that processes a dataset.
8. Implement clustering techniques using SPARK.
9. Implement an application that stores big data in MongoDB / Pig using Hadoop / R.

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge or skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of Experiments and may be followed by sample questions.

Course outcomes:

After completion of this course student will be able to:

CS1507(B).1 Configure Hadoop and perform File Management Tasks

CS1507(B).2 Critically analyze huge data set using Hadoop distributed file systems and MapReduce

CS1507(B).3 Apply different data processing tools like Pig, Hive and Spark.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1507(B).1	2	2	1	0	0	0	0	0	2	2	1	2	3	3	2
CS1507(B).2	2	2	1	0	2	0	0	0	2	2	1	2	3	3	2
CS1507(B).3	3	2	1	0	2	0	0	0	2	0	1	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1507(B).1	2	2	1	0	0	0	0	2	2	1	2	3	3	2
CS1507(B).2	2	2	1	0	2	0	0	2	2	1	2	3	3	2
CS1507(B).3	3	2	1	0	2	0	0	2	0	1	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1507(C)**	**Course category**	PE
Course Name	**IMAGE PROCESSING LAB**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
00	00	02	02	00	0	00	00	--	25	25	50	01

Course Objectives:

Aim of the course is

I. To introduce the concepts of image processing and basic analytical methods to be used in image processing.

II. To familiarize students with image enhancement and restoration techniques, To explain different image compression techniques

III. To introduce segmentation and morphological processing techniques.

Minimum eight experiments shall be performed and the list given is just a guideline. However, course coordinator may prepare their own list

1. Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale)
2. Implementation of Relationships between Pixels
3. Implementation of Transformations of an Image
4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization
5. Display of bit planes of an Image
6. Display of FFT(1-D & 2-D) of an image
7. Computation of Mean, Standard Deviation, Correlation coefficient of the given Image
8. Implementation of Image Smoothening Filters(Mean and Median filtering of an Image)
9. Implementation of image sharpening filters and Edge Detection using Gradient Filters
10. Image Compression by DCT,DPCM, HUFFMAN coding
11. Implementation of image restoring techniques
12. Implementation of Image Intensity slicing technique for image enhancement
13. Canny edge detection Algorithm

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge or skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of Experiments and may be followed by sample questions.

Course Outcomes:

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

CS1507(C). 1 Analyse the different types of digital images.

CS1507(C). 2 Perform image enhancement techniques in spatial and frequency domain.

CS1507(C). 3 Apply the concept of image segmentation.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1507(C).1	2	2	1	0	0	0	0	0	0	0	0	2	2	1	1
CS1507(C).2	3	2	1	0	0	0	0	0	0	0	0	2	2	1	1
CS1507(C).3	2	2	1	0	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1507(C).1	2	2	1	0	0	0	0	0	0	0	2	2	1	1
CS1507(C).2	3	2	1	0	0	0	0	0	0	0	2	2	1	1
CS1507(C).3	2	2	1	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1507(D)**	**Course category**	PE
Course Name	**FULL STACK DEVELOPMENT LAB**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
00	00	02	02	00	0	00	00	--	25	25	50	01

Course Objectives:

Aim of the course is

I. To understand Usage of various front and backend Tools
II. To understand and create applications on their own
III. To implement web-based application using effective database access.

Minimum eight experiments shall be performed and the list given is just a guideline. However, course coordinator may prepare their own list

1 Designing static WebPages required for an Online Book Store website

2 Designing a webpage using CSS Which includes different styles

3 Write a JavaScript to implement the various events.

4 Write a program to create and Build a Password Strength Check using JQuery

5 Write a program to create and Build a star rating system using JQuery.

6 Write a program for sending request to a server by using AJAX.

7 Develop an Angular JS application that displays a list of shopping items. Allow users to add and remove items from the list using directives and controllers.

8 Write a program to create a simple calculator Application using React JS.

9 Write a program to create a voting application using React JS.

10 Write a server side program for Accessing MongoDB from Node.js.

11 Write a server side program for Manipulating MongoDB from Node.js.

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge or skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of Experiments and may be followed by sample questions.

Course Outcomes:

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

CS1507(D). 1 Demonstrate and designing of websites can be carried out.

CS1507(D). 2 Develop web-based application using suitable client side and server-side code

CS1507(D). 3 Implement web-based application using effective database access.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1507(D).1	2	2	1	0	0	0	0	0	0	0	0	2	2	1	1
CS1507(D).2	3	2	1	0	0	0	0	0	0	0	0	2	2	1	1
CS1507(D).3	2	2	1	0	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1507(D).1	2	2	1	0	0	0	0	0	0	0	2	2	1	1
CS1507(D).2	3	2	1	0	0	0	0	0	0	0	2	2	1	1
CS1507(D).3	2	2	1	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**SH1503**								**Course Category**			**MNC2**
Course Name	**SOFT SKILLS**											
Teaching Scheme				**Examination Scheme**								**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
02	-	-	02	-	-	20	-	-	-	-	20	2

Course Objectives:

To make the student aware and understand:

1. Develop essential soft skills for academic, professional, and personal growth.
2. Enhance communication, teamwork, leadership, and emotional intelligence.
3. Provide hands-on training through interactive activities and real-world scenarios.
4. Improve employability and workplace readiness.

Course Contents:

Introduction to Soft Skills:

- Definition and importance of soft skills
- Difference between hard skills and soft skills
- Self-assessment: Identifying strengths and areas for improvement

Effective Communication:

- Verbal & Non-verbal communication
- Active listening & feedback techniques
- Public speaking & presentation skills
- Business email etiquette

Interpersonal & Teamwork Skills:

- Building rapport & networking
- Conflict resolution & negotiation
- Collaboration & team dynamics

Emotional Intelligence:

- Self-awareness & self-regulation
- Empathy & social skills
- Stress management & resilience

Leadership & Professional Ethics:
- Traits of effective leaders
- Decision-making & problem-solving
- Workplace ethics & professionalism

Time Management & Adaptability:
- Prioritization & goal setting
- Handling multitasking & deadlines
- Adapting to change & workplace challenges

Career Readiness:
- Resume writing & interview skills
- Personal branding (LinkedIn, networking)
- Workplace etiquette & corporate culture

Text Books:
1. Text Book of Soft Skills (Paperback, Paul Martin, Kavita Krishnamurthi)
2. How to Win Friends & Influence People (Dale Carnegie), Emotional Intelligence 2.0 (Travis Bradberry)
3. Soft Skills Unleashed By Krishna Suresh

Reference Books:
1. "Personality Development and Soft Skills (Old Edition)" by Barun K Mitra
2. "Soft Skills - Enhancing Employability: Connecting Campus with Corporate" by M S Rao
3. "communication and soft skill development (first edition)" by career publications and Ashwini Deshpande
4. "Soft Skills Training: A Workbook to Develop Skills for Employment" by Frederick H Wentz

Course Outcomes:

After successful completion of this course student will be able to:

SH1503.1. Understand the importance of soft skill.
SH1503.2. Communicate confidently in professional settings.
SH1503.3. Work effectively in teams with strong interpersonal skills.
SH1503.4. Demonstrate leadership and problem-solving abilities.
SH1503.5. Be better prepared for job interviews and workplace challenges.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1503.1	0	1	0	0	0	1	2	2	2	0	2	0
SH15032	0	0	0	0	0	1	2	2	2	0	2	0
SH1503.3	0	1	0	0	0	1	2	2	2	0	2	0
SH1503.4	0	0	0	0	0	1	2	2	2	0	2	0
SH1503.5	0	1	0	0	0	1	2	2	2	0	2	0

CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1503.1	0	0	1	0	0	2	0	2	0	2	1
SH15032	0	0	1	0	0	2	0	2	0	2	1
SH1503.3	0	0	1	0	0	2	0	2	0	2	1
SH1503.4	0	0	1	0	0	2	0	2	0	2	1
SH1503.5	0	0	1	0	0	2	0	2	0	2	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

ADDITIONAL CRITERIA FOR DOUBLE MINOR (SPECIALIZATION)

Course Code	**CS1541**								**Course category**			MN
Course Name	**COMPUTER VISION**											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Course objectives:

Aim of the course is

I. To review image processing techniques for computer vision.
II. To understand shape and region analysis.
III. To understand hough transform and its applications to detect lines, circles, ellipses.
IV. To understand three-dimensional image analysis techniques.
V. To understand motion analysis.

Course Content

IMAGE PROCESSING FOUNDATIONS: Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.

SHAPES AND REGIONS: Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

HOUGH TRANSFORM: Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

3D VISION AND MOTION : Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

Text Book:

1. D. L. Baggio et al., ―Mastering OpenCV with Practical Computer Vision Projects‖, Packt Publishing, 2012.
2. E. R. Davies, ―Computer & Machine Vision‖, Fourth Edition, Academic Press, 2012.
3. Jan Erik Solem, ―Programming Computer Vision with Python: Tools and algorithms for analyzing images, O'Reilly Media, 2012.

Reference Books:

1. Mark Nixon and Alberto S. Aquado, ―Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
2. R. Szeliski, ―Computer Vision: Algorithms and Applications‖, Springer 2011.
3. Simon J. D. Prince, ―Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.

Course outcomes:

After completion of this course student will be able to:

CS1541.1 Implement fundamental image processing techniques required for computer vision.
CS1541.2 Develop applications using computer vision techniques.
CS1541.3 Implement boundary tracking techniques.
CS1541.4 Apply chain codes and other region descriptors.
CS1541.5 Apply Hough Transform for line, circle, and ellipse detections.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1541.1	3	2	2	0	1	0	0	0	0	0	0	2	2	1	0
CS1541.2	2	2	1	0	2	0	0	0	0	0	0	2	2	1	1
CS1541.3	3	2	1	0	0	0	0	0	0	0	0	2	2	1	0
CS1541.4	3	2	1	0	0	0	0	0	0	0	0	2	2	1	1
CS1541.5	2	2	3	0	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1541.1	3	2	2	0	1	0	0	0	0	0	2	2	1	0
CS1541.2	2	2	1	0	2	0	0	0	0	0	2	2	1	1
CS1541.3	3	2	1	0	0	0	0	0	0	0	2	2	1	0
CS1541.4	3	2	1	0	0	0	0	0	0	0	2	2	1	1
CS1541.5	2	2	3	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

ADDITIONAL CRITERIA FOR DOUBLE MINOR (SPECIALIZATION)

Course Code	**CS1542**								**Course category**			MN
Course Name	**BUSINESS INTELLIGENCE & ANALYTICS**											
Teaching Scheme				Examination Scheme								
				Theory					Practical			Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Course Objective:

Aim of the course is

- **I.** To improve decision-making by providing actionable insights,
- **II.** To enhance operational efficiency, identify market trends and opportunities, and gain a competitive advantage through deeper understanding of customer behaviour and market dynamics by analyzing data.
- **III.** To improve strategic decision-making and providing a competitive advantage.
- **IV.** To Understand impact of BI&A on the organization

Course Content

Introduction to Business Intelligence & Analytics (BIA): Drivers of BIA, types of analytics: descriptive to prescriptive, vocabulary of business analytics, course plan and resources.

Technical architecture of BIA: Case analysis of AT&T Long distance, fundamentals of data management, On Line Transaction Processing (OLTP), design process of databases

Relational databases: Normalisation, SQL queries, Shop Sense case of management questions, data warehousing, online Analytical Processing (OLAP), data cube

Descriptive analytics: visualization, customer analytics, survival analysis, customer lifetime value, case study

Data mining process: introduction to statistical learning, data pre-processing, data quality, overview of data mining techniques, case study using regression analysis

Introduction to decision trees: tree induction, measures of purity, tree algorithms, pruning, ensemble methods

Text books:

1. Han, J., Pei, J. & Tong H. (2023). Data Mining Concepts and Techniques, 4th ed, New Delhi: Elsevier.

2. James, G., Witten, D., Hastie, T. and Tibshirani,R. (2013) An Introduction to Statistical Learning with Applications in R, Springer: NY

Course outcomes:

After completion of this course student will be able to:

CS1542.1 Analyze the impact of BI&A on the organization
CS1542.2 Apply BI&A methods and techniques in addressing strategic business problems
CS1542.3 Understand the role of BI&A in helping organizations make better decisions
CS1542.4 Conduct an in-depth analysis of a strategic business problem
CS1542.5 Communicate the results of an in-depth analysis to both a technical and management audience

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1542.1	3	2	2	0	1	0	0	0	0	0	0	2	2	1	0
CS1542.2	2	2	1	0	2	0	0	0	0	0	0	2	2	1	1
CS1542.3	3	2	1	0	0	0	0	0	0	0	0	2	2	1	0
CS1542.4	3	2	1	0	0	0	0	0	0	0	0	2	2	1	1
CS1542.5	2	2	3	0	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS15412.1	3	2	2	0	1	0	0	0	0	0	2	2	1	0
CS1542.2	2	2	1	0	2	0	0	0	0	0	2	2	1	1
CS1542.3	3	2	1	0	0	0	0	0	0	0	2	2	1	0
CS1542.4	3	2	1	0	0	0	0	0	0	0	2	2	1	1
CS1542.5	2	2	3	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1601**	**Course category**	PC
Course Name	**COMPUTER NETWORK**		

Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Course objectives:

Aim of the course is

I. Introduce students to the basic concepts of computer networking.
II. To learn how data is transmitted across network
III. Explore network protocol, architecture and security mechanism.
IV. To gain practical skill in configuring and troubleshooting networks
V. Solidify understanding of the inner working of networking protocols by a term project involving with socket programming

Course Content

Introduction to computer networks: Network Component and Categories - Topologies - Transmission Media - Reference Models: ISO/OSI Model and TCP/IP Model.

Physical Layer: Digital and Analog Signals - Periodic Analog Signals - Transmission Impairments - Digital data transmission techniques - Analog data transmission techniques - Multiplexing and Spread Spectrum.

Data Link Layer: Error Detection and Correction - Parity - LRC - CRC - Hamming Code - Flow Control and Error Control - Stop and wait - ARQ - Sliding window - HDLC - Multiple Access Protocols - CSMA - CSMA/CD and CSMA/CA - IEEE 802.3 Ethernet.

Network Layer: Packet Switching and Datagram approach - IP Addressing methods - Subnetting - Routing - Distance Vector Routing - RIP - Link State Routing - OSPF - BGP - Multicast Routing - MOSPF - DVMRP - Broadcast Routing.

Transport Layer: Transport Services - UDP - TCP - Congestion Control - Quality of Services (QOS) - **Application Layer:** HTTP, FTP, SMTP, DNS, SMTP, Client Server Model, Peer-to-Peer Network, www, Cryptography Techniques.

Text books:

1. Behrouz A. Forouzan, "Data Communication and Networking," 4th Edition, McGraw-Hill.
2. Larry Peterson & Bruce Davie, "Computer Networks: A Systems Approach."
3. William Stallings, "Data and Computer Communication," 6th Edition, PHI Publication, 2007.

Reference Book:

1. A.S. Tanenbaum, "Computer Networks," 4th Edition, PHI Publication, 2002.
2. Jim Kurose & Keith Ross, "Networking: A Top-Down Approach Featuring the Internet," 6th Edition, Addison Wesley, July 2002.

Web Resources:

1. Online Resource: NPTEL - IIT Kanpur.

Course Outcome:

After completion of course student will be able to

CS1601.1. Explain the basic concepts of computer networks, including network models (OSI, TCP/IP) and topologies.
CS1601.2. Apply protocols and techniques at various layers (e.g., IP addressing, routing, TCP/UDP) to solve networking problems.
CS1601.3. Analyze network performance and troubleshoot connectivity issues using tools like Wireshark or Packet Tracer.
CS1601.4. Design and implement a simple network system with appropriate addressing and routing mechanisms.
CS1601.5. Evaluate security threats in networks and apply basic security measures (e.g., encryption, firewalls).

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1601.1	3	2	0	0	0	1	0	0	2	0	0	2	3	2	1
CS1601.2	3	3	2	1	2	0	0	0	0	0	0	1	3	2	1
CS1601.3	2	3	2	3	3	0	0	0	1	1	0	2	3	2	1
CS1601.4	3	3	3	2	3	1	1	0	2	1	2	2	3	2	1
CS1601.5	2	2	2	3	2	2	1	2	0	0	0	2	3	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1601.1	3	2	0	0	0	1	0	0	2	0	2	3	2	1
CS1601.2	3	3	2	1	2	0	0	0	0	0	1	3	2	1
CS1601.3	2	3	2	3	3	0	0	0	1	1	2	3	2	1
CS1601.4	3	3	3	2	3	1	1	0	2	1	2	3	2	1
CS1601.5	2	2	2	3	2	2	1	2	0	0	2	3	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**CS1602**	**Course category**	PC
Course Name	**SOFTWARE ENGINEERING**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
04	00	00	04	15	15	10	60	**2**hr 30 min	00	00	100	04

Course Objective:

Aim of the course is

I. To improve decision-making by providing actionable insights,

II. To enhance operational efficiency, identify market trends and opportunities, and gain a competitive advantage through deeper understanding of customer behavior and market dynamics by analyzing data.

III. To improve strategic decision-making and providing a competitive advantage.

IV. To learn how to develop a software system from scratch using object-oriented technology

Course Content

Software Engineering Fundamentals: Introduction to software engineering, The Nature of Software, Defining Software, Software Engineering Practice. Software Process: A Generic Process Model. Prescriptive Process Models, The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Evolutionary Processes. Unified Process, Agile software development: Agile methods, plan driven and agile development.

Software Requirement Specification: Eliciting Requirements, Collaborative Requirements Gathering, Usage Scenarios, Elicitation Work Products, Elements of the Requirements Model, Negotiating Requirements, Validating Requirements.

System Design: System modelling- Unified modelling language (UML)-Design Challenges Design Practices ,Problem partitioning, abstraction, top-down and bottom-up design, structured approach. Functional versus object-oriented approach, design specification and verification metrics, monitoring and control.(Star Uml)

Testing: A Strategic Approach to Software Testing, Verification and Validation, Organizing for Software, Testing, Software Testing Strategy, Criteria for Completion of Testing, Strategic, Issues, Test Strategies for Conventional Software, Unit Testing, Integration Testing, Test Strategies for Object-Oriented Software, Unit Testing in the OO Context, Integration Testing in the OO Context, Test Strategies for Web Apps.(Selenium, JUnit)

Software Quality: Static Analysis, Software Quality Assurance, metrics and measurement, Quality management system, software reviews, software reengineering, Software Maintenance.

Text Books:

1. Pressman R.S, Software Engineering: A Practitioner's Approach, 6th Edition, McGraw Hill, 2005.

2. The Unified modeling Language User Guide, Grady Booch, James Rumbaugh, Jacobson, 2nd Edition, Addison-Wesley, 2005.

Reference Books:

1. Software Engineering, Ian Sommerville, 7th Edition, Pearson Education Asia, 2004.
2. A concise introduction to software engineering, P. Jalote, Springer Verlag, 2008.
3. An integrated approach to software engineering, third edition By P. Jalote Springer Verlag, 2005

Course Outcomes:

After completion of this course student will be able to

CS1602.1 Apply software engineering principles and techniques.
CS1602.2 Develop, maintain and evaluate large-scale software systems.
CS1602.3 Produce efficient, reliable, robust and cost-effective software solutions.
CS1602.4 Perform independent research and analysis
CS1602.5 Work as an effective member or leader of software engineering teams.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1602.1	3	3	3	3	2	1	0	0	0	2	2	2	3	2	3
CS1602.2	2	2	3	3	2	1	2	0	0	2	2	1	3	2	3
CS1602.3	2	2	2	3	2	1	2	0	0	2	2	0	3	2	2
CS1602.4	3	2	2	3	2	0	2	0	0	2	2	0	0	0	0
CS1602.5	2	2	2	3	2	0	2	2	3	2	2	1	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1602.1	3	3	2	2	2	1	0	0	0	1	1	3	2	3
CS1602.2	3	2	3	2	2	1	0	1	0	1	1	3	2	3
CS1602.3	2	2	2	2	2	1	0	0	0	0	0	3	2	2
CS1602.4	1	3	2	3	1	0	0	0	0	0	1	0	0	0
CS1602.5	0	0	0	0	0	0	3	3	2	0	1	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1603(A)**	**Course category**	PE
Course Name	**ADVANCED MACHINE LEARNING AND DEEP LEARNING**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Course Objectives

Aim of the course is

I. To understand the fundamental concepts of machine learning and its applications
II. To master the concepts of classification and clustering techniques.
III. To develop a deep understanding of convolutional neural networks (CNNs) and their architecture.
IV. To apply deep learning techniques to large-scale datasets and real-world problems.

Course Content

Introduction: Training, Rote Learning, Learning Concepts, General-to-Specific Ordering, Version Spaces, Candidate Elimination, Inductive Bias, Decision-Tree Induction, The Problem of Overfitting, Learning Neural Networks, Supervised Learning, Unsupervised Learning, Reinforcement Learning.

Neural Networks: Introduction, Neurons, Perceptrons, Multilayer Neural Networks, Recurrent Networks, Unsupervised Learning Networks, Evolving Neural Networks.

Convolutional Neural Networks: The operation, Pooling, Convolution and Pooling as an infinitely strong prior, Variants of the basic functions, efficient algorithms, Random or Unsupervised Features, Neuroscientific Basis for Convolutional Networks.

Recurrent Neural Networks: RNN, Bidirectional RNN, Encoder-Decoder Sequence to sequence architecture, Deep Recurrent Networks, Recursive Neural Networks, The Long Short Term Memory and other Gated RNNs, Optimization for Long Term Dependencies.

Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing, Other Applications.

Text Book:

1. Artificial Intelligence Illuminated - Ben Coppin

2. Deep Learning - Ian Goodfellow, Yoshua Bengio, Aaron Courville

Reference Books:

1. Fundamentals of Deep Learning – Nikhil Budama
2. Neural Networks and Deep Learning – Charu Aggarwal
3. Hands-on Deep Learning Algorithms with Python – Sudharsan Ravichandran

Course Outcomes:

After completion of this course student will be able to

CS1603(A).1 Demonstrate a comprehensive understanding of machine learning and deep learning fundamentals
CS1603(A).2 Illustrate the learning processes and their statistical properties.
CS1603(A).3 Apply various machine learning algorithms and deep learning architectures to solve complex problems.
CS1603(A).4 Develop and implement machine learning models using appropriate programming languages and tools.
CS1603(A).5 Develop and analyze the applications

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1603(A).1	3	1	1	0	2	0	0	0	0	0	0	1	3	1	1
CS1603(A).2	3	2	1	1	2	0	0	0	0	0	0	1	3	1	1
CS1603(A).3	3	2	1	1	2	0	0	0	0	0	0	1	3	1	1
CS1603(A).4	3	2	1	1	2	0	0	0	0	0	0	1	3	1	1
CS1603(A).5	3	2	1	1	2	0	0	0	0	0	0	1	3	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1603(A).1	3	1	1	0	2	0	0	0	0	0	1	3	1	1
CS1603(A).2	3	2	1	1	2	0	0	0	0	0	1	3	1	1
CS1603(A).3	3	2	1	1	2	0	0	0	0	0	1	3	1	1
CS1603(A).4	3	2	1	1	2	0	0	0	0	0	1	3	1	1
CS1603(A).5	3	2	1	1	2	0	0	0	0	0	1	3	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1603(B)**	**Course category**	PE
Course Name	**INTERNET OF THINGS**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Course Objectives:

Aim of the course is

I. To understand about the fundamentals of IoT and its building blocks along with their characteristics
II. To understand the recent application domains of IoT in everyday life
III. To understand the protocols and standards designed for IoT and the current research on it.
IV. To understand the other associated technologies like cloud and fog computing in the domain of IoT

Course Content

Introduction to Internet of Things: Application areas of IoT, Characteristics of IoT, Things in IoT, IoT stack, Enabling technologies, IoT challenges, IoT levels, IoT and cyber physical system, IoT and WSN, Sensors

Sensor networks and Their Interfacing: Sensor interfacing, Types of sensors, controlling sensors, Microcontrollers, ARM, gateway, data storage and historical analysis in the cloud, localization, node mobility, energy efficiency in WSN, Low power devices, energy harvesting, performance trade-off, choosing the right hardware

Protocols for IoT: Messaging protocols, Transport protocols, IPv4, IPv6, URI Cloud for IoT: IoT and cloud, Fog computing, Security in cloud, Edge Computing, Case study MQTT, wifi, Bluetooth, RFID, LoRa, LoRaWAN, communication security.

Applications of deep learning in IoT: Introduction to deep learning, camera-based IoT applications in healthcare, retail, agriculture, Food, Lavatory maintenance, Water quality, Warehouse, Retail, Driver Assistance, Collision impact

Smart and connected devices: Raspberry-pi, Arduino Architecture, Alexa, case studies: smart home and agriculture, Smart cities, transportation, manufacturing, automobile

Text Books:

1. Peter Waher “Learning Internet of Things”
2. S. Misra, C. Roy, and A. Mukherjee, 2020 “Introduction to Industrial Internet of Things and Industry 4.0”, CRC Press.
3. Simone Cirani, Gianluigi Ferrari, Marco Picone, and Luca Veltri, “Internet of Things: Architectures, Protocols and Standards” WILEY.

Reference Books:

1. IoT Based Projects, Rajesh Singh at el, BPB

2. Internet of Things with ARDUINO and BOLT, Ashwin Pajankar, BPB

3. Internet of Things, Vasudevan, Nagrajan and Sundaram, Wiley India

4. IoT Fundamentals, David Hence at el, Cisco Press

Course Outcomes:

After completion of the course, student will be able to

CS1603(B). 1 Understand building blocks of Internet of Things and characteristics

CS1603(B). 2 Realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.

CS1603(B). 3 Use the IoT technologies in practical domains of society.

CS1603(B). 4 Gain knowledge about the state-of-the-art methodologies in IoT application domains.

CS1603(B). 5 Deploy IoT applications to the cloud

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1603(B).1	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1603(B).2	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1603(B).3	3	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1603(B).4	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1603(B).5	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1603(B).1	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1603(B).2	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1603(B).3	3	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1603(B).4	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1603(B).5	2	2	1	0	0	0	0	0	0	0	2	2	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1603(C)**	**Course category**	PE
Course Name	**HIGH PROCESSING COMPUTING**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Course Objective:

Aim of the course is

I. To understand High Performance Computing (HPC) system architectures and various computational models.
II. To learn basics of CUDA programming.
III. To apply parallel execution models and methodologies for parallel programming and parallel applications development.
IV. To design and implement compute intensive applications on HPC platform.

Course Content

Parallel Programming & Computing: Introduction in Era of Computing, Parallel Computing, Multiprocessors and Multicomputer Architectures, Scalar VS Vector Processing, Multivector and Superscalar Machines, Pipelined Processors, SIMD Computers, Conditions of parallelism, Program flow mechanisms, Types of Parallelism – ILP, PLP, LLP, Program Partitioning and scheduling.

Introduction to High Performance Computing: Era of Computing, Scalable Parallel Computer Architectures, towards low-cost computing, Network of Workstations project by Berkeley, Cluster Computing Architecture, Components, Cluster Middleware and SSI, Need of Resource Management and Scheduling, Programming Environments

Cluster Computing: Clustering Models, Clustering Architectures, Clustering Architectures key factors, types of clusters, Mission critical Vs Business Critical Applications, Fault Detection and Masking Algorithms, Check pointing, Heartbeats, Watchdog Timers, Fault recovery through Failover and Failback Concepts

High Speed Networks & Message Passing: Introduction to High-Speed Networks, Lightweight Messaging Systems, Xpress Transport Protocol, Software RAID and Parallel File systems, Load Balancing Over Networks – Algorithms and Applications, Job Scheduling approaches and Resource Management in Cluster

CUDA Programming: Introduction to CUDA architecture for parallel processing, CUDA Parallelism Model, Foundations of Shared Memory, Introduction to CUDA-C, Parallel programming in CUDA-C, Thread Cooperation and Execution Efficiency, Constants memory and events, memory management, CUDA C on multiple GPUs, Hashing and Natural Parallelism, Scheduling and Work Distribution, Atomics, Barriers and Progress, Transactional Memory

Open CL Programming: Introduction to OpenCL, OpenCL Setup, Basic OpenCL, Advanced OpenCL

Shared-memory programming: Introduction to OpenMP, Parallel Programming using OpenMP

Text Books:

1. Rajkumar, High Performance Cluster Computing: Architectures and Systems, Vol. 1 Pearson Education
2. Georg Hager and Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, CRC Press

Reference Books:

1. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill International Editions
2. J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann.
3. A. Silberschatz, P. B. Galvin, G. Gagne, Operating System Concepts, John Wiley.
4. R. E. Bryant and D. R. O'Hallaron, Computer Systems: A Programmer's Perspective, Prentice Hall.

Web Resources:

1. High Performance Computing: https://nptel.ac.in/courses/106/108/106108055/
2. High Performance Computing Architecture: https://nptel.ac.in/courses/106/105/106105033/

Course Outcomes:

After completion of this course student will be able to

CS1603(C).1 Understand High Performance Computing (HPC) system architectures and various computational models.
CS1603(C).2 Learn basics of CUDA programming.
CS1603(C).3 Apply parallel execution models and methodologies for parallel programming and parallel applications development.
CS1603(C).4 Design and implement compute intensive applications on HPC platform.
CS1603(C).5 Understand the concept of Cluster Computing

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1603(C).1	3	2	3	3	3	0	0	0	0	0	0	3	2	1	0
CS1603(C).2	2	2	3	2	2	0	0	0	0	0	0	2	2	1	0
CS1603(C).3	2	3	3	3	2	0	0	0	0	0	0	2	2	1	0
CS1603(C).4	3	3	2	2	2	0	0	0	0	0	0	3	2	1	0
CS1603(C).5	2	2	1	0	0	0	0	0	0	0	0	2	2	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1603(C).1	3	2	3	3	3	0	0	0	0	0	3	2	1	0
CS1603(C).2	2	2	3	2	2	0	0	0	0	0	2	2	1	0
CS1603(C).3	2	3	3	3	2	0	0	0	0	0	2	2	1	0
CS1603(C).4	3	3	2	2	2	0	0	0	0	0	3	2	1	0
CS1603(C).5	2	2	1	0	0	0	0	0	0	0	2	2	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1603(D)**	**Course category**	PE
Course Name	**AUGMENTED AND VIRTUAL REALITY**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Course Objectives:

Aim of the course is

I. Understand the fundamental concepts of AR and VR technologies.

II. Explore hardware and software components used in AR/VR systems.

III. Develop skills to design and implement AR/VR applications.

IV. Analyze challenges and opportunities in AR/VR development.

V. Apply AR/VR concepts to real-world problems through projects.

Course Content

Introduction to AR and VR : Definition and history of Augmented Reality (AR) and Virtual Reality (VR), Differences between AR, VR, and Mixed Reality (MR)nApplications of AR/VR: Gaming, Education, Healthcare, Military, Entertainment Overview of the XR (Extended Reality) ecosystem and market trends Key challenges: Latency, Immersion, User Interaction

Hardware Components: Input Devices: Tracking systems (e.g., 3D position trackers, motion capture), Gesture interfaces (e.g., data gloves, hand tracking), 3D mice and specialized devices

Output Devices: Visual displays (HMDs, stereoscopic screens),Audio systems (spatial audio, 3D sound), Haptic feedback devices, Sensors and Displays: IMUs (Inertial Measurement Units), cameras, depth sensors, Optics and display technologies (e.g., OLED, LCD), Mobile vs. standalone AR/VR systems (e.g., Oculus Quest, Google Cardboard)

Software Development for AR/VR : AR Software: Camera calibration and marker-based AR (e.g., ARToolkit), Markerless tracking (SLAM - Simultaneous Localization and Mapping), Visualization techniques (overlay rendering, occlusion handling), VR Software: ,Rendering pipelines (real-time rendering, lens distortion),Game engines: Unity, Unreal Engine, Godot ,SDKs: Oculus SDK, OpenVR, Google VR, Programming: Basics of C# (Unity), C++ (Unreal), or JavaScript (WebVR), 3D graphics programming (OpenGL, WebGL, GLSL)

3D User Interfaces and Interaction: Principles of 3D UI design, Interaction techniques: Selection and manipulation (e.g., raycasting, grabbing),Navigation (e.g., teleportation, joystick movement) ,User tasks in Virtual Environments (VEs) Evaluating 3D UIs: Usability, ergonomics, and , performance,Presence and immersion: Concepts, measurement, and applications

Advanced Topics and Applications: Geometric and kinematic modeling in VR, Physical and behavioral modeling, AR/VR in specific domains: Medical simulations (e.g., surgical training) Robotics and teleoperation , Real-time tracking advancements, Emerging trends: Cloud-based AR/VR, Haptics and multi-sensory feedback, Social VR and collaborative environments, Health and safety: Cybersickness, ergonomic considerations

Text Books:

1. Understanding Virtual Reality: Interface, Application, and Design by William R. Sherman and Alan B. Craig (Morgan Kaufmann)
2. Developing Virtual Reality Applications by Alan B. Craig, William R. Sherman, and Jeffrey D. Will (Morgan Kaufmann)

Reference Books:

1. 3D User Interfaces: Theory and Practice by Doug A. Bowman et al. (Addison Wesley)
2. Learning Virtual Reality by Tony Parisi (O'Reilly Media)
3. Augmented Reality: Principles and Practice by Dieter Schmalstieg and Tobias Hollerer (Addison-Wesley)

Course Outcomes:

After completion of this course student will be able to

CS1603(D).1 Differentiate between AR and VR systems and their use cases.
CS1603(D).2 Identify and utilize appropriate hardware and software for AR/VR.
CS1603(D).3 Design and develop interactive 3D environments.
CS1603(D).4 Evaluate the usability and effectiveness of AR/VR applications.
CS1603(D).5 Propose innovative solutions using AR/VR technologies.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1603(D).1	3	1	0	1	0	2	1	0	1	0	2	1	1	1	3
CS1603(D).2	2	3	2	3	3	1	0	0	0	0	1	1	3	2	3
CS1603(D).3	2	2	3	1	3	1	1	2	1	2	2	1	3	3	3
CS1603(D).4	1	3	2	2	2	2	1	1	2	1	2	1	2	2	3
CS1603(D).5	2	2	3	3	3	2	2	3	2	3	3	1	3	3	3

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1603(D).1	3	1	0	1	0	2	1	0	1	0	2	1	1	3
CS1603(D).2	2	3	2	3	3	1	0	0	0	0	1	3	2	3
CS1603(D).3	2	2	3	1	3	1	1	2	1	2	2	3	3	3
CS1603(D).4	1	3	2	2	2	2	1	1	2	1	2	2	2	3
CS1603(D).5	2	2	3	3	3	2	2	3	2	3	3	3	3	3

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1604(A)**	**Course category**	PE
Course Name	**COMPUTER VISION**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	01	00	04	15	15	10	60	**2**hr 30 min	00	00	100	04

Course Objectives:

Aim of the course is

I. To review image processing techniques for computer vision.
II. To understand shape and region analysis.
III. To understand Hough Transform and its applications to detect lines, circles, ellipses.
IV. To understand three-dimensional image analysis techniques.
V. To understand motion analysis.

Course Content

Image Processing Foundations: Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.

Shapes And Regions: Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

Hough Transform Line detection: Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

3d Vision and Motion Methods for 3D Vision: projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human

gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

Text book:

1. D. L. Baggio et al., ―Mastering OpenCV with Practical Computer Vision Projects‖, Packt Publishing, 2012.
2. E. R. Davies, ―Computer & Machine Vision‖, Fourth Edition, Academic Press, 2012.
3. Jan Erik Solem, ―Programming Computer Vision with Python: Tools and algorithms for analyzing images‖, O'Reilly Media, 2012.

Reference Books:

1. Mark Nixon and Alberto S. Aquado, ―Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
2. R. Szeliski, ―Computer Vision: Algorithms and Applications‖, Springer 2011.
3. Simon J. D. Prince, ―Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.

Course Outcomes:

After completion of this course student will be able to
CS1604(A).1 Implement fundamental image processing techniques required for computer vision.
CS1604(A).2 Perform shape analysis.
CS1604 (A).3 Implement boundary tracking techniques.
CS1604(A).4 Apply Hough Transform for line, circle, and ellipse detections.
CS1604(A).5 Develop applications using computer vision techniques.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1604(A).1	2	2	2	3	2	0	0	0	0	0	0	2	3	2	1
CS1604(A).2	2	2	3	3	2	0	0	0	0	0	0	1	3	2	1
CS1604(A).3	2	2	2	3	2	0	0	0	0	0	0	0	3	2	1
CS1604(A).4	3	2	2	3	2	0	0	0	0	0	0	0	3	2	1
CS1604(A).5	2	2	2	3	2	0	0	0	0	0	0	1	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1604(A).1	2	2	2	3	2	0	0	0	0	0	2	3	2	1
CS1604(A).2	2	2	3	3	2	0	0	0	0	0	1	3	2	1
CS1604(A).3	2	2	2	3	2	0	0	0	0	0	0	3	2	1
CS1604(A).4	3	2	2	3	2	0	0	0	0	0	0	3	2	1
CS1604(A).5	2	2	2	3	2	0	0	0	0	0	1	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1604(B)**	**Course category**	PE
Course Name	**SOFTWARE PROJECT MANAGEMENT**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	01	00	04	15	15	10	60	**2**hr 30 min	00	00	100	04

Course objectives:

Aim of the course is

I. To understand the Software Project Planning and Evaluation techniques.
II. To plan and manage projects at each stage of the software development life cycle (SDLC).
III. To learn about the activity planning and risk management principles.
IV. To manage software projects and control software deliverables.
V. To develop skills to manage the various phases involved in project management and people management.

Course Content

Project Evaluation and Project Planning

Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolioNManagement – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management –NStepwise Project Planning.

Project Life Cycle and Effort Estimation

Software process and Process Models – Choice of Process models - Rapid Application development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II - a Parametric Productivity Model.

Activity Planning and Risk Management

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules

Project Management and Control

Framework for Management and control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control – Software Configuration Management – Managing contracts – Contract Management.

Staffing In Software Projects

Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham – Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams – Communications genres – Communication plans – Leadership.

Text Book:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

Reference Books:

1. Robert K. Wysocki ―Effective Software Project Management – Wiley Publication, 2011.‖
2. Walker Royce: ―Software Project Management - Addison-Wesley, 1998.‖
3. Gopalaswamy Ramesh, ―Managing Global Software Projects – McGraw Hill Education (India), ‖ Fourteenth Reprint 2013.

Course Outcomes:

After completion of this course student will be able to

CS1604(B).1 Understand Project Management principles while developing software.
CS1604(B).2 Gain extensive knowledge about the basic project management concepts, framework and the process models.
CS1604(B).3 Obtain adequate knowledge about software process models and software effort estimation techniques.
CS1604(B).4 Estimate the risks involved in various project activities.
CS1604(B).5 Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1604(B).1	3	3	3	3	2	1	0	0	0	2	2	2	3	2	3
CS1604(B).2	2	2	3	3	2	1	2	0	0	2	2	1	3	2	3
CS1604(B).3	2	2	2	3	2	1	2	0	0	2	2	0	3	2	2
CS1604(B).4	3	2	2	3	2	0	2	0	0	2	2	0	0	0	0
CS1604(B).5	2	2	2	3	2	0	2	2	3	2	2	1	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1604(B).1	3	3	3	3	2	1	0	0	0	2	2	2	3	2	3
CS1604(B).2	2	2	3	3	2	1	2	0	0	2	2	1	3	2	3
CS1604(B).3	2	2	2	3	2	1	2	0	0	2	2	0	3	2	2
CS1604(B).4	3	2	2	3	2	0	2	0	0	2	2	0	0	0	0
CS1604(B).5	2	2	2	3	2	0	2	2	3	2	2	1	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1604(C)**	**Course category**	PE
Course Name	**DATA WAREHOUSING AND DATA MINING**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	01	00	04	15	15	10	60	**2**hr 30 min	00	00	100	04

Course Objectives:

Aim of the course is

I. To understand the principles of Data warehousing and Data Mining.
II. To be familiar with the Data warehouse architecture and its Implementation.
III. To know the Architecture of a Data Mining system.
IV. To understand the various Data preprocessing Methods.
V. To perform classification and prediction of data.

Course Content

Data Warehousing and Business Analysis: - Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

Data Mining: Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture of A Typical Data Mining Systems- Classification Of Data Mining Systems.
Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.

Classification and Prediction: Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

Cluster Analysis: Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

Text Book:

1. Jiawei Han, Micheline Kamber and Jian Pei"Data Mining Concepts and Techniques", Third Edition, Elsevier, 2011.

Reference Books:

1. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.
2. K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.
3. G. K. Gupta "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.
4. Pang-Ning Tan, Michael Steinbach and Vipin Kumar "Introduction to Data Mining", Pearson Education, 2007.

Course Outcomes:

After completion of this course, student will be able to

CS1604(C).1 Understand the functionality of the various data mining and data warehousing component

CS1604(C).2 Appreciate the strengths and limitations of various data mining and data warehousing models

CS1604(C).3 Explain the analyzing techniques of various data

CS1604(C).4 Describe different methodologies used in data mining and data ware housing.

CS1604(C).5 Compare different approaches of data ware housing and data mining with various technologies.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1604(C).1	2	2	2	1	2	1	0	0	0	1	0	2	3	2	3
CS1604(C).2	2	2	3	1	2	1	2	0	0	1	0	1	3	2	3
CS1604(C).3	2	2	2	1	2	1	2	0	0	1	0	0	3	2	2
CS1604(C).4	3	2	2	1	2	0	2	0	0	1	0	0	0	0	0
CS1604(C).5	2	2	2	1	2	0	2	2	3	1	0	1	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1604(C).1	2	2	2	1	2	1	0	0	0	1	0	2	3	2	3
CS1604(C).2	2	2	3	1	2	1	2	0	0	1	0	1	3	2	3
CS1604(C).3	2	2	2	1	2	1	2	0	0	1	0	0	3	2	2
CS1604(C).4	3	2	2	1	2	0	2	0	0	1	0	0	0	0	0
CS1604(C).5	2	2	2	1	2	0	2	2	3	1	0	1	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1604(D)**	**Course category**	PE
Course Name	**SOCIAL NETWORK ANALYSIS**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	01	00	04	15	15	10	60	**2**hr 30 min	00	00	100	04

Course Objectives:

Aim of the course is

I. To understand the concept of semantic web and related applications.
II. To learn knowledge representation using ontology.
III. To understand human behaviour in social web and related communities.
IV. To learn visualization of social networks.
V. To have access to a variety of descriptive measures for networks and software to calculate them, and have the ability to interpret the results.

Course Content

Introduction: Introduction to Semantic Web: Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Social Network analysis: Development of Social Network Analysis – Key concepts and measures in network analysis – Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities – Web-based networks – Applications of Social Network Analysis.

Modelling, Aggregating and Knowledge Representation: Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modelling and aggregating social network data: State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.

Extraction And Mining Communities in Web Social Networks: Extracting evolution of Web Community from a Series of Web Archive – Detecting communities in social networks – Definition of community – Evaluating communities – Methods for community detection and mining – Applications of community mining algorithms – Tools for detecting communities social network infrastructures and communities – Decentralized online social networks – Multi-Relational characterization of dynamic social network communities.

Predicting Human Behavior and Privacy Issue: Understanding and predicting human behavior for social communities – User data management – Inference and Distribution – Enabling new human experiences – Reality mining – Context – Awareness – Privacy in online social networks – Trust in online environment – Trust models based on subjective logic – Trust network analysis – Trust

transitivity analysis – Combining trust and reputation – Trust derivation based on trust comparisons – Attack spectrum and counter measures.

Visualization And Applications of Social Networks: Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing online social networks, visualizing social networks with matrix-based representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications – Cover networks – Community welfare – Collaboration networks – Co-Citation networks.

Text Book:

1. Peter Mika, ―Social Networks and the Semantic Web, First Edition, Springer 2007.
2. Borko Furht, ―Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010.

Reference Book:

1. Guandong Xu ,Yanchun Zhang and Lin Li,-Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.
2. Dion Goh and Schubert Foo,-Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling, IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, -The Social Semantic Web, Springer, 2009.

Course Outcomes:

After completion of this course, student will be able to

CS1604(D).1 Understand key principles of social network analysis
CS1604(D).2 Design and develop semantic web related applications
CS1604(D).3Represent knowledge using ontology
CS1604(D).4 Predict human behavior in social web and related communities
CS1604(D).5 Visualize social networks

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1604(D).1	2	2	2	1	2	1	0	0	0	1	0	2	3	2	3
CS1604(D).2	2	2	3	1	2	1	2	0	0	1	0	1	3	2	3
CS1604(D).3	2	2	2	1	2	1	2	0	0	1	0	0	3	2	2
CS1604(D).4	3	2	2	1	2	0	2	0	0	1	0	0	0	0	0
CS1604(D).5	2	2	2	1	2	0	2	2	3	1	0	1	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1604(D).1	2	2	2	1	2	1	0	0	0	1	0	2	3	2	3
CS1604(D).2	2	2	3	1	2	1	2	0	0	1	0	1	3	2	3
CS1604(D).3	2	2	2	1	2	1	2	0	0	1	0	0	3	2	2
CS1604(D).4	3	2	2	1	2	0	2	0	0	1	0	0	0	0	0
CS1604(D).5	2	2	2	1	2	0	2	2	3	1	0	1	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1605**	**Course category**	VSE
Course Name	**COMPUTER NETWORK LAB**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	
00	00	02	02	00	00	00	00	--	25	25	50	01

Course Objectives

Aim of the course is

I. Enable students to configure, manage, and troubleshoot network devices such as routers, switches, and computers.
II. Provide practical exposure to protocols like TCP/IP, DNS, DHCP, HTTP, and others in real-world scenarios.
III. Develop critical thinking and problem-solving skills by diagnosing and resolving network-related issues.

Minimum eight experiments shall be performed and the list given is just a guideline. However, course coordinator may prepare their own list

1. Implementation a Bluetooth network with application as transfer of a file from one device to another.
2. Implement an application that creates an alert upon receiving a message.
3. Develop a native application that uses GPS location information
4. Setting up simple networks using tools like Cisco Packet Tracer or Wireshark.
5. Configuring IP addresses and subnets.
6. Simulating routing protocols.
7. Analyzing network traffic and troubleshooting connectivity issues.
8. Basic socket programming (e.g., creating a client-server application).
9. Implement the data link layer framing methods such as character count, character stuffing and bit stuffing
10. Now obtain Routing table art each node using distance vector routing algorithm

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge or skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of Experiments and may be followed by sample questions.

Course Outcomes:

After completion of this course, student will be able to

CS1605.1 Configure and manage network hardware and software effectively

CS1605.2 Analyse network traffic using tools like Wireshark and understand how data moves across a network.

CS1605.3 Competence in identifying and resolving common network issues, such as connectivity problems or misconfigurations.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1605.1	2	2	1	0	0	0	0	0	0	0	0	2	2	1	1
CS1605.2	3	2	1	0	0	0	0	0	0	0	0	2	2	1	1
CS1605.3	2	2	1	0	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1605.1	2	2	1	0	0	0	0	0	0	0	2	2	1	1
CS1605.2	3	2	1	0	0	0	0	0	0	0	2	2	1	1
CS1605.3	2	2	1	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1606(A)**	**Course category**	PE
Course Name	**ADVANCED MACHINE LEARNING AND DEEP LEARNING LAB**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
00	00	02	02	00	0	00	00	--	25	25	50	01

Course Objectives

Aim of the Course is

I. To provide understanding of various Deep Learning algorithms
II. To apply Deep Learning to learn, predict and classify the real-world problems.
III. To understand, learn and design Artificial Neural Networks

Minimum eight experiments shall be performed and the list given is just a guideline. However, course coordinator may prepare their own list

1. a) Design a single unit perceptron for classification of a linearly separable binary dataset without using pre-defined models. Use the Perceptron() from sklearn.
   b) Identify the problem with single unit Perceptron. Classify using Or-, Andand Xor-ed data and analyze the result.
2. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets. Vary the activation functions used and compare the results.
3. Build a Deep Feed Forward ANN by implementing the Backpropagation algorithm and test the same using appropriate data sets. Use the number of hidden layers >=4.
4. To Learn neural networks basics, and build your first network with Python and NumPy.Use the modern deep learning framework PyTorch to build multi-layer neural networks, andanalyze real data.
5. Design and implement an Image classification model to classify a dataset of images using Deep Feed Forward NN. Record the accuracy corresponding to the number of epochs. Use the MNIST, CIFAR-10 datasets or any data set
6. Design and implement a CNN model (with 2 layers of convolutions) to classify multi category image datasets. Record the accuracy corresponding to the number of epochs. Use the MNIST, CIFAR-10 datasets
7. Implement Auto encoders for image denoising on MNIST, Fashion MNIST or any suitable dataset.
8. Implement RNN for sentiment analysis on movie reviews.
9. To Build your own recurrent networks and long short-term memory networks withPyTorch; perform sentiment analysis and use recurrent networks to generate new textfrom TV scripts.

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge or skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of Experiments and may be followed by sample questions.

Course Outcome:

After completion of course students will able to

CS1606(A).1 Understand the basic concepts and techniques of Deep Learning and the need of Deep Learning techniques in real-world problems.

CS1606(A).2 Understand CNN algorithms and the way to evaluate performance of the CNN architectures.

CS1606(A).3 Apply RNN to learn, predict and classify the real-world problems in the paradigms of Deep Learning.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1606(A).1	2	2	1	0	0	0	0	0	0	0	0	2	2	1	1
CS1606(A).2	3	2	1	0	0	0	0	0	0	0	0	2	2	1	1
CS1606(A).3	2	2	1	0	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1606(A).1	2	2	1	0	0	0	0	0	0	0	2	2	1	1
CS1606(A).2	3	2	1	0	0	0	0	0	0	0	2	2	1	1
CS1606(A).3	2	2	1	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1606(B)**								**Course category**			PE
Course Name	**INTERNET OF THINGS LAB**											
Teaching Scheme				Examination Scheme								
				Theory					Practical			Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	
00	00	02	02	00	0	00	00	**00**	25	25	50	01

Course Objective:

Aim of course is

I. To design and build IoT-based prototypes, including devices for sensing, actuation, processing, and communication.
II. To develop skills in IoT hardware and software, including embedded programming and sensor interfacing.
III. To learn about IoT architecture, layering concepts, IoT platforms, wireless sensor networks, and IoT application development.

Minimum eight experiments shall be performed and the list given is just a guideline. However, course coordinator may prepare their own list

1. Installation of Arduino Software (IDE
2. Controlling the Light Emitting Diode (LED) with a push button
3. Interfacing the RGB LED with the Arduino
4. Controlling the LED blink rate with the potentiometer interfacing with Arduino
5. Detection of the light using photo
6. Interfacing of temperature sensor LM35 with Arduino
7. Interfacing Servo Motor with the Arduino
8. Interfacing of the Active Buzzer with Arduino
9. Interfacing of the Relay with Arduino.
10. Building Intrusion Detection System with Arduino and Ultrasonic
11. Directional Control of the DC motor using Arduino

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge or skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of Experiments and may be followed by sample questions.

Course Outcome:

After completion of this course, the students will be able to:

CS1606(B).1 Demonstrate the working of simple IoT task of LED control

CS1606(B).2 Apply IoT concept in simple real-life applications.

CS1606(B).3 Apply IoT concepts in speed control of DC motor

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1606(B).1	2	2	1	0	0	0	0	0	0	0	0	2	2	1	1
CS1606(B).2	3	2	1	0	0	0	0	0	0	0	0	2	2	1	1
CS1606(B).3	2	2	1	0	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1606(B).1	2	2	1	0	0	0	0	0	0	0	2	2	1	1
CS1606(B).2	3	2	1	0	0	0	0	0	0	0	2	2	1	1
CS1606(B).3	2	2	1	0	0	0	0	0	0	0	2	2	1	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1606(C)**	**Course category**	PE
Course Name	**HIGH PROCESSING COMPUTING LAB**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	
00	00	02	02	00	0	00	00	--	25	25	50	01

Course Objective:

Aim of the course is

I. To understand High Performance Computing (HPC) system architectures and various computational models.
II. To learn basics of CUDA programming.
III. To apply parallel execution models and methodologies for parallel programming and parallel applications development.

Minimum eight experiments shall be performed and the list given is just a guideline. However, course coordinator may prepare their own list

1. To analyse the Linux based computer systems using following commands: a. top, b.ps , c. kill, d. cat /proc/cpuinfoe.vmstat
2. To setup SSH password less logins for two or more Linux based machines and execute commands on a remote machine.
3. Write a program in C to multiply two matrices of size 10000 x 10000 each and find it's execution-time using "time" command. Try to run this program on two or more machines having different configurations and compare execution-times obtained in each run. Comment on which factors affect the performance of the program
4. Write a "Hello World" program using OpenMP library also display number of threads created during execution.
5. Write a parallel program to calculate the value of PI/Area of Circle using OpenMP library.
6. Write a parallel program to multiply two matrices using openMP library and compare the execution time with its serial version. Also change the number of threads using omp_set_num_threads() function and analyse how thread count affects the execution time.
7. Install MPICH library and write a "Hello World" program for the same.
8. Write a parallel program to multiply two matrices using MPI library and compare the execution-time with it‘s OpenMP and serial version.
9. Install MPICH on two and more machines and create a MPI cluster. Execute MPI programs on this cluster and check the performance.
10. Implement a program to demonstrate balancing workload on MPI platform

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge or skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of Experiments and may be followed by sample questions.

Course Outcomes:

After completion of this course student will be able to

CS1606(C).1 Learn basics of CUDA programming.
CS1606(C).2 Apply parallel execution models and methodologies for parallel programming and parallel applications development.
CS1606(C).3 Design and implement compute intensive applications on HPC platform.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1606(C).1	3	2	3	3	3	0	0	0	0	0	0	3	2	1	0
CS1606(C).2	2	2	3	2	2	0	0	0	0	0	0	2	2	1	0
CS1606(C).3	2	3	3	3	2	0	0	0	0	0	0	2	2	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1606(C).1	3	2	3	3	3	0	0	0	0	0	3	2	1	0
CS1606(C).2	2	2	3	2	2	0	0	0	0	0	2	2	1	0
CS1606(C).3	2	3	3	3	2	0	0	0	0	0	2	2	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1606(D)**	**Course category**	PE
Course Name	**AUGMENTED AND VIRTUAL REALITY LAB**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
00	00	02	02	00	0	00	00	--	25	25	50	01

Course Objective:

Aim of the course is

I. To explore the concepts of Virtual reality
II. To engage students in AR/VR development, contributing to their skills and knowledge.
III. To Facilitate Complex Concept Understanding

Minimum eight experiments shall be performed and the list given is just a guideline. However, course coordinator may prepare their own list

1. Installation of Unity and Visual Studio, setting up Unity for VR development, understanding documentation of the same.
2. Demonstration of the working of HTC Vive, Google Cardboard, Google Daydream and Samsung gear VR.
3. Develop a scene in Unity that includes:
    i. a cube, plane and sphere, apply transformations on the 3 game objects.
    ii. add a video and audio source.
4. Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the colour, material and texture of each Game object separately in the scene. Write a C# program in visual studio to change the colour and Material/texture of the game objects dynamically on button click.
5. Develop a scene in Unity that includes a sphere and plane . Apply Rigid body component, material and Box collider to the game Objects. Write a C# program to grab and throw the sphere using vr controller.
6. Develop a simple UI(User interface) menu with images, canvas, sprites and button. Write a C# program to interact with UI menu through VR trigger button such that on each successful trigger interaction display a score on scene
7. Create an immersive environment (living room/ battlefield/ tennis court) with only static game objects. 3D game objects can be created using Blender or use available 3D models.
8. Include animation and interaction in the immersive environment created in experiment 7.
9. Case Study Create a virtual environment for any use case. The application must include at least 4 scenes which can be changed dynamically, a good UI, animation and interaction with game objects. (e.g VR application to visit a zoo)

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge or skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of Experiments and may be followed by sample questions.

Course Outcomes:

After completion of this course student will be able to

CS1606(D).1 Create and deploy a VR application.
CS1606(D).2 Understand the physical principles of VR
CS1606(D).3 Identify, examine and develop software that reflects fundamental techniques for the design and deployment of VR experiences.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1606(D).1	3	2	3	3	3	0	0	0	0	0	0	3	2	2	1
CS1606(D).2	2	2	3	2	2	0	0	0	0	0	0	2	2	2	1
CS1606(D).3	2	3	3	3	2	0	0	0	0	0	0	2	2	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1606(D).1	3	2	3	3	3	0	0	0	0	0	3	2	2	1
CS1606(D).2	2	2	3	2	2	0	0	0	0	0	2	2	2	1
CS1606(D).3	2	3	3	3	2	0	0	0	0	0	2	2	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1607**	**Course category**	FP
Course Name	**MINOR PROJECT**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
00	00	04	04	00	00	00	00	--	25	25	50	02

Course Objectives:

Aim of the course is

I. Apply knowledge of Computer Science and Engineering to solve an identified problem

II. Use software development life cycle activities in the project development

III. Develop communication skills, technical writing skills

IV. Develop ability to work in a team.

The project will consist of the work on the topic selected for the project .The project must be done in a group not exceeding three students. The candidates are expected to select the project topic, do the requirements analysis, and carry out the necessary design procedure for the completion of project.

Guidelines for completing the Minor Project: Weekly report of students work after finalization of topic of project should be submitted to the faculty during designated hours meant for Minor Project. It should have following stages:

Stage 1: Finalization of Project Groups and Project Topic.

Stage 2: Presentation on selected topic.

Stage 3: Development of Project

Stage 4: Pre submission changes/improvements suggested by faculty

Stage 5: Final submission of project with Demo, Presentation, Viva and Report.

Course Outcomes:

CS1607.1 Apply the software development cycle with emphasis on different processes - requirements, design, and implementation phases for the development of the identified project work.

CS1607.2 Work as a team and to focus on getting project done within time with each student being held accountable for their part of the project.

CS1607.3 Present technical report of project work

CO – PO – PSO Mapping:

CO															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1607.1	2	2	1	0	1	1	1	1	2	2	1	2	3	3	2
CS1607.2	2	2	1	0	2	1	1	1	2	2	1	2	3	3	2
CS1607.3	3	2	1	0	2	1	1	1	2	0	1	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1607.1	2	2	1	0	0	1	1	1	2	2	2	3	3	2
CS1607.2	2	2	1	0	2	1	1	1	2	2	2	3	3	2
CS1607.3	3	2	1	0	2	1	1	1	2	0	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1608**	**Course category**	MNC
Course Name	**PRIVACY AND SECURITY IN ONLINE SOCIAL-MEDIA**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
02	00	00	02	15	15	20		--	00	00	50	00

Course Objectives:

Aim of the course is

I. To learn about threats like spam, phishing, identity theft, and fraudulent activities on online social media platforms.
II. To understand how data is collected from social networks and the implications for user privacy.
III. To study how information is shared, the risks involved, and best practices to protect personal data.
IV. To learn methods to identify fake accounts, fraudulent entities, and other security threats.

Course Content

Online Social Networks Data collection from social networks Challenges Opportunities, and pitfalls in online social networks, APIs.

Collecting data from Online Social Media

Trust, credibility, and reputations in social systems, Text analysis of social media data – Analyze data and report

Cyber crime on social media – Analyze data and report, Cyber crime on social media – Reading paper and report

Fake news on social media – Analyze data and report, Fake news on social media – Reading paper and report

Privacy on social media – Analyze data and report , Privacy on social media – Reading paper and report

Ethics, bias on online social media – Reading paper and report , Computational social science – Reasoning / Comprehension of ideas

Computational social science on online social media – Reading paper and report

Text Book:

1. Security and Privacy in Social Networks, by Yaniv Altshuler , Yuval Elovici , Armin B. Cremers , Nadav Aharony , Alex Pentland , Springer-Verlag New York Inc.; 2013th edition
2. M. Cross, Social Media Security: Leveraging Social Networking While Mitigating Risk. Waltham, MA, USA: Syngress, 2013.
3. 2. H. A. Oliver, Privacy and Security in the Digital Age: Social Media Security Threats and Vulnerabilities. Independently Published, 2019.

Web Resources:

1. https://study.iitm.ac.in/ds/course_pages/BSCS3007.html
2. https://onlinecourses.nptel.ac.in/noc25_cs79/preview
3. https://onlinecourses.nptel.ac.in/noc23_cs13/preview

Course Outcomes:

After completion of this course, student will be able to

CS1608.1 Understand the importance of privacy, surveillance, and data protection in social media platforms.

CS1608.2 Analyze different types of social media data and report

CS1608.3 Evaluate the privacy settings on various social media platforms

CS1608.4 Apply ethical considerations in social media content management.

CS1608.5 Analyze data of fake news on social media

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8		PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1608.1	2	2	2	1	1	0	2	0		0	0	0	0	3	2	1
CS1608.2	2	2	3	1	1	0	2	0		0	0	0	0	3	2	1
CS1608.3	2	2	2	1	1	0	2	0		0	0	0	0	3	2	1
CS1608.4	3	2	2	1	1	0	2	0		0	0	0	0	3	2	1
CS1608.5	2	2	2	1	1	0	2	0		0	0	0	0	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1608.1	2	2	2	1	1	0	2	0	0	0	0	3	2	1
CS1608.2	2	2	3	1	1	0	2	0	0	0	0	3	2	1
CS1608.3	2	2	2	1	1	0	2	0	0	0	0	3	2	1
CS1608.4	3	2	2	1	1	0	2	0	0	0	0	3	2	1
CS1608.5	2	2	2	1	1	0	2	0	0	0	0	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

ADDITIONAL CRITERIA FOR DOUBLE MINOR (SPECIALIZATION)

Course Code	**CS1641**								**Course category**			MN
Course Name	**NATURAL LANGUAGE PROCESSING**											
Teaching Scheme				Examination Scheme								
				Theory					Practical			Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Course objectives:

Aim of course is

I. To introduce to some of the problems and solutions of NLP and their relation to linguistics and statistics.
II. To understand linguistic phenomena and learn to model them with formal grammars.
III. To understand and carry out proper experimental methodology for training and evaluating empirical NLP systems.
IV. To learn how to manipulate probabilities, construct statistical models over string sand trees 5. To estimate parameters using supervised and unsupervised training methods.
V. To design, implement, and analyze NLP algorithms. Able to design different language modeling Techniques.

Course Content

Natural Language processing (NLP) : Introduction, Applications or Use cases of NLP, Components of NLP, Steps in NLP, Finding the Structure of Words: Words and Their Components, Lexemes, Morphemes, Morphology, Problems in morphological processing, Typology, Morphological Typology, Natural Language Processing with python NLTK package (Text Preprocessing Tasks): Word Tokenization, Sentence Tokenization, Filtering Stop words, Stemming, Tagging Parts of Speech, Lemmatization, Chunking, Chinking, Named Entity Recognition, Term Frequency and Inverse Document Frequency (TF-IDF).

Syntax Analysis: Parsing Natural Language, Tree banks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure: Syntax Analysis using Dependency Graph, Syntax Analysis using Phrase Structure Trees, Parsing Algorithms: Shift Reduce Parsing, Hyper Graphs and Chart Parsing (CYK Parsing), Models for ambiguity Resolution in Parsing: Probabilistic Context Free Grammar, Generative Models, Discriminative models for Parsing.

Language Modeling: Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems.

Semantic Parsing: Introduction, Semantic Interpretation, System Paradigms, Word Sense Systems, Software.

Predicate-Argument Structure, Meaning Representation Systems, Software. Discourse Processing: Cohesion, Reference Resolution, Discourse Cohesion and Structure.

Text Books:

1. Multilingual natural Language Processing Applications: From Theory to Practice–Daniel M.Bikel and Imed Zitouni, Pearson Publication.
2. Speech and Natural Language Processing-Daniel Jurafsky & James H Martin, Pearson Publications.

Reference Books:

1. Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S.Tiwary.

Course Outcomes:

CS1641.1. Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
CS1641.2. Understand and carry out proper experimental methodology for training and evaluating empirical NLP systems.
CS1641.3. Able to manipulate probabilities, construct statistical models over strings and trees
CS1641.4. Will be able to estimate parameters using supervised and unsupervised training methods.
CS1641.5. Able to design, implement, and analyse NLP algorithms. Able to design different language modelling Techniques.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1641.1	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1641.2	3	3	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1641.3	3	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1641.4	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0
CS1641.5	2	2	1	0	0	0	0	0	0	0	0	2	2	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1641.1	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1641.2	3	3	1	0	0	0	0	0	0	0	2	2	0	0
CS1641.3	3	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1641.4	2	2	1	0	0	0	0	0	0	0	2	2	0	0
CS1641.5	2	2	1	0	0	0	0	0	0	0	2	2	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

ADDITIONAL CRITERIA FOR DOUBLE MINOR (SPECIALIZATION)

Course Code	**CS1642**	**Course category**	MN
Course Name	**AFFECTIVE COMPUTING**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
03	00	00	03	15	15	10	60	**2**hr 30 min	00	00	100	03

Course Objectives:

Aim of course is

I. To understand the fundamental concepts of affective computing and its role in human-computer interaction.
II. To learn various models of emotions and how they can be computationally represented.
III. To explore techniques for recognizing emotions from facial expressions, speech, text, and physiological signals.
IV. To study multimodal emotion recognition and its applications in AI-driven systems.
V. To analyze the ethical, legal, and social implications of affective computing in real-world scenarios.

Course Content

Introduction of Affective Computing: Definition and scope of Affective Computing, Importance in Human-Computer Interaction (HCL), Theories of Emotion

Theories and Models: Promise of Affective Computing, Appraisal Models, Emotions in Interpersonal Life, Social Signal Processing, Affect and Machines in the Media

Affect Detection and Generation: Speech in Affective Computing, Affect Detection in Texts, Affective Brain-Computer Inferences, Facial Expressions of Emotions for Virtual Characters, Expressing Emotion through Posture and Gesture, Emotional Speech Synthesis

Methodologies and Databases: Ethical Issues, Affect Elicitation, Crowdsourcing Techniques, Emotion Markup Language, Machine Learning for Affective Computing

Applications of Affective Computing: Feeling, Thinking and Computing with Affect-Aware Learning Technologies, Emotions in Games, Affect in Human-Robot Interaction

Text Books:

1. R. W. Picard, Affective Computing. Cambridge, MA: MIT Press, 1997.
2. R. A. Calvo, S. D'Mello, J. Gratch, and A. Kappas, The Oxford Handbook of Affective Computing. Oxford, U.K.: Oxford University Press, 2015.

References Books:

1. M. Soegaard and R. F. Dam, Eds., The Encyclopedia of Human-Computer Interaction, 2nd ed. Aarhus, Denmark: Interaction Design Foundation, 2013.

2. J. Preece, H. Sharp, and Y. Rogers, Interaction Design: Beyond Human-Computer Interaction, 5th ed. Hoboken, NJ: Wiley, 2019.

Course Outcomes:

After completing this course, students will be able to:

CS1642.1 To understand the fundamentals, key concepts, history, and significance of affective computing
CS1642.2 To understand psychological theories of emotions and how they can be modeled for computational systems.
CS1642.3 To develop algorithms and techniques for recognizing emotions from facial expressions, voice, text, and physiological signals.
CS1642.4 To implement and analyze multimodal approaches that integrate different affective signals.
CS1642.5 To apply affective computing techniques in real-world applications such as healthcare, education, gaming, and human-robot interaction.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1642.1	3	2	1	1	0	0	0	0	0	0	0	2	2	1	0
CS1642.2	3	3	1	1	0	0	0	0	0	0	0	2	2	1	0
CS1642.3	3	2	1	1	0	0	0	0	0	0	0	2	2	1	0
CS1642.4	2	2	1	1	0	0	0	0	0	0	0	2	2	1	0
CS1642.5	2	2	1	1	0	0	0	0	0	0	0	2	2	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1642.1	3	2	1	1	0	0	0	0	0	0	0	2	2	1	0
CS1642.2	3	3	1	1	0	0	0	0	0	0	0	2	2	1	0
CS1642.3	3	2	1	1	0	0	0	0	0	0	0	2	2	1	0
CS1642.4	2	2	1	1	0	0	0	0	0	0	0	2	2	1	0
CS1642.5	2	2	1	1	0	0	0	0	0	0	0	2	2	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

EXIT CRITERIA FOR B. VOC.

Course Code	**CS1611**	**Course category**	EX
Course Name	**USER – CENTRIC MOBILE COMPUTING**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	
00	00	00	00	00	0	00	00	**00**	50	00	50	04

Course Objectives:

Aim of course is

I. To learn the mobile computing tools and software for implementation.
II. To understand the security algorithms in mobile networks
III. To learn security concepts

Minimum eight experiments shall be performed and the list given is just a guideline. However, course coordinator may prepare their own list

1. Implementation a Bluetooth network with application as transfer of a file from one device to another.
2. To implement a basic function of Code Division Multiple Access (CDMA). 3 Implementation of GSM security algorithms (A3/A5/A8)
3. To setup & configuration of Wireless Access Point (AP). Analyse the Wi-Fi communication range in the presence of the access point (AP) and the base station (BS). Consider BS and AP are static. Find out the maximum distance to which two way communications is possible. Try multiple iterations by adjusting its distance in the code and test it.
4. Study of security tools
5. Develop an application that uses GUI components.
6. Write an application that draws basic graphical primitives on the screen.
7. Develop an application that makes use of database.
8. Develop a native application that uses GPS location information.
9. Implement an application that creates an alert upon receiving a message.
10. Implementation of income tax/loan EMI calculator and deploy the same on real devices (Implementation of any real time application)

Course Outcome

After completion of course students will able to

CS1611.1 Develop and demonstrate mobile applications using various tools

CS1611.2 Articulate the knowledge of GSM, CDMA & Bluetooth technologies and demonstrate it

CS1611.3 demonstrate simulation and compare the performance of Wireless LAN

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1611.1	2	2	2	3	2	0	2	0	2	2	2	2	3	3	2
CS1611.2	2	2	3	3	2	0	2	0	0	2	2	1	3	3	2
CS1611.3	2	2	2	3	2	0	2	0	0	2	2	0	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1611.1	2	2	1	0	0	0	0	2	2	1	2	3	3	2
CS1611.2	2	2	1	0	2	0	0	2	2	1	2	3	3	2
CS1611.3	3	2	1	0	2	0	0	2	0	1	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3-Strongly Correlated

Course Code	**CS1612**	**Course category**	EX
Course Name	**Ethical Hacking Lab**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
00	00	00	00	00	0	00	00	--	50	00	50	04

Course Objectives:

Aim of course is

I. To understand basics of ethical hacking
II. To understand the concept of DNS spoofing and firewall
III. To Demonstrate knowledge of ethical hacking to perform live attacks

Minimum eight experiments shall be performed and the list given is just a guideline. However, course coordinator may prepare their own list

1. To study the basic concept of Internet, Networking and Hacking
2. To study and Implementation of information Gathering, Google Hacking and Windows Security
3. To study and Implementation of SQL injection Attacks
4. To study and Implementation of Man in Middle Attacks
5. To study and Implementation of Phishing, Trojan & Viruses Attacks
6. To study and Implementation of Session hijacking & Cookie grabbing.
7. To study and Implementation of various Social Network Attacks, Call & SMS Spoofing
8. To study and Implementation of DNS Spoofing
9. To study and Implementation of Firewalls & Keyloggers

Text Books:

1. Certified Ethical Hacker Michael Gregg, Pearson IT Certification
2. Hacking the Hacker, Roger Grimes, Wiley
3. Learn Ethical Hacking from Scratch: Your stepping stone to penetration testing Zaid Sabih by Packt Publishing Ltd.

References

1. Ethical Hacking and Penetration Testing Guide Rafay Baloch by CRC Press
2. https://nptel.ac.in/courses/106/105/106105217/

Course Outcome

After completion of course students will able to

CS1612.1 Understand the different ethical hacking techniques, Social Network Attacks
CS1612.2 Discover the vulnerabilities, loophole on web server and system
CS1612.3 Apply the knowledge of ethical hacking to perform live attacks

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1612.1	2	2	2	3	2	0	2	0	2	2	2	2	3	3	2
CS1612.2	2	2	3	3	2	0	2	0	0	2	2	1	3	3	2
CS1612.3	2	2	2	3	2	0	2	0	0	2	2	0	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1612.1	2	2	1	0	0	0	0	2	2	1	2	3	3	2
CS1612.2	2	2	1	0	2	0	0	2	2	1	2	3	3	2
CS1612.3	3	2	1	0	2	0	0	2	0	1	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1613**	**Course category**	EX
Course Name	**INTERNSHIP/ TECHNICAL PROJECT**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
00	00	00	00	00	0	00	00	--	100	00	100	08

Course Objectives:

Aim of course is

I. To collect information on novel and latest development in core and allied area of the subject.
II. To encourage the process of independent thinking
III. To implement innovative ideas for social benefit
IV. To develop the ability to describe, interpret and analyse technical issues
V. To help the students to critically evaluate their own work

A) INTERSHIP PROJECT:

The aim of Industry Internship Project is to closely work with industry to apply theoretical knowledge in a real-world context providing real industrial project enabling learning focused on the application knowledge. This gives a student an opportunity to make their first traces in the industrial reality and start building a personal network, an important prerequisite for a successful industry career.

The purpose of the INDUSTRY INTERSHIP PROJECT to solve real industrial problems by following established engineering methods, working in teams, and effectively communicating with various stakeholders.

The students can work in group decided by the department as per availability of Faculty. The individual students can also undertake the Industry Institute Project subject to availability of Industry Mentor/Guide. Students/Group select the industry which is ready to provide INDUSTRY INTERSHIP PROJECT through oral/written communication. Once selected the student group has to visit the industry/stay as per need. The institute will not provide any assistance in Travel and Stay.

B) TECHNICAL PROJECT:

The project will consist of the work on the topic selected for the project. The project must be done in a group not exceeding three students. The candidates are expected to select the project topic, do the requirements analysis, and carry out the necessary design procedure for the completion of project.

Guidelines for completing the Technical Project:

It should have following stages:

Stage 1: Finalization of Project Topic.
Stage 2: Presentation on selected topic.
Stage 3: Development of Project
Stage 4: Pre submission changes/improvements suggested by faculty
Stage 5: Final submission of project with Demo, Presentation, Viva and Report.

Course Outcomes:

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

CS1613.1 Undertake problem identification, formulation and solution.
CS1613.2 Design engineering solutions to complex problems utilizing a systems approach.
CS1613.3 Demonstrate the knowledge, skills and attitudes of a professional engineer.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1613.1	2	2	1	0	1	1	1	1	2	2	1	2	3	3	2
CS1613.2	2	2	1	0	2	1	1	1	2	2	1	2	3	3	2
CS1613.3	3	2	1	0	2	1	1	1	2	0	1	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1613.1	2	2	1	0	0	1	1	1	2	2	2	3	3	2
CS1613.2	2	2	1	0	2	1	1	1	2	2	2	3	3	2
CS1613.3	3	2	1	0	2	1	1	1	2	0	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

ADDITIONAL CRITERIA FOR HONORS

Course Code	**CS1521**	**Course category**	PEH
Course Name	**PARALLEL COMPUTER ARCHITECTURE**		

Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE		
				15	15	10	60		00	00	100	03

Course Objectives:
Aim of the course is

I. Understand the fundamental principles of parallel computing
II. Learn about the hardware and software challenges of parallel computing
III. Learn about parallel programming tools and how to use them
IV. Learn how to effectively utilize parallel computing systems in real world.

Course Content

Parallel Computer Architecture: Introduction to Parallel Computer Architecture, Evolution of Processor Architecture, Moore's Law and Multi-core, Evaluating Performance, Shared Memory Multiprocessor.

Single Thread Execution: Pipeline and Hazards, Instruction Issue Algorithm, Virtual Memory and Cache-Virtual Memory, TLB and caches, Cache Hierarchy and Memory level Parallelism.

Parallel Computers: Communication Architecture, Design issues in Parallel Computers, Parallel Programming-Steps in writing Parallel Programming, Parallelizing a sequential program. Performance Issues: Load Balancing and Domain Decomposition, Locality and Communication Optimization.

Shared Memory Multiprocessor: Multiprocessor Organization and Cache Coherence, Sequential Consistency and Cache Coherence protocols, Performance of Coherence Protocols.

Synchronization: Introduction to Synchronization, Synchronization mechanisms Scaling Locking primitives, Software Distributed Shared Memory Multiprocessor, Interconnection Network, Routing Algorithms, Network Topologies and Properties, Buses, Crossbar and Multistage Switches, Software Multithreading.

Text Book:

1. Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, 2nd Edition, Addison Wesley, 2003.

Reference Books:

1. The Sourcebook of Parallel Computing, Jack Dongarra, Geoffrey Fox,Ken Kennedy, Linda Torczon, William Gropp, 1st Edition , Berkeley Publication,2003.

2. Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes,F. T. Leighton, 1st Edition, Morgan Kaufmann Publishers, CA 1992.

3. Analysis and Design of Parallel Algorithms, Laxmivarahn and Dahl, 1st Edition, McGraw Hill. 1990

Course Outcomes:

After completion of this course student will be able to

CS1521.1 Demonstrate how parallel architecture interacts with applications and technology.
CS1521.2 Discuss memory organization and mapping techniques
CS1521.3 To evaluate design decisions based on application requirements and performance with the use of Parallel Computing
CS1521.4 Develop an understanding of basic concepts associated with parallel computing environments.
CS1521.5 Enhance a processor's ability to exploit instruction-level parallelism.

CO – PO – PSO Mapping:

CO	PO 1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1521.1	3	3	3	1	2	2	0	0	0	0	0	2	3	2	1
CS1521.2	3	3	3	1	2	1	0	0	0	0	0	2	3	2	1
CS1521.3	3	3	2	1	2	2	0	0	0	0	0	2	3	2	1
CS1521.4	3	2	2	1	2	2	0	0	0	0	0	2	3	2	1
CS1521.5	3	2	1	1	1	1	0	0	0	0	0	1	2	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: CO – PO – PSO Mapping: As per new format from 2025-26

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1521.1	3	3	3	1	2	2	0	0	0	0	2	3	2	1
CS1521.2	3	3	3	1	2	1	0	0	0	0	2	3	2	1
CS1521.3	3	3	2	1	2	2	0	0	0	0	2	3	2	1
CS1521.4	3	2	2	1	2	2	0	0	0	0	2	3	2	1
CS1521.5	3	2	1	1	1	1	0	0	0	0	1	2	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	CS1522							Course category			PEH
Course Name	ENTERPRISE RECOURSE PLANNING										
Teaching Scheme				Examination Scheme							Credits
				Theory					Practical		
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total
				15	15	10	60				100	03

Course Objectives:
Aim of the course is

I. To provide a contemporary and forward-looking on the theory and practice of Enterprise Resource Planning Technology.
II. To focus on a strong emphasis upon practice of theory in Applications and Practicaloriented approach.
III. To train the students to develop the basic understanding of how ERP enriches the business organizations in achieving a multidimensional growth.
IV. To aim at preparing the students technological competitive and make them ready to self-upgrade with the higher technical skills

Course Content

Introduction Overview of enterprise systems – Evolution - Risks and benefits - Fundamental technology - warehouse management.

ERP Solutions and Functional Modules Overview of ERP software solutions, BPR, Project management, Functional modules Organisational data, master data and document flow.

ERP Implementation Planning Evaluation and selection of ERP systems - Implementation life cycle – ERP implementation, Methodology and Frame work- Training – Data Migration. People Organization in implementation- Consultants, Vendors and Employees.

Post Implementation Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors of ERP Implementation.

Emerging Trends on ERP Extended ERP systems and ERP add-ons -CRM, SCM, Business analytics - Future trends in ERP systems-web enabled, Wireless technologies, cloud computing and Augmented reality.

Text Books:
1. Alexis Leon, ERP demystified, second Edition Tata McGraw-Hill, 2008.

2. Simha R. Magal , Jeffrey Word, Integrated Business processes with ERP systems, John Wiley & Sons, 2012.

Reference Book:

1. Jagan Nathan Vaman, ERP in Practice, Tata McGraw-Hill, 2008

2. Alexis Leon, Enterprise Resource Planning, second edition, Tata McGraw-Hill, 2008.

3. Mahadeo Jaiswal and Ganesh Vanapalli, ERP Macmillan India, 2009

4. Vinod Kumar Grag and N.K. Venkitakrishnan, ERP- Concepts and Practice, Prentice Hall of India, 2006.

5. Summer, ERP, Pearson Education, 2008.

Course Outcomes:

After completion of this course student will be able to

CS1522.1 Knowledge of risk and benefits associated with Enterprise Resource Planning.
CS1522.2. Knowledge or ERP solutions and functional modules
CS1522.3 Exposure to the implementation environment
CS1522.4 Understanding of post implementational impact and maintenance of ERP
CS1522.5 Knowledge of emerging trends on ERP

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2	PSO3
CS1522.1	3	3	3	1	1	0	0	0	0	0	0	2	3	2	1
CS1522.2	3	3	3	1	1	0	0	0	0	0	0	2	3	2	1
CS1522.3	3	3	2	1	1	0	0	0	0	0	0	2	3	2	1
CS1522.4	3	2	2	1	1	0	0	0	0	1	0	2	3	2	1
CS1522.5	3	2	2	1	1	0	1	0	0	1	0	2	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: CO – PO – PSO Mapping: As per new format from 2025-26

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1522.1	3	3	3	1	1	0	0	0	0	0	2	3	2	1
CS1522.2	3	3	3	1	1	0	0	0	0	0	2	3	2	1
CS1522.3	3	3	2	1	1	0	0	0	0	0	2	3	2	1
CS1522.4	3	2	2	1	1	0	0	0	0	1	2	3	2	1
CS1522.5	3	2	2	1	1	0	1	0	0	1	2	3	2	1

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1621**	**Course category**	PEH
Course Name	**FUNDAMENTALS OF INFORMATION RETRIEVAL**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
				15	15	10	60				100	03

Course Objectives:
Aim of the course is

I. To understand the basics of information retrieval with pertinence to modeling, query operations and indexing
II. To get an understanding of machine learning techniques for text classification and clustering.
III. To understand the various applications of information retrieval giving emphasis to multimedia IR, web search
IV. To understand the concepts of digital libraries

Course Content

Introduction: Motivation , Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open-Source IR Systems–History of Web Search – Web Characteristics– The impact of the web on IR —IR Versus Web Search–Components of a Search engine

Modeling: Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing

Indexing: Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency

Classification And Clustering: Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering – Matrix decompositions and latent semantic indexing – Fusion and Meta learning 41

Searching The Web: Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries

Text Books:
1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, ―Introduction to Information Retrieval‖, Cambridge University Press, First South Asian Edition, 2008.

2. Implementing and Evaluating Search Engines‖, The MIT Press, Cambridge, Massachusetts London, England, 2010

Reference Book:

1. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, ―Modern Information Retrieval: The concepts and Technology behind Search‖ (ACM Press Books), Second Edition, 2011.

2. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, ―Information Retrieval

Course Outcomes:

After completion of this course student will be able to

CS1621.1 Build an Information Retrieval system using the available tools.

CS1621.2 Identify and design the various components of an Information Retrieval system.

CS1621.3 Apply machine learning techniques to text classification and clustering which is

Used for efficient Information Retrieval.

CS1621.4 Design an efficient search engine and analyze the Web content structure.

CS1621.5 Apply Searching web structure for information retrieval.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1621.1	3	3	3	1	1	0	0	0	0	0	0	2	3	2	1
CS1621.2	3	3	3	1	1	0	0	0	0	0	0	2	3	2	1
CS1621.3	3	3	2	1	1	0	0	0	0	0	0	2	3	2	1
CS1621.4	3	2	2	1	1	0	0	0	0	1	0	2	3	2	1
CS1621.5	3	2	2	1	1	0	1	0	0	1	0	2	3	2	1

0-Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: CO – PO – PSO Mapping: As per new format from 2025-26

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1621.1	3	3	3	1	1	0	0	0	0	0	2	3	2	1
CS1621.2	3	3	3	1	1	0	0	0	0	0	2	3	2	1
CS1621.3	3	3	2	1	1	0	0	0	0	0	2	3	2	1
CS1621.4	3	2	2	1	1	0	0	0	0	1	2	3	2	1
CS1621.5	3	2	2	1	1	0	1	0	0	1	2	3	2	1

0-Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1622**							**Course category**			PEH
Course Name	**FUNCTIONAL AND LOGICAL PROGRAMMING**										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
				15	15	10	60				100	03

Course Objectives:

Aim of the course is

I. To learn various prevalent programming paradigms.
II. To compare programming paradigms in terms of the variant of approaches used, the thought process, representation of computation, etc in the context of various problem-solving tasks.
III. To understand and implement the functional and logical programming paradigm in real time applications.
IV. To learn the fundamentals of each paradigm and how a difference in the paradigms affects programs.

Course Content

Introduction Different paradigms of programming: Imperative - Object Oriented - Functional - Logic Imperative and Object-oriented Programming - Role of Types - Static and Dynamic Type Checking - Scope rules.

Grouping Data and operations: Information Hiding and Abstract Data Types, Objects, Inheritance, Polymorphism, Templates.

Functional Programming: Expressions and Lists, Evaluation, types, type systems, values and operations, function declarations, lexical scope, lists and programming with lists, polymorphic functions, higher order and Curried functions, abstract data types.

Logic Programming: Review of predicate logic, clausal-form logic, logic as a programming language, Unification algorithm.

Abstract interpreter for logic programs: Semantics of logic programs, Programming in Prolog.

Text Book:

Programming Languages: Concepts and Constructs; 2nd Edition, Ravi Sethi, Pearson Education Asia, 1996.

Reference Book:

1- Programming Languages: Design and Implementation (4th Edition), by Terrence W. Pratt, Marvin V. Zelkowitz, Pearson, 2000.
2- Programming Language Pragmatics, Third Edition, by Michael L. Scott, Morgan Kaufmann, 2009.

Course Outcomes:

After completion of this course student will be able to

CS 1622.1 Use the concepts and terms used to describe languages that support the imperative, functional, object-oriented, and logic programming paradigms.
CS 1622.2 write programs in functional and logic programming languages
CS 1622.3 Critically evaluate what paradigm and language are best suited for a new problem.
CS 1622.4 Develop applications based on functional and logical programming or the blend of boths per the requirements.
CS1622.5 Write and use higher-order functions.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1622.1	3	3	3	1	2	2	0	0	0	0	0	2	3	2	1
CS1622.2	3	3	3	1	2	1	0	0	0	0	0	2	3	2	1
CS1622.3	3	3	2	1	2	2	0	0	0	0	0	2	3	2	1
CS1622.4	3	2	2	1	2	2	0	0	0	0	0	2	3	2	1
CS1622.5	3	1	3	0	1	1	0	0	0	0	0	1	3	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: CO – PO – PSO Mapping: As per new format from 2025-26

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1622.1	3	3	3	1	2	2	0	0	0	0	2	3	2	1
CS1622.2	3	3	3	1	2	1	0	0	0	0	2	3	2	1
CS1622.3	3	3	2	1	2	2	0	0	0	0	2	3	2	1
CS1622.4	3	2	2	1	2	2	0	0	0	0	2	3	2	1
CS1622.5	3	1	3	0	1	1	0	0	0	0	1	3	1	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

ADDITIONAL CRITERIA FOR HONORS WITH RESEARCH

Course Code	**CS1531**	**Course category**	PER
Course Name	**RESEARCH PROJECT STAGE 1**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	Credits
00	00	08	08						100		100	04

Course Objectives:

Aim of course is

I. To collect information on novel and latest development in core and allied area of the subject.
II. To encourage the process of independent thinking
III. To implement innovative ideas for social benefit
IV. To develop the ability to describe, interpret and analyze technical issues
V. To help the students to critically evaluate their own work

The purpose of this course is to introduce students to the process of conducting research projects/work. The students will be helped to conceptualize, design and execute a research project by a teacher guide.

Stage-1:

Student have to complete online course related to topic/perquisite course prescribed by the assigned guide/BOS

OR

The focus will be on discussions and analysis of assignments. Learners will be encouraged to read books and research journals related to his/her research topic (literature review, theory and hypotheses etc) and share them in the seminars and evaluated by two member Team of department and same to be enter in ICA format.

Course Outcomes:

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

CS1531.1 Demonstrate a sound technical knowledge of their selected project topic.
CS1531.2 Undertake problem identification, formulation and solution.
CSU1531.5 Demonstrate the knowledge, skills and attitudes of a professional engineer.

CO – PO – PSO Mapping:

CO																
	PO1	PO2	PO3	PO4	PO5		PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1531.1	2	2	1	0	1		1	1	1	2	2	1	2	3	3	2
CS1531.2	2	2	1	0	2		1	1	1	2	2	1	2	3	3	2
CS1531.3	3	2	1	0	2		1	1	1	2	0	1	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1531.1	2	2	1	0	0	1	1	1	2	2	2	3	3	2
CS1531.2	2	2	1	0	2	1	1	1	2	2	2	3	3	2
CS1531.3	3	2	1	0	2	1	1	1	2	0	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**CS1631**	**Course category**	PER
Course Name	**RESEARCH PROJECT STAGE 2**		

Teaching Scheme				Examination Scheme								
				Theory					Practical			Credits
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE	Total	
00	00	12	12						100	100	200	06

Course Objectives:

Aim of course is

I. To collect information on novel and latest development in core and allied area of the subject.
II. To encourage the process of independent thinking
III. To implement innovative ideas for social benefit
IV. To develop the ability to describe, interpret and analyze technical issues
V. To help the students to critically evaluate their own work

Sample steps:

- Research design/Methodology
- Sampling tool of data collection
- Data processing and analysis
- Plan of research report
- Publish review paper in peer view journal/Scopus indexed journal and seminar on it
- The faculty supervisor will assess the method and procedures used by the learner
- At end evaluated by two member Team of department

Research project (stage-2): Internal assessment of research project (complete work) is to be carried out by two members panel of examiners wherein guide should be one of the members of the panel, for 100 marks. The external assessment of research project work is to be carried out by panel of examiners consisting of internal (guide) and external examiner for 100 marks. Candidate shall present the entire work on research project, followed by viva-voce. Last date of submission of research project will be the end of the semester.

Course Outcomes:

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

CS1631.1 Design engineering solutions to complex problems utilizing a systems approach.
CS1631.2 Conduct an engineering project.
CS1632.3 Demonstrate the knowledge, skills and attitudes of a professional engineer.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS1631.1	2	2	1	0	1	1	1	1	2	2	1	2	3	3	2
CS1631.2	2	2	1	0	2	1	1	1	2	2	1	2	3	3	2
CS1631.3	3	2	1	0	2	1	1	1	2	0	1	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping: As per the new NBA Guidelines w.e.f. 01/01/2025

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CS1631.1	2	2	1	0	0	1	1	1	2	2	2	3	3	2
CS1631.2	2	2	1	0	2	1	1	1	2	2	2	3	3	2
CS1631.3	3	2	1	0	2	1	1	1	2	0	2	3	3	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated