Bharatiya Vidya Bhavan's

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai)

Computer Science and Engineering [AIML]

Effective from Academic Year 2021-22

Board of Studies Approval : 8th May, 2023

Academic Council Approval : 3rd February, 2023

Dr. D.R. Kalbande	**Dr. Y.S. Rao**	**Dr. B.N. Chaudhari**
HOD, CSE	**Dean Academics**	**Principal**

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[Knowledge is Nectar]

Liberal, Pi-Model of Engineering Education @ SPIT

(Department of Computer Science & Engineering[AIML])

CURRICULUM SCHEME FOR UNDERGRADUATE ACADEMIC PROGRAM (COMPUTER SCIENCE & ENGG[AIML]) AT SPIT

(For 2021-2025 Batch)

Salient Features

- 160-Credit **Liberal** Engineering Education Model.
- A strong **program core of 15 courses** and **6 baskets of program electives** to ensure the breadth and depth in a chosen domain of studies. Program electives are arranged either to grow in a specified vertical or have diversified exposure.
- **Full semester industry internship to interested students.**
- Aggressive model of **"Learning-by-doing". (**Engagement in classroom and laboratory sessions is 50:50)
- Special tracks for **"Minor"** Certification for interested learners, ensuring significant awareness of additional discipline leading to multiple specializations
- **Unique, multi-track model of "Honors" Certification,** for well performers for enhanced depth in the domain of study.
- Special sequel of optional **industry floated "SCOPE"** courses (Skilled Certification for Outcome-based Professional Education) for interested learners, ensuring high technical skills, in the diversified cutting-edge technologies.
- **First-of-its-kind-in-education** blend to Engineering Curriculum. **"ABLL@LLC"®** (Activity Based Liberal Learning about **Life, Literature and Culture**) in **Six** semesters, ensuring **all dimensional holistic growth** of the learner.

This curriculum aims at development of an **all-rounded** personality. It follows **holistic** approach of education, ensures strong science, mathematics foundation and program core, develops expertise in domain vertical though sequel of electives, ensures significant exposure of additional discipline through "Minor" program, collaborates outside world for the imparting relevant skills through "SCOPE" courses, challenges good learners through "Honors" evaluation, and systematically develops soft skills, and social, physical, mental, spiritual personality through carefully articulated **Liberal Learning** and **Humanities** sequels. Thus, offers a unique, liberal **"Pi-Model"** of Engineering Education.

Program Core

At SPIT, every undergraduate program consists of **Twelve Core Courses** referred to as Program **Core**. Several academic models from reputed institutions in the country and outside the country are studied in articulating this Program Core, to make curriculum Globally Competitive. All courses in this Core have laboratory components to augment the learning. Each program core course has an additional optional component of "Contents beyond the curriculum" which is carefully designed to ensure additional 15-20 hours engagement of the learners. The learner thus is nurtured towards the "Self-Learning" and "lifelong learning "which are essential attributes of 21st Century learner.

Program Electives

At SPIT, every program has **Six baskets** of Program Electives, each basket having a minimum 3 courses. This enables learners to grow in a **domain-specialization** or **domain-vertical**. For example, learners can graduate with B.Tech Electronics with a vertical in "Embedded Systems" or "VLSI" or "Signal Processing". Or a learner can graduate with B.Tech Computer Engineering with specialization in "Security" or "ML & AI" or "Computer Networking" or "Data Science". At the same time, a learner can increase her bandwidth by opting for elective courses which are general in nature, not pointing out towards a specific vertical.

Open Electives

Every undergraduate program has three baskets of open electives. This is planned to give exposure to interdisciplinary and cross disciplinary domains. The courses in these baskets are planned both at department and institute level. Students can choose any combination of these courses (not floated by the parent department) to get familiar with other domains of learning. One of these open electives must be chosen from Basic science courses or Engineering Science courses. **This unique approach of offering additional basic science or engineering science elective at senior level aims at appreciating the importance of other domains of learning.**

Humanities and Social Science Electives

National Education policy 2019 has aptly spelled out the necessity of Humanities in Professional Education. It quotes, "A holistic and liberal education as described so beautifully in India's past is indeed what is needed for the education of India in the future to truly lead the country into the 21st century and the fourth industrial revolution. Even engineering schools such as the IITs must move towards a more liberal education integrating arts and humanities". Every program at SPIT has three baskets of humanities. Learners are encouraged to take diversified courses in the field of languages, law, history, economics, management, finance etc.

SCOPE Certification

This unique sequel is designed to systematically develop skills required for an industrial sector. SPIT is partnering with various industries to offer the high-end skills required for a specific industrial sector. Well performing students can stretch the envelope and add a new dimension to their Professional Personality by earning this certification. There are multiple tracks for SCOPE certification. Each track is offered with partnership with a reputed institution or industry. These tracks are jointly designed by SPIT and partnering industry. Each track has four courses (modules). Each module/course is of 2-3 credits including laboratory

components for most of the tracks. These tracks are also open for outside learners, leading to Certificate Program in a chosen domain.

Minor Certification

This additional and optional certification provides an opportunity to learners to develop the learners in the additional domain of interests. It broadens the education and ensures the multi-disciplinary development which is an essential attribute of 21st century engineers. However, this is optional. Well performing students can stretch the envelope and add a new dimension to their Professional Personality. Each track for this minor certification is offered either by SPIT or with partnership with other reputed institutions. Each track has four courses (modules). Each course is of 3 credits and laboratory components if any. These tracks are also open for outside learners, leading to a Certificate Program of 12 credits in a chosen domain.

Honors Certification

While the Minor and SCOPE certifications aim at adding an additional professional dimension to the professional personality of the learners, the Honors certification gives opportunity to well performing learners to drive deep in the chosen field of study. Multiple plans/ways are planned to encourage learners to earn this certification which essentially excite the learners to push an envelope and go extra/deep in the chosen area of the study. Students earn additional stars (*) as shown in Table 1 during their program. If at the time of graduation a student earns total **TWELVE** stars, she is conferred with “Honors” certification.

<table>
<tr><th colspan="3">Table 1: Additional “STAR” Earning leading to “Honors” certification</th></tr>
<tr><th>Activity</th><th>Definition of “STAR”</th><th>Maximum Limit</th></tr>
<tr><td>Earning top grade in any of the 15 courses which constitute the program core.</td><td>Top Grade: Full STAR
Next GRADE: Half STAR</td><td>8 STARs</td></tr>
<tr><td>Enrolling additional “Honors” Course in fourth year.</td><td>Top Grade: 3 STARs
Next GRADE: 2 STARs
Next GRADE: 1 STAR</td><td>6 STARs</td></tr>
<tr><td>Success in the GATE examination</td><td><table><tr><th>Percentile Score</th><th>STARs Earned</th></tr><tr><td>Above 99</td><td>6</td></tr><tr><td>Above 98</td><td>5</td></tr><tr><td>Above 95</td><td>4</td></tr><tr><td>Above 90</td><td>4</td></tr><tr><td>Valid score</td><td>2</td></tr></table></td><td>8 STARs</td></tr>
<tr><td>Research Publication</td><td>Journal* :2- 6 STARs
SPIT supported Patent : 3 STARs</td><td>8 STARs</td></tr>
<tr><td>Completion of PG level on line course from IITs available on NPTEL</td><td><table><tr><th>Percentile Score</th><th>STARs Earned</th></tr><tr><td>Above 95</td><td>3</td></tr><tr><td>Above 90</td><td>2</td></tr><tr><td>Above 80</td><td>1</td></tr></table></td><td>6 STARs</td></tr>
<tr><td>#Winning prestigious technical competitions at National level</td><td><table><tr><th>Rank</th><th>STARs Earned</th></tr><tr><td>1</td><td>4</td></tr><tr><td>2</td><td>3</td></tr><tr><td>3</td><td>2</td></tr></table></td><td>6 STARTs</td></tr>
</table>

**Enrolling for optional “Special Honors Paper” in Semester 3, 4, and 5.	Above 70% : 3 STARs Above 60%: 2 STARs Above 50%: 1 STAR	8 STARs

*In identified journals only. No. of STARs to be decided by the Institute Committee.

#In identified events by the institute

**This special paper will cover all core courses in the semester and its difficulty level will be higher than the normal end semester examination paper. The question paper will be of GATE standard.

Activity Based Liberal Learning about Life, Literature and Culture (ABLL@LLC)

"Education will fail ignominiously in its objective if it manufactures only a robot and called him an economic man stressing the adjective economic and forgetting the substantive man. A university cannot afford to ignore the cultural aspects of education whatever studies it specializes in. Science is a means, not an end. Whereas culture is an end in itself. Even though you may ultimately become a scientist, a doctor, or an engineer, you must, while in college, absorb fundamental values which will make you a man of culture..."

Kulpati Dr. K. M. Munshi

How aptly our visionary founder has given direction to the education. His wisdom towards education inspires, encourages us to experiment in the field of education, to make it as relevant and helpful to the society as possible. Mahatma Gandhi once quoted, *"By education I mean an all-round drawing out of the best in man; body, mind and spirit."*

Recently announced National Policy on Education-2019, reconfirms this and profoundly stresses the need of liberalizing the higher education including professional education. It quotes, *"Higher education must develop good, well-rounded and creative individuals, with intellectual curiosity, spirit of service and a strong ethical compass".* Moving towards a more liberal undergraduate education is one of the most important features of this policy. It narrates, *"The needs of the 21st century require that liberal broad-based multidisciplinary education become the basis for all higher education. This will help develop well-rounded individuals that possess critical 21st century capacities in fields across arts, humanities, sciences, social sciences, and professional, technical, and vocational crafts, an ethic of social engagement, and rigorous specialization in a chosen field or fields. Such a liberal education would be, in the long run, the approach across all undergraduate programs, including those in professional, technical, and vocational disciplines. Imaginative and flexible curricular structures will enable creative combinations of disciplines for students to study, thus demolishing currently prevalent rigid boundaries and creating new possibilities for lifelong learning. The notion of 'knowledge of many arts'- i.e. what is called 'liberal arts' in modern times – must be brought back to Indian education, as it is exactly the kind of education that will be required for the 21st century."*

We at Bhavan's SPIT, make sincere attempt to blend engineering education appropriately with arts, humanities, crafts, ethic of personal and social engagement to ensure holistic development of the learner. We have carefully designed liberal learning courses covering Life, Literature, and Culture (LLC @ LLC) for all the semesters of the program. Learner concurrently studies these courses. These courses broadly fall under LLC. Further each module has multiple courses of 1 or 2 credits (An engagement of 35-40 hours is expected to earn one credit). Every learner at SPIT is expected to take 1 such course on LLC every semester. We strongly believe that these EIGHT liberal learning modules will help us to appropriately blend the professional education as envisaged by the National Policy Makers.

SUGGESTED LIST OF COURSES (INDICATIVE ONLY)

Open Electives I and II

OEXXX	IoT and I^2oT
OEXXX	Cloud Computing
OEXXX	Augmented and Virtual Reality
OEXXX	3D Printing
OEXXX	Industrial Automation
OEXXX	Artificial Intelligence and Machine learning
OEXXX	Cyber Security & Digital Forensics
OEXXX	Block Chain Technology
OEXXX	E-Mobility
OEXXX	Smart Grid
	courses floated as **Open elective** by the **Departments**
OEXXX	Consumer Electronics
OEXXX	Robotic & Machine Vision
OEXXX	Data Structures and Algorithms
OEXXX	Information and Network Security
OEXXX	Human Machine Interaction
OEXXX	Software Engineering
OEXXX	Database Management Systems
OEXXX	Internet Technology
OEXXX	Data Analytics
	Any other 12 weeks Course approved by the Dean Academics and Principal

Open Elective III-Basic Science Electives

OEMA1	Advanced Statistics
OEAS1	Biology for Engineers-Part II
OEAS2	Climate and Earth Science
OEMA2	Engineering Optimization
OEAS3	Environment and Sustainability
OEAS4	Semiconductor Optoelectronics
OEMA3	Numerical Methods for Engineers
OEXXX	Any other Course approved by the Dean Academics and Principal

Open Elective III-Engineering Science Electives

OEXXX	Thermal & Fluid Engineering
OEXXX	Manufacturing Processes
OEXXX	Electric Drives
OEXXX	Engineering Materials
OEXXX	Data Structures
OEXXX	Algorithms
OEXXX	Sensors and Actuators
OEXXX	Communication Engineering
OEXXX	Any other Course approved by the Dean Academics and Principal

Open Elective IV: Humanities and Management Related

OEHXX	Management Principles
OEHXX	Research Methodology
OEHXX	IPR and Patents
OEHXX	Law for Engineers
OEHXX	Organizational Behavior
OEHXX	Leadership, Innovation and Entrepreneurship
OEHXX	Project Management
OEHXX	Finance for Engineers
OEHXX	Any course approved by Dean Academics and Principal

Humanities and Social Sciences Electives

Special Tracks

	HSSE-I		**HSSE-II**		**HSSE-III**
HSE11	Law for Engineers-I	HSE12	Law for Engineers-II	HSE13	Law for Engineers-III
HSE21	Finance for Engineers-I	HSE22	Finance for Engineers-II	HSE23	Finance for Engineers-III
HSE31	Psychology-I	HSE32	Psychology-II	HSE33	Psychology-III
HSE41	Economics-I	HSE42	Economics-II	HSE43	Economics-III
HSE51	Ancient India	HSE52	Medieval India	HSE53	Modern India
HSE6X1	Language X-I	HSE6X2	Language X-II	HSE6X3	Language X-III

Common Pool for HSSE-I, II and III (May be studied on MOOC's)

HSEC01	Film Appreciation	HSEC02	Universal Values
HSEC03	Game Theory	HSEC04	Human Behavior
HSEC05	Ecology and Society	HSEC06	Energy Economics and Policies
HSEC07	Drama Appreciation	HSEC08	Political Ideologies
HSEC09	Justice	HSECXX	Any other Approved Course
HSEXX	Any course from HSSE-I		

ABLL@LLC

- **Students are required to earn 6 credits through 8 semesters.**
- **If student is not able attendance/performance requirements, he/she will be dropped from the course and will have to enroll in additional course in the next semester.**
- **A student can enroll in maximum 2 courses in a semester.**

Table 2: SEVA

SEVA (Social Empowerment through Various Activities)			
Module	**Title**	**Courses**	**CODE**
SEVA-I	**SOCHO BHARAT**	Study of Green & White Revolutions in India	SV10
		Government Missions [Study of any 2]	SV11
		Study of India's top 2 problems	SV12
		Study of World's top 2problems	SV13
		How Government Works? [Study of one department of the Central/ State Government]	SV14
		Study of one of the identified Books	SV15
		Study of two National policies	SV16
		Any other activity approved by Dean Academics	SV1X
Module	**Title**	**Courses**	**CODE**
SEVA-II	**SWACCH BHARAT**	River/Beach/Mohalla/School/Campus/Govt offices Cleaning	SV20
		Waste Segregation Surveys	SV21
		NSS camp in village for a week	SV22
		Medical camps in schools	SV23
		First Aid training for a week	SV24
		Surveys and Estimation for roof top solar	SV25
		NCC participation	SV26
		Any activity approved by Dean Academics	SV2X
Module	**Title**	**Courses**	**CODE**
SEVA-III	**SHIKSHIT** BHARAT	Mentoring of School Children	SV30
		Digital Literacy for yielders	SV31
		Value addition for deprived schools	SV32
		Mentoring junior (first year) students at SPIT	SV33
		Teaching Assistantship at SPIT	SV34
		Development of learning material for schools/ITIs	SV35
		Participation in "Teach-for-India" movement	SV36

		Any other activity approved by Dean Academics	SV3X
Module	**Title**	**Courses**	**CODE**
SEVA-IV	**SAMRUDDHA** BHARAT	Great Grass Root Innovations	SV40
		Innovation and Creativity	SV41
		Critical Thinking and Problem solving	SV42
		Team work and collaboration	SV43
		Leadership & Entrepreneurship	SV44
		Design Thinking	SV45
		Study of one of the identified books	SV47
		Work with START-UP at SPIT	SV48
		Any other activity approved by Dean Academics	SV49

Table 3: SATVA

SATVA (Self Accomplishment Through Various Activities)			
Module	**Title**	**Courses**	**CODE**
SATVA-I	**SANSKARIT** BHARAT	Values and Ethos of Bhavan	ST10
		Essence of Indian traditional knowledge	ST11
		Philosophy of religion (any)	ST12
		Study of Life Management / Kindle Life / Life Empowerment and Enriching Program or any other book cited.	ST13
		Study of any of GREAT sons of INDIA [Ex. Gandhi, Ambedkar, Phule, Savarkar, Sardar Patel, Nehru, Shivaji, JRD Tata etc]	ST14
		Any other course approved by Dean Academics	ST1X
SATVA-II	**SAKSHAM** BHARAT	Target based Physical Exercise for example-Running [Test 5 kms in a stretch], Swimming [Test 1 km in a stretch], Walking [Test 20 kms in a stretch], Trekking [7days], Cycling	ST20
		Sports – Representation of Institute at University level/Inter college level and above in ANY sport	ST21
		Participation in National Tech Fest, AICTE-Hackathon, Industry floated global and national competitions, Robocon, BAHA etc	ST22
		Yoga vidya -I	ST23
		Any other activity approved by Dean Academics	ST2X
SATVA-III	**SUNDER** BHARAT	Institute representation in prestigious cultural fests/competitions	ST30
		Dance [Bharatanatyam /Kathak /Lavani /Western Dance]. Only for beginners	ST31
		Learning musical instruments [Any type]. Only for beginners.	ST32
		Film Appreciation/Dramatics/Seeing through Painting	ST33
		Making short film/Photography	ST34
		Yogvidya-II	ST35

		Any other activity approved by Dean Academics and DOSA	ST3X
SATVA-IV	**SURAKSHIT** BHARAT	Food that Heals	ST40
		Personal and Social Hygiene	ST41
		Intellectual Property Rights	ST42
		Etiquette and Conversational skills	ST43
		Basics of Ayurveda	ST44
		Study of one of the identified Books	ST45
		Any other course approved by Dean Academics	ST4X

Indicative SCOPE Certification

Minor/SCOPE Certification

Minor/SCOPE Track	Partner Institute if any.	Module	C
Computer Engineering	SPIT	Data Structures and Algorithms	MN11
		Database Management Systems	MN12
		Machine Learning	MN13
		Internet Technology	MN14
Industrial IoT	SPIT	Application Specific System Design	MN21
		Embedded “C” Programming & Real-time Software Development	MN22
		Software Design for Discrete time Control Algorithms	MN23
		Industrial Internet of Things (IIoT) System design and Applications	MN24
Management	S.P. Jain Institute of Management and Research [SPJIMR]	Finance and cost Management	MN31
		Supply Chain Management, operations and project Management	MN32
		IT for Business, HR and Organization	MN33
		Marketing	MN34
User Experience (UX) Design	ImaginXP, Pune	UX Design & Digitalization	SC11
		Empathy & Its Tools	SC12
		User Research & Its Application	SC13
		Design Thinking & Its Applications	SC14

CURRICULUM SCHEME FOR UNDERGRADUATE ACADEMIC PROGRAM AT SPIT

2021-ITERATION: B.Tech. (Computer Science and Engineering [AIML])

Nomenclature of the Courses

BSC	Basic Science Course	**PC**	Program Core
BSE	Basic Science Elective	**PE**	Program Elective
ESC	Engineering Science Course	**MLC**	Mandatory Learning Course
ESE	Engineering Science Elective	**SCOPE**	Skill Certification for Outcome based Professional Education
SBC	Skilled Based Course	**OE**	Open Elective
ABL-SATVA	Self- Accomplishment Through Various Activities	**HSSE**	Humanities and Social Science Elective
ABL-SEVA	Social Empowerment Through Various Activities		

Abbreviations

L	Lecture Hour	O	Other Work (Self Study)
T	Tutorial Hour	E	Total Engagement in Hours
P	Laboratory Hour	C	Credit Assigned

Sem I									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	BSC	MA101	Engineering Calculus	3	1	0	8	12	4
2	BSC	AS102	Engineering Chemistry	2	0	2	3	07	3
3	BSC	AS103	Biology for Engineers	2	0	0	3	05	2
4	ESC	AS105	Engineering Mechanics	2	0	2	4	08	3
5	ESC	CS101	Problem solving using Imperative Programming	2	0	4	4	10	4
6	ESC	EC101	Digital Systems and Microprocessors	3	0	2	5	10	4
7	SBC	AS107	Communication Skills	1	0	2	2	05	2
TOTAL				**15**	**1**	**12**	**29**	**57**	**22**

Sem II									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	BSC	MA102	Differential Equations and Complex Analysis	3	1	0	8	12	4
2	BSC	AS101	Engineering Physics	2	1	2	5	10	4
3	ESC	AS104	Engineering Graphics	1	0	2	2	05	2
4	ESC	ET101	Basic Electrical Engineering	3	0	2	6	11	4
5	ESC	CS102	Problem Solving using OOP	2	0	4	4	10	4
6	SBC	AS106	Skill Shop	0	0	2	0	02	1
7	ABL	SV1X/ST1X	SEVA-I or SATVA-I	0	0	0	2	02	1
TOTAL				**11**	**2**	**12**	**27**	**52**	**20**

Sem III									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	BSC	MA203	Probability and Statistics	3	0	0	5	08	3
1	BSC*	MA202	Foundation of Mathematics-I*	2	1	0	6	09	3
2	PC	CS201	Discrete Structures and Graph Theory	3	0	0	4	07	3
3	PC	CS202	Data Structures	3	0	2	5	10	4
4	PC	CS203	Computer Architecture and Organization	3	0	2	4	09	4
5	PC	CS204	Database Management Systems	3	0	2	5	10	4
6	ABL	SVXX/ STXX	SEVA II or III /SATVA II or III	0	0	0	3	03	1
7	HSSE	HSEX1	HSS-I	2	0	0	3	05	2
TOTAL				**17**	**0**	**6**	**29**	**52**	**21**

**Only for Lateral Entry Students*

Sem IV									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	BSC	MA201	Linear Algebra	2	0	2	5	09	3
1	BSC*	MA204	Foundation of Mathematics-II	3	0	0	6	09	3
2	PC	CS205	Design and Analysis of Algorithms	3	0	2	5	10	4
3	PC	CS206	Operating Systems	3	0	2	5	10	4
4	PC	CS207	Computer Communications and Networks	3	0	2	5	10	4
5	SBC	CS208	Mini Project-I	0	0	0	4	04	2
6	ABL	SVXX/STXX	SEVA II or III /SATVA II or III	0	0	0	3	01	1
7	HSSE	HSEX2	HSS-II	2	0	0	3	05	2
8	SBC	AS201	Professional Communication Skills	1	0	2	2	05	2
9	S/M	SCX1/MNX1	SCOPE-I/Minor-I						3
TOTAL				**14**	**0**	**10**	**32**	**54**	**22**

**Only for Lateral Entry Students*

Summer term for HSC students									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	MLC	AS202	Constitution of India	1	0	0	05	06	NC

Summer term (For Lateral Entry Students)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	BSC	MA201	Linear Algebra	2	0	2	5	09	3
1	BSC	MA203	Probability and Statistics	3	0	0	5	08	3
2	MLC	AS202	Constitution of India				06	06	NC

Sem V									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	PC	AI301	Theory of Computation	3	0	0	6	9	3
2	PC	AI302	Fundamentals of signal & Image Processing	3	0	2	5	10	4
3	PC	AI 303	Fundamentals of AI	3	0	2	5	10	4
4	PC	AI304	Neural Network & Fuzzy Logic	3	0	2	5	10	4
5	SBC	AI 305	Internet Technology Lab	1	0	2	5	08	2
7	HSSE	HSEX3	HSS-III	2	0	0	3	05	2
8	ABL	SVXX/STXX	SEVA II or III /SATVA II or III	0	0	0	3	3	1
9	S/M	SCX2/MNX2	SCOPE-II/Minor-II						3
TOTAL				**15**	**0**	**8**	**29**	**52**	**20**

Sem VI (Cat 1- For Students who have **NOT** preferred semester long internship)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	OE	OEXXX	Open Elective-I	2	0	2	4	8	3
2	PC	AI306	Distributed Computing	3	0	2	5	10	4
3	PC	AI307	Machine Learning	3	0	2	5	10	4
4	PE	AI3X1	PE-I	2	0	2	4	8	3
5	PE	AI3X2	PE-II	2	0	2	4	8	3
6	SBC	AI308	Main Project-Stage-I	0	0	0	8	8	3
7	ABL	SVXX/STXX	SEVA II or III /SATVA II or III	0	0	0	3	3	1
8	S/M	SCX3/MNX3	SCOPE-III/Minor-III						3
TOTAL				**12**	**0**	**10**	**33**	**55**	**21**

Sem VI (Cat 2-For Students who have preferred semester long internship)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	PE*	AI3X1	PE-I	2	0	2	4	8	3
2	PE*	AI3X2	PE-II	2	0	2	4	8	3
4	SBC	AI309	Research Internship	0	0	0	40	40	15
5	S/M*	SCXX/MNXX	SCOPE-III/Minor-III						3
TOTAL				**4**	**0**	**4**	**48**	**56**	**21**
*To be completed online mode or allied courses from MOOCs									

Sem VII									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	PC	AI401	Natural Language Processing	2	0	2	4	8	3
1	OE	OEXXX	OE-II	2	0	2	4	8	3
2	OE	OEXXX	OE-III*	2	0	2	4	8	3
3	PE	AI4X3	PE-III	2	0	2	4	8	3
4	PE	AI4X4	PE-IV	2	0	2	4	8	3
5	SBC	AI402	Main Project Stage-I/ Main Project Stage- II	0	0	0	6	6	3
6	ABL	SVXX/STXX	SEVA-IV/SATVA-IV	0	0	0	4	4	1
7	S/M/H	SCX4/MNX4 /HOXX	SCOPE-IV/Minor-IV/Honors-I						3
TOTAL									**19**
*OE-III must be from Basic Science Elective or Engineering Science Elective									

Sem VIII (Option A: Cat1/Cat2)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	PC	AI403	Human Machine Interaction	2	0	2	4	8	3
2	OE *	OEHXX	OE-IV	2	0	2	4	8	3
3	PE	AI4X5	PE-V	2	0	2	4	8	3
4	PE	AI4X6	PE-VI	2	0	2	4	8	3
5	SBC	AI404	Main Project Stage-II	0	0	0	6	6	3
6	H	HOXX	Honors-II						3
	*May be taken from MOOCs, Essentially Humanities, Management related								
TOTAL									**15**

Sem VIII (Option B: Only for Cat1 students)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	SBC	AI405	Industry Internship/ Major Project	0	0	0	36	36	15
3	H	HOXX	Honors-II						3
	*May be taken from MOOCs, Essentially Humanities, Management related								
TOTAL								**40**	**15**

The 'Major Project' in the "Option B" must be completed from an institute of national interest. If a student wishes to complete a Major Project under the mentorship of SPIT faculty, approval from the Dean Academics and Research is required.

Table 2 - PROGRAM ELECTIVES

Sem	**VI**		**VII**		**VIII**	
Program Elective/ Thread	Program Elective-I	Program Elective-II	Program Elective- III	Program Elective- IV	Program Elective- V	Program Elective- VI
Industry-driven AIML	1T11: Computer Vision	1T12: Big Data Analytics	1T13: Deep Learning	1T14: Data Warehousing and Business Intelligence	1T11,1T12, 1T21,1T22, 1X,1Y, 2T11,2T12, 2T21,2T22 2T31,2T32 2X, 2Y	1T11,1T12, 1T21,1T22, 1X,1Y, 2T11,2T12, 2T21,2T22 2T31,2T32 2X, 2Y
Emerging AIML	1T21: Explainable Artificial Intelligence	1T22: Blockchain Technology	1T23: Data-Driven Internet of Things	1T24: AI for Healthcare Analytics		
General	1T11,1T12, 1T21,1T22, 1X,1Y, 2T11,2T12, 2T21,2T22 2T31,2T32 2X, 2Y	1T11,1T12, 1T21,1T22, 1X,1Y, 2T11,2T12, 2T21,2T22 2T31,2T32 2X, 2Y	1T13,1T14, 1T23,1T24 1P,1Q, 2T13,2T14, 2T23,2T24 2T33,2T34 2P, 2Q	1T13,1T14, 1T23,1T24 1P,1Q, 2T13,2T14, 2T23,2T24 2T33,2T34 2P, 2Q		

In this case the Computer Science & Engineering Department has to offer 1T11,1T12,1T21,1T22, 1X,1Y, 1T13,1T23,1T14,1T24, 1P,1Q i.e. 12 Courses to take care of 6 Elective Baskets, where,
1X: Software Engineering
1Y: User Experience Design
1P: Information System and Security
1Q: Advanced Algorithm and Complexity

Semester-I

Sem I									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	BSC	MA101	Engineering Calculus	3	1	0	8	12	4
2	BSC	AS102	Engineering Chemistry	2	0	2	3	07	3
3	BSC	AS103	Biology for Engineers	2	0	0	3	05	2
4	ESC	AS105	Engineering Mechanics	2	0	2	4	08	3
5	ESC	CS101	Problem solving using Imperative Programming	2	0	4	4	10	4
6	ESC	EC101	Digital Systems and Microprocessors	3	0	2	5	10	4
7	SBC	AS107	Communication Skills	1	0	2	2	05	2
TOTAL				**15**	**1**	**12**	**29**	**57**	**22**

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Engineering Calculus	3	1	0	8	12	3	1	0	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
MA101		Theory	100		100		200			400
		Laboratory	--		--		--			--

Pre-requisite Course Codes, if any.	
Course Objective: To develop mathematical skills for solving engineering problems.	
Course Outcomes (CO):*At the End of the course students will be able to:-*	
MA101.1	Differentiate a function partially.
MA101.2	Find extreme values of a given function.
MA101.3	Find the nth order derivative of a given function.
MA101.4	Expand a given function as a power series.
MA101.5	Calculate the value of integrals in one variable using different techniques and solve multiple integrals in various coordinate systems.
MA101.6	Calculate Area using double integration.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MA101.1	3											
MA101.2	3	1										
MA101.3	2											
MA101.4	2											
MA101.5	3											
MA101.6	2	1										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	**PEO2**	**PEO3**	**PEO4**	**PSO1**	**PSO2**
MA101.1						
MA101.2						
MA101.3						
MA101.4						
MA101.5						
MA101.6						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember ✓	**Understand** ✓	**Apply** ✓	**Analyze**	**Evaluate**	**Create**

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref**	**Hrs.**
1	**Title**	**Partial Differentiation**	1,2,3	**10**
	1.1	Partial derivatives of first and higher order. Partial derivatives of composite functions.		4
	1.2	Euler's theorem for homogeneous functions with two and three independent variables, deductions from Euler's theorem.		3
	1.3	Application of partial derivatives: i) Local Maxima and Minima of functions of two variables. ii) Lagrange's Method of undetermined multipliers.		3
2	**Title**	**Successive Differentiation and Series**	1,2,3	**10**
	2.1	Successive Differentiation: Proofs of nth derivatives of standard functions. Use of De Moivre's theorem and partial fractions to calculate nth derivatives of given functions.		3
	2.2	Leibnitz's Theorem on nth derivative of product of two functions		2
	2.3	Infinite series: 1) Maclaurian's series (without proof) and derivation of series of some standard functions using Maclaurin series. Expansion of functions in powers of x by using i) Standard series method ii) Method of differentiation and integration. 2) Taylor's series and applications.		5
3	**Title**	**Integral Calculus (one variable)**	1,2,3	**8**
	3.1	Gamma functions: properties of gamma functions and integrals reducible to gamma functions.		2
	3.2	Beta functions: properties, relation between Beta and Gamma functions, integrals reducible to Beta functions, Duplication formula.		4
	3.3	Differentiation under Integral sign: differentiating integrals with constant limits of integration for one parameter.		2
4	**Title**	**Integral Calculus (multi variable)**	1,2,3	**14**
	4.1	Tracing of curves. Sketching standard solids (Spheres, Ellipsoids, Cylinders, Cones, Tetrahedrons, planes)		2
	4.2	Double Integration: definition and evaluation. Evaluate by changing the order of integration and by changing to polar form.		7
	4.3	Application of double integral to finding area of given regions.		2
	4.4	Triple integration: definition and evaluation (Cartesian and cylindrical coordinates).		3

5	**Self Study**	1.1 Partial differentiation of implicit functions. 2.3 Series by method of Substitution 3.2 Proof of Duplication Formula 3.3 Differentiation under Integral sign using two parameters and variable limits 4.1 Finding lengths of curves in Cartesian and polar form	1,2,3	**08**
Total				**42***

***Total of 42 hours does not include self study hours.**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Higher Engineering Mathematics	Forty Fourth	Dr. B. S. Grewal	Khanna Publications	2020

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Advanced Engineering Mathematics	Twenty Eighth	H.K Das	S. Chand	2014
2	Advanced Engineering Mathematics	Tenth	Erwin Kreysizg	John Wiley & Sons	2011
3	Advanced Engineering Mathematics	Fourth	Jain and Iyengar	Narosa Publications	2014

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
BS	Engineering Chemistry	2	0	2	3	7	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AS102		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pte-requisite Course Codes, if any.	HSC level Chemistry
Course Objective: To provide necessary background of Chemistry suited for relevant areas of engineering	
Course Outcomes (CO):*At the End of the course students will be able to*	
AS102.1	Relate thermodynamic principles and laws to crucial applications like heat engines (Understanding)
AS102.2	Summarize properties and applications of different materials like polymers, ceramics, alloys , nanomaterials, conductors and insulators (Understanding)
AS102.3	Identify methods for corrosion control based on knowledge of different types of corrosion and factors affecting rate of corrosion (Application)
AS102.4	Compare different sources of energy like conventional fossil fuels, alternative fuels, batteries and fuel cells with respect to availability, working principles, constitution, efficiency of performance and environmental impact (Understanding)
AS102.5	Apply knowledge of electro-chemistry and green chemistry in the interest of public health and environment (Application)
AS102.6	Make use of analytical techniques (complexometric and iodometric titrations) and instruments (pHmeter, conductometer and Orsats's Apparatus) for various purposes like hardness parameters of water, composition of alloys etc.
AS102.7	Estimate key properties of lubricants like flash point, viscosity and acid value
AS102.8	Estimate molecular weight of polymer

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS102.1	1											
AS102.2	1											
AS102.3	2											
AS102.4	2						1					
AS102.5	1						2					
AS102.6				1								
AS102.7				1								
AS102.8				1								

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2
AS102.1						
AS102.2						
AS102.3						
AS102.4						
AS102.5						
AS102.6						
AS102.7						
AS102.8						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Thermodynamics**		**4**
	1.1	Introduction, Terminology, Concepts of Internal Energy and Thermodynamic equilibrium, Zeroth and First Law of Thermodynamics, Implications and Limitations of First law	1,3	
	1.2	Concept of Enthalpy, Joule Thomson Effect, Carnot's Cycle, Carnot's theorem and related numericals, Second Law of Thermodynamics	1,3	
	1.3	Applications of thermodynamic principles to the working of refrigerator and air conditioner	1,3	
2	**Title**	**Polymers**		**3**
	2.1	Introduction, Effect of heat on polymers : Glass transition temperature and melting with significance;	1,2,3	
	2.2	Conducting polymers, Liquid crystal polymers, Engineering Polymers	1,2,3	
3	**Title**	**Corrosion**		**5**
	3.1	Introduction, Dry corrosion (i) Due to oxygen (ii) Due to other gases	1,2	
	3.2	Electrochemical corrosion and mechanism, Galvanic, differential aeration corrosion, Significance of galvanic series for corrosion phenomenon	1,2	
	3.3	Factors affecting rate of corrosion (i)Position in galvanic series, (ii) relative areas of anode and cathode, (iii) conductance of medium	1,2	
	3.4	Methods to decrease the rate of corrosion : Material selection, Proper designing, Cathodic protection- i) Sacrificial anodic protection ii) Impressed current method, Metallic coatings, Cathodic and anodic coatings (Galvanization and Tinning : principle and application only)	1,2	
4	**Title**	**Energy Sciences**		**5**
	4.1	Definition and classification of fuels, Calorific value : Definition, Gross or Higher calorific value & Net or lower calorific value, Dulong's formula & numerical for calculations of Gross and Net calorific values.	1,2	
	4.2	Knocking, Octane number, Cetane number, Antiknock agents, unleaded petrol	1,2	

	4.3	Combustion- Calculations for requirement of only oxygen and air (by weight and by volume only) for given solid & gaseous fuels.	1,2	
	4.4	Disadvantages of fossil fuels, Alternative (Green) Fuels : Power alcohol , Biomass, Biogas, Bio diesel, Natural Gas and CNG (Description, Utility, advantages and disadvantages)	1,2	
5	**Title**	**Batteries and Battery Technology**		**4**
	5.1	Introduction, Important terms, Nickel-Hydrogen(metal hydride), Rechargeable Lithium ion batteries	1,2	
	5.2	Reserve Batteries, Fuel cells, characteristics, description, construction and working of Hydrogen-oxygen fuel cells, Types of fuel cells (in brief)	1,2	
	5.3	Electrochemical sensors : Working principle, construction and applications	1,2	
6	**Title**	**Green Chemistry**		
	6.1	12 principles of green chemistry with examples, numericals on Atom Economy, Green Solvents (Water, Supercritical Fluids),	1,2	**3**
7	**Title**	**Engineering Materials**		
	7.1	Eutectic mixtures and soft solders, Advanced Ceramic materials and cermets : magnetic, electronic and electrical applications Carbon nanomaterials : Fullerenes and Carbon nanotubes, Structure, Properties and applications	1,2,3	**4**
	7.2	Insulators, Semiconductors and Superconductors : Thermal and electrical insulating materials and important engineering applications, Stoichiometric, defect and controlled valency semiconductors.	1,2,3	
	7.3	Superconductors, perovskite structure and 1:2:3 compound YBa2Cu3O7-y, properties and applications	1,2,3	
8	**Self Study**	1. Supramolecular polymers and their applications 2. Anodic Protection as a corrosion control strategy 3. Current research and advances in fuel cells 4. Commercial applications of superconducting materials 5. Tops down vs bottoms up approach to nanotechnology and applications of nanoparticles other than carbon		**4***
			Total (* Not Included)	**28**

Laboratory Component

Sr. No.	Title of the Experiment
1	Determination of total, temporary and permanent hardness of water sample
2	Removal of hardness using ion exchange column
3	Molecular weight determination of polymers by Oswald's Viscometer
4	To determine flash point of a lubricating oil
5	Determination of Viscosity of oil by Redwood Viscometer
6	Estimation of acid value of lubricant
7	Determination of amount of strong acid present in a solution using a conductometer
8	Determination of strength of acid using a pH meter
9	Estimation of Copper in brass by Iodometric Titration
10	Analysis of Flue gas for its composition (by Orsat's Apparatus)
11	Estimation of Iron in plain Carbon steel
12	Determination of COD of wastewater sample

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Engineering Chemistry	Eleventh	P.C.Jain & M.Jain	Dhanpat Rai & Co. (Pvt) Ltd.	2014
2	A Textbook of Engineering Chemistry	Twelfth	S.S.Dara & S.S.Umare	S. Chand & Co.	2014
3	A Textbook of Engineering Chemistry	Third	S Chawla	Dhanpat Rai & Co. (Pvt) Ltd.	2015

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Physical Chemistry	Eleventh	Peter Atkins	Oxford University Press	2017

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Biology for Engineers	2	0	0	3	5	2	0	0	2
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AS103		Theory	50		50		100			200
		Laboratory	-		--		-			-

Pre-requisite Course Codes, if any.	HSC level Biology
Course Objective: To provide engineering perspective towards the biological principles and systems	
Course Outcomes (CO):*At the End of the course students will be able to*	
AS103.1	understand basic biological principles and organizational structure of living systems at molecular level.
AS103.2	comprehend basic biological principles and organizational structure of living systems at cellular level
AS103.3	know Energy transformation and information processing in biological systems
AS103.4	appreciate biological process with engineering perspective
AS103.5	identify significance of Gene, Blood and Skin in human health system.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS103.1	3											
AS103.2	3											
AS103.3	2											
AS103.4	2	1										
AS103.5	2	1										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2
AS103.1						
AS103.2						
AS103.3						
AS103.4						
AS103.5						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember ✓	Understand ✓	Apply ✓	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Bio-molecules and bio-polymers:** Structure and Function	1,3	**4**
	1.1	Organic and inorganic molecules, Unique Properties of water		
	1.2	Carbohydrates, Lipids, Amino Acids and proteins, Nucleic Acids (DNA and RNA)		
2	**Title**	**Levels of organization of life**	1,3	**4**
	2.1	Cell as a basic unit of life, prokaryotic and eukaryotic cells, microbes, plant and animal cells; Cell organelles – structure and function; Cell membrane.		
	2.2	**Levels of organization:** cells, tissues, organs, systems & organism		
3	**Title**	**Energy transformations**	1,3	**5**
	3.1	**Energy transformations in Chloroplast:** Photosynthesis (photochemical & biochemical phase) and ATP generation, Aerobic and anaerobic systems		
	3.2	**Energy transformations in Mitochondria:** Cellular respiration (glycolysis and Kreb cycle) and ATP generation		
4	**Title**	**Transport and Defense mechanisms**	1,3	**5**
	4.1	**Transport Phenomena in Biological Systems:** Membrane channels and ion channels; Fluid flow and mass transfer (nutrients & ions); In plants: Xylem and Phloem; In animals: Blood and Lymph Transport of gases: Oxygen and Carbon dioxide Heat Transport - Body temperature regulation.		
	4.2	**Defense mechanisms:** In plants: Herbivory, secondary metabolites In animals: Innate and Adaptive immune systems		
5	**Title**	**Engineering perspectives of biological sciences:**	1,3	
	5.1	Biology and engineering crosstalk – At cell level: Hybridoma technology At tissue level: Plant Tissue Culture, Animal Tissue Culture;		**6**
	5.2	Tissue Engineering: Principles, methods and applications Introduction to Biomimetics and Bio-mimicry, nano-biotechnology		

6	**Title**	**Role of Gene, Blood and Skin in human health system.**	2,4	**4**
	6.1	Introduction to Genetic Engineering. Blood Type, Complete Blood Count Test and Abnormalities.		
	6.2	Structure of Skin, Functions of Skin. Engineering methods for identification of Skin diseases.		
7	**Self Study**	Introduction to Biosensors, transducers, amplifiers; Introduction to medical imaging and different medical Imaging modalities; Review of Signals and system; Electro Physiological Signal Analysis.		**4***
			Total (* Not included)	**28**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Molecular Cell Biology	Fourth	Lodish H, Berk A, Zipursky SL	W. H. Freeman	2000
2	Textbook of Anatomy and Physiology for Nurses and allied Health Sciences	First	Indu Khurana & Arushi	CBS Publsihers & Distributors Pvt Ltd	2019

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
3	Lehninger Principles of Biochemistry	Fourth	Nelson, D. L., & Cox, M. M.	Freeman	2004
4	Introduction to Biomedical Engineering.	Third	Joseph D. Bronzino, John Enderle	Academic Press	2012

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(ESC)	Engineering Mechanics	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AS105		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective: To provide knowledge of force analysis methods required in engineering applications and solutions. Also, to develop analytical and computational ability.	
Course Outcomes (CO):*At the End of the course students will be able to*	
AS105.1	Draw free body diagram and determine reactive forces using conditions of equilibrium and Lami's theorem
AS105.2	Determine coefficient of friction for various contact surfaces
AS105.3	Analyze the three-dimensional system of space forces.
AS105.4	Analyze the kinematics of particle and obtain the various parameters of motion.
AS105.5	Determine Instantaneous centre of rotation (ICR).
AS105.6	Design and conduct an experiment to demonstrate principles of statics and dynamics

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS105.1	3	3										
AS105.2	3	3										
AS105.3	3	3										
AS105.4	3	3										
AS105.5	3	3										
AS105.6	3	3										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2
AS105.1	3					
AS105.2	3					
AS105.3	3					
AS105.4	3					
AS105.5	3					
AS105.6	3					

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	A Apply ✓	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Unit1**	**Equilibrium of forces**		**8**
	1.1	Equilibrant force, conditions of equilibrium for concurrent forces, parallel forces and general force system, equilibrium of connected bodies, Lami's theorem.	1,3	
	1.2	Types of supports, types of loads, Beams, Determination of reactions at supports for various types of loads on beams	3	
2	**Unit2**	**Friction**		**4**
	2.1	Introduction to Laws of friction, Cone of friction, Equilibrium of bodies on inclined plane, Application to problems involving wedges, ladders.	1,2	
3	**Unit3**	**Forces in space**		**5**
	3.1	Rectangular Components of Forces in Space, Resultant of Space forces, Moment of a Force about a point, axis and line. Equilibrium of a particle in space.	1	
4	**Unit4**	**Kinematics of Particle**		**8**
	4.1	Motion along straight and curved path, Rectangular component of velocity and acceleration, Tangential & Normal component of acceleration, Motion curves(a-t, v-t, s-t curves), Projectile motion,	2,3	
5	**Unit5**	**Kinematics of Rigid Bodies**		**3**
	5.1	Instantaneous center of rotation for the velocity of bodies in plane motion, (up to 2 linkage mechanism)	3	
6	**Self Study**	1. Applications of resultant of forces, concept of couple and moments, 2. Centroid and center of gravity, analysis of trusses. 3. Kinetics of rigid body, work energy principle. 4. Principle of Law of Conservation of momentum, Impact and collision.	1,2,3	**6***
			Total (*Not included)	**28**

Laboratory Component

Sr. No.	Title of the Experiment
1	Draw the force polygon and determine the equilibrant force for concurrent coplanar force system.
2	Use the conditions of equilibrium for parallel force system and determine the support reactions.
3	Apply the principle of moment for equilibrium of levers.
4	Determine the coefficient of friction for glass slab and a metal plate on an inclined plane.
5	Determine the axial forces using Lami's theorem for Jib crane apparatus.
6	Use the conditions of equilibrium for non-concurrent non-parallel force system and draw the force polygon.
7	Measure the acceleration due to gravity with the help of simple pendulum apparatus.
8	Determine the range of projectile and the time of flight for the projectile motion.
9	Verify the law of conservation of momentum and determine the coefficient of restitution for collision
10	(Plot the motion of projectile using air-cushion table apparatus.) A small project based on Engineering Mechanics concept.

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Vector Mechanics for Engineers statics and dynamics	Nineth	Beer and Johnston	McGraw Hill	2010
2	Engineering Mechanics	Fifth	Bhavikatti S and Rajsekharappa	New Age International	2009
3	Engineering Mechanics Statics and Dynamics	Fourteenth	A K Tayal	Umesh Publication, Delhi	2012

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Engineering Mechanic: Statics and Dynamics,	Fifth	E.W. Nelson, C.L. Best, W.G. McLean,	McGraw Hill	1998
2	Singer's Engineering Mechanics Statics and Dynamics	Third	Vijaya Kumar Reddy. K. and Suresh Kumar. J	BS Publication	2012

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(ESC)	Problem Solving using Imperative Programming	2	0	4	6	12	2	0	2	4
		Examination Scheme								
CS101		Component	ISE		MSE		ESE		Total	
		Theory	-		-		-		-	
		Laboratory	300		--		100		400	

Pre-requisite Course Codes, if any.	
Course Objective: To develop problem solving skills using imperative programming.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS101.1	Explain the problem solving aspects using various programming paradigms.
CS101.2	Solve real world problems using imperative programming approach.
CS101.3	Solve problems using control structures for real world problems.
CS101.4	Solve problems using Arrays and Text processing.
CS101.5	Develop modular code for a given problem.
CS101.6	Solve real world problems using Structures and Unions

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS101.1	1											
CS101.2	2	2										
CS101.3	2	2										
CS101.4	2	2										
CS101.5	2	2										
CS101.6	2	2										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS101.1	1(CS)/1(IT)	1(IT)	1(CS)/1(IT)				1(IT)
CS101.2	1(CS)/1(IT)	1(IT)	1(CS)/1(IT)			1(CS)	1(IT)
CS101.3	1(CS)/1(IT)	1(IT)	1(CS)/1(IT)			1(CS)	1(IT)
CS101.4	1(CS)/1(IT)	1(IT)	1(CS)/1(IT)			1(CS)	1(IT)
CS101.5	1(CS)/1(IT)	1(IT)	1(CS)/1(IT)			1(CS)	1(IT)
CS101.6	1(CS)/1(IT)	1(IT)	1(CS)/1(IT)			1(CS)	1(IT)

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✔	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Introduction to Problem Solving and Programming Paradigms**		
	1.1	What is a Problem, Problem Solving Aspect, Top Down Design, Implementation of Algorithms, Characteristics of a good algorithm, what is a computer program, real life examples of programming, Computer based applications of programming, Steps followed in Program Development, Characteristics of good Program	3,4	2
	1.2	Overview of Programming Paradigms - Declarative and Imperative, Problem solving using Algorithm and Flowcharts,	3,4	2
2	**Title**	**Basic Elements of Computer Programming and Control flow**		
	2.1	Variables, keywords, Data types, Operators**:** Arithmetic, Relational and Logical, Assignment, Unary, Conditional, Bitwise, Expression, Statements.	1,2	1
	2.2	Branching Structures: if statement, if-else statement, multi-way decision, switch statement, continue statement, break statement Iterative Structures: while, do-while, for, nested loops	1,2	3
	2.3	Problem solving using Control Structures for real world problems	1,2,4	2
3	**Title**	**Problem Solving using Array Techniques**		
	3.1	Introduction to Arrays: Declaration, Definition, accessing array elements, one-dimensional array, two-dimensional array, array of characters, Strings	1,2	2
	3.2	Classical Problem Solving using Arrays like Array Order Reversal, Array Counting or Histogramming, Finding the maximum number in a set.	1,2,4	2
	3.3	Text Processing problems like finding length, keyword search, finding anagrams	1,2,4	2
4	**Title**	**Problem Solving using Modular Approach**		
	4.1	Defining a Function, accessing a Function, Function Prototype, Passing Arguments to a Function, call by value, pointers and call by reference, Recursion	1,2	4
	4.2	Problem solving using Functions and Recursive applications	1,2,4	3
5	**Title**	**Structures and Unions**		
	5.1	Structures and Union: Declaration, Initialization, structure within structure, Array of Structure, Operation on structures, Concept of Union, Difference between structure and union,	1,2	3
	5.2	Real world problems using Structures and Unions	1,2,4	2

6	**Self Study**	File handling**:** Types of File, File operation- Opening, Closing, Creating, Reading, Processing File, Command line arguments, Dynamic Memory Allocation	1,2,4	**4***
			Total (* not counted in total hours)	**28**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Note: All problems should be implemented using C language.

Sr. No.	Title of the Experiment
1	Use the formatted input/output statements, operators and expressions of C language
2	Apply various control structures to solve given problems.
3	Apply the concept of functions to incorporate modularity.
4	Demonstrate the use of one-dimensional arrays to solve a given problem.
5	Demonstrate the use of two-dimensional arrays to solve a given problem.
6	Apply the concept of recursion to solve a given problem.
7	Implement various text processing problems.
8	Apply the concepts of structures/union to solve a given problem.
9	Demonstrate the use of pointers to solve a given problem.
10	Implement various operations on files to solve a given problem.

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Programming with C	Fourth	Byron Gottfried	McGraw Hill (Schaum's outline series)	2018
2	The C programming Language	Second	Kernighan , Ritchie	Pearson	2015
3	Foundations of Programming Languages	Second	Kent D. Lee	Springer	2017
4	How to Solve it by Computer	First	R.G. Dromey	Prentice Hall India	1998

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Let Us C	Sixteenth	Yashavant Kanetkar	BPB	2017
2	Programming Language Concepts	Third	Carlo Ghezi, Mehdi Jazayeri	John Wiley & Sons	2008
3	Computer Programming in C	Second	V. Rajaraman & Neeharika Adabala	PHI Learning, Eastern Economy Edition,	2014

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(ESC)	Digital Systems and Microprocessor	3	0	2	5	10	3	0	1	4
		Examination Scheme								
EC101		Component	ISE		MSE		ESE			Total
		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective: To prepare students to perform the analysis and design of various digital electronic circuits and introduce them to the concept of microprocessors	
Course Outcomes (CO):*At the End of the course students will be able to*	
EC101.1	Explain various logic gates, SOP, POS forms and their minimization with k- map for given combinational circuits.
EC101.2	Construct combinational circuits using given MSI devices.
EC101.3	Apply the knowledge of flip-flops and MSI to design sequential circuits
EC101.4	Compare the logic families based on their characteristics
EC101.5	Comprehend the architectural features of 8085 with basic assembly language programming

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EC101.1												
EC101.2												
EC101.3												
EC101.4												
EC101.5												

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
EC101.1							
EC101.2							
EC101.3							
EC101.4							
EC101.5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Combinational Circuits**		**11**
	1.1	**Logic Gates:** Basic gates, Universal gates, Sum of products and products of sum, minimization with Karnaugh Map (up to four variables), Quine Mc'Clusky method and realization.	1,4	
	1.2	**Combinational Circuits using basic gates as well as MSI devices:** Half adder, Full adder, Half Subtractor, Full Subtractor, Multiplexer, Demultiplexer, Decoder, Comparator	1,4	
2	**Title**	**Sequential Circuits**		**11**
	2.1	**Sequential Logic:** Latches and Flip-Flops. Conversions of Flip-Flops.	1,4	
	2.2	**Counters:** Asynchronous Counters, Synchronous Counters, UpDown Counters, Mod Counters, Ring and Twisted Ring Counters , Shift Registers, Universal Shift Register	1,4	
	2.3	MSI counters (IC 7490, IC 74160, IC 74163, IC 74169), MSI Shift registers (IC 74194) and their applications	2,5	
3	**Title**	**Clocked Synchronous Machines**		**05**
	3.1	Mealy and Moore Machines, Clocked synchronous state machine analysis, State reduction techniques.	2,5	
4	**Title**	**Logic Families**		**05**
	4.1	Types of logic families (TTL and CMOS), characteristic parameters (propagation delays, power dissipation, Noise Margin, Fan-out and Fan-in), transfer characteristics of TTL NAND.	1,4	
5	**Title**	**Introduction to Microprocessors**		**10**
	5.1	Evolution of computers and Microprocessors	3	
	5.2	Essential components of a conventional Central Processing Unit (CPU)	3	
	5.3	Architecture of 8-bit microprocessor 8085	3	
	5.4	Basic instruction set with its addressing modes and concepts of Instruction cycle, Machine cycle and T states. Elementary programming in assembly language.	3	

	5.5	Elements of I/O data transfer with the concept of interrupts	3	
6	**Self Study**	Concepts of PROM, PAL and PLA. Timing Considerations and Meta-stability in Flip-Flops. Clocked synchronous state machine design. Interfacing CMOS to TTL and TTL to CMOS. Concepts of peripherals and memory with its interfacing with 8085 microprocessor		**5***
			Total (*Not included)	**42**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No.	**Title of the Experiment**
1	To implement the combinational logic for given function using basic gates/MSI ICs. a. To study and verify the truth table of logic gates b. To study the universal NAND and NOR gate c. To study the working of half adder, full adder, half subtractor, Full subtractor along with truth table
2	To implement TTL and CMOS logic family a. To study TTL NAND gate (BJT implementation). b. To study CMOS NAND gate c. To study interfacing of the TTL /CMOS
3	To implement 4-bit, 5-bit and 8 bit comparator using given MSI
4	To design implement gate level multiplexers and MSI multiplexers
5	To design and implement gate level and MSI circuits of flip-flops
6	To design counters a. To design a MOD4 synchronous up/down counter b. To study IC 7490 – Asynchronous Decade Counter
7	To synchronous counters, synchronous counters and shift register using given MSI. a. To study IC 74160 as Synchronous Decade Counter and Mod 6 counter b. To study IC 74163 as Synchronous MOD 16 Counter and Mod 10 counter c. To verify the truth table of IC 74194 as Universal Shift Register and implement Ring and Twisted Ring Counter.
8	To perform basic arithmetic operations through assembly language program in 8085
9	To simulate COPY and PASTE operation through 8085 assembly program
10	To write a program to add N elements stored in an array of 8 bit numbers (8085)

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1.	Modern Digital Electronics	Fourth	R. P. Jain	Tata McGraw Hill	2009
2	Digital Design Principles And Practices	Third	John F. Wakerly	Pearson Education	2001
3	Microprocessor Architecture, Programming, and Applications with the 8085	Sixth	Ramesh S. Gaonkar	Penram International	2013

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Digital Design	Forth	Morris Mano	Pearson Education	2008
2	Fundamentals of digital logic design with VHDL	Second	Stephen Brown and ZvonkoVranesic	McGraw Hill	2006

<table>
<tr><th rowspan="2">Course (Category) Code</th><th rowspan="2">Course Name</th><th colspan="5">Teaching Scheme (Hrs/week)</th><th colspan="4">Credits Assigned</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>O</th><th>E</th><th>L</th><th>T</th><th>P</th><th>Total</th></tr>
<tr><td rowspan="3">(SBC)</td><td rowspan="4">Communication Skills</td><td>1</td><td>0</td><td>2</td><td>2</td><td>5</td><td>1</td><td>0</td><td>1</td><td>2</td></tr>
<tr><td colspan="9">Examination Scheme</td></tr>
<tr><td colspan="2">Component</td><td colspan="2">ISE</td><td colspan="2">MSE</td><td colspan="2">ESE</td><td>Total</td></tr>
<tr><td rowspan="2">AS107</td><td colspan="2">Theory</td><td colspan="2">--</td><td colspan="2">50**</td><td colspan="2">--</td><td>50</td></tr>
<tr><td colspan="2">Laboratory</td><td colspan="2">150*</td><td colspan="2">--</td><td colspan="2">--</td><td>150</td></tr>
</table>

** MSE will be evaluated on the basis of written test based on module 1 and 2.
** ISE will be evaluated on the basis of marks scored in practicals, out of 150.

Pre-requisite Course Codes, if any.	
Course Objective: To apply the principles of communication in personal and professional environment.	
Course Outcomes (CO):*At the end of the course students will be able to*	
AS107.1	Apply the principles of business writing for professional documents.
AS107.2	Develop advance vocabulary and grammar for spoken and written communication.
AS107.3	Design the draft a formal speech.
AS107.4	Analyze received information by using active listening and reading skills.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
AS107.1										**2**		
AS107.2										**2**		
AS107.3										**2**		
AS107.4										**2**		

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	**PEO2**	**PEO3**	**PEO4**	**PSO1**	**PSO2**	**PSO3**
AS107.1							
AS107.2							
AS107.3							
AS107.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	**Understand**	**Apply** ✓	**Analyze** ✓	**Evaluate**	**Create**

Theory Component

Module No.	Unit No.	Topics	Ref.	L Hrs.	P Hrs
1	Title	**Vocabulary Building & Grammar**		2	4
	1.1	Concept of word formation, the root words from foreign languages and their use in English	7,1		
	1.2	Common errors in writing, confused pair of words, redundancies, clichés	6, 2		
2	Title	**Writing Skills**		7	14
	2.1	Principles of Business Writing: 7Cs of communication, sentence structures, Organizing paragraph in direct and indirect style; Summarization	4		
	2.2	Practices in Writing: E-mail Etiquettes, e-mail for business purposes	3		
	2.3	Critical Reading: understanding the concept of critical reading and applying to analyze a given text.	5		
3	Title	**Oral Skills**		5	10
	3.1	Listening Comprehension(audio): Pronunciation, intonation, Stress and Rhythm	5		
	3.2	Speaking Practices: Common everyday situation: Conversation and dialogues (group activity, ice-breaking session) Public Speaking: Extempore, formal speech	3		
4	Self Study	1. Basic Rules Of Grammar 2. GRE Vocabulary 3. Reading a book(fiction/non-fiction) and preparing a review on it		6*	
			Total (*Not included)	42 hrs	

List of activities (Graded, Non-graded)

Sr. No.	Title of the assignments	Marks
1	Skit based on a given situation	-
2	ISE 1 – Summary Writing	10
3	ISE 2 – Extempore	10
4	ISE 3 – Grammar	20
5	ISE 4 – Vocabulary	20
6	Reviewing a book (fiction/ non-fiction)	10
7	ISE 5 – Email Writing (Inquiry)	20
8	ISE 6 – Email Writing (Complaint)	20
9	ISE 6 – Speech	20
10	ISE 7 – Critical Reading	20
	Total	**150**

Text Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Communication Skills	2013	Shirley Mathews	Technical Publication, Pune	2013
2	English Vocabulary in Use	1999	Michael McCarthy , Felicity O'Dell	Cambridge University Press, India	1999

Reference Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Oxford Practice Grammar	1999	John Eastwood	Oxford, India	1999
2	Communication Skills	2011	Meenakshi Raman, Sangeeta Sharma	Oxford, India	2011
3	Communication Skills	2010	Dr. Meera Bharwani	Synergy Knowledgeware, India	2010
4	English Grammar for Today	2005	Geoffrey Leech	Palgrave, UK	2005
5	Word Power Made Easy	1978	Norman Lewis	Anchor Books, New York	1978

Semester-II

Sem II									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	BSC	MA102	Differential Equations and Complex Analysis	3	1	0	8	12	4
2	BSC	AS101	Engineering Physics	2	1	2	5	10	4
3	ESC	AS104	Engineering Graphics	1	0	2	2	05	2
4	ESC	ET101	Basic Electrical Engineering	3	0	2	6	11	4
5	ESC	CS102	Problem Solving using OOP	2	0	4	4	10	4
6	SBC	AS106	Skill Shop	0	0	2	0	02	1
7	ABL	SV1X/ST1X	SEVA-I or SATVA-I	0	0	0	2	02	1
TOTAL				**11**	**2**	**12**	**27**	**52**	**20**

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Differential Equations and Complex Analysis	3	1	0	8	12	3	1	0	4
		Examination Scheme								
		Component	ISE		MSE		ESE		Total	
MA102		Theory	75		75		150		400	
		Laboratory	--		--		--		--	

Pre-requisite Course Codes, if any.	MA101
Course Objective: To develop mathematical skills for solving engineering problems.	
Course Outcomes (CO):*At the End of the course students will be able to:-*	
MA102.1	Solve differential equations of first order.
MA102.2	Solve differential equations of higher order using operators.
MA102.3	Solve differential equations in electrical engineering problems.
MA102.4	Find powers, roots & logarithm of a complex number and to separate the function of a complex number into real and imaginary.
MA102.5	Check whether a given function is analytic and construct analytic functions.
MA102.6	Compute integrals of complex valued functions.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MA102.1	3											
MA102.2	3											
MA102.3	1	1										
MA102.4	3											
MA102.5	2											
MA102.6	2	1										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
MA102.1							
MA102.2							
MA102.3							
MA102.4							
MA102.5							
MA102.6							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember ✓	Understand ✓	Apply ✓	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref**	**Hrs.**
1	**Title**	**Linear Differential Equations of first order**	1,2,3	11
	1.1	Exact Differential Equations, Integrating Factors, equations reducible to exact form.		3
	1.2	Linear differential equations (Definition), equations reducible to linear form, Bernoulli's equation		2
	1.3	Simple application of differential equation of first and second order to electrical engineering problems.		2
	1.4	Numerical solution of ordinary differential equations of first order and first degree using (a)Taylor's series method (b)Euler's method (c) Modified Euler method (d) Runge-Kutta fourth order formula.		4
2	**Title**	**Linear Differential Equations of higher order**	1,2,3	**11**
	2.1	Linear Differential Equation with constant coefficient- complementary function, particular integrals of differential equation of the type f(D)y = X where X is e^{ax} , sin(ax+b), cos(ax+b), x^m, e^{ax}V, xV, where V is a function of x.		7
	2.2	Cauchy's homogeneous linear differential equation and Method of variation of parameters for second order.		2
	2.3	System of Differential Equations.		2
3	**Title**	**Complex Numbers**	1,2,3	**12**
	3.1	**Revision:** Complex Numbers as ordered pairs, Argand's diagram, Cartesian, Polar and Exponential form of Complex Numbers.		1
	3.2	De Moivre's Theorem and its application to determine powers of complex numbers. Roots of complex numbers by De Moivre's Theorem.		3
	3.3	Expansion of $\sin n\theta$ and $\cos n\theta$ in terms of powers of $\sin\theta$ and $\cos\theta$. Expansion of $sin^n\theta$ and $cos^n\theta$ in terms of sines and cosines of multiples of θ.		2
	3.4	Hyperbolic Functions: relation between circular and hyperbolic functions, Inverse hyperbolic functions. Separation into real and imaginary parts of complex functions.		4
	3.5	Logarithm of a complex number.		2

4	**Title**	**Analytic functions and Complex Integrals**	1,2,3	**8**
	4.1	Analytic functions, Cauchy Reimann equations in cartesian and polar form, construction of analytic functions using Milne-Thompson's method, Harmonic functions, poles of f(z).		4
	4.2	Line Integral, Cauchy's Integral theorem for simply connected regions, Cauchy's Integral formula (for poles lying inside or outside the curve).		4

5	**Self Study**	1.3 To form D.E. for given L-C-E-R circuit 1.4 Picard's method 2.1 Method of undetermined coefficients to solve differential equations. 2.2 Legendre's differential equation, Method of variation of parameters for third order differential equations. 3.2 Complex examples using De Moivre's Theorem. 4.1 Construction of analytic function f(z) =u+iv when u+v or u-v is given. Orthogonal trajectories		**08**
			Total	**42***

***Total of 42 hours does not include self study hours.**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1.	Higher Engineering Mathematics	Forty Fourth	Dr.B.S. Grewal	Khanna Publications	2020

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1.	Advanced Engineering Mathematics	Twenty Eighth	H.K Das	S.Chand	2014
2.	Advanced Engineering Mathematics	Tenth	Erwin Kreysizg	John Wiley & Sons	2011
3.	Advanced Engineering Mathematics	Fourth	Jain and Iyengar	Narosa Publications	2014

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
BSC	Engineering Physics	2	1	2	5	10	2	1	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AS101		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	HSC level physics
Course Objective: To provide the knowledge and methodology necessary for solving problems in the field of engineering	
Course Outcomes (CO):*At the End of the course students will be able to*	
AS101.1	Illustrate the knowledge of basic concepts of semiconductor physics, lasers and quantum mechanics.
AS101.2	Solve the problems by applying the basics concepts of physics.
AS101.3	Use the Schrodinger equation to realize the concept of discreteness and quantum tunneling.
AS101.4	Explain the working of various LASERs and its practical applications.
AS101.5	To develop experimental skills and the practical abilities.
AS101.6	To develop an ability of understanding of concepts and principles of physics.
AS101.7	To comprehend importance of precision, accuracy of the experimental data.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS101.1	1											
AS101.2		1										
AS101.3		1										
AS101.4	1											
AS101.5				1								
AS101.6				1								
AS101.7												

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
AS101.1							
AS101.2							
AS101.3							
AS101.4							
AS101.5							
AS101.6							
AS101.7							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Quantum Mechanics**		**09**
	1.1	de-Broglie hypothesis; experimental verification of de Broglie hypothesis; wave packet, group velocity and phase velocity; Wave function, Physical interpretation of wave function; Heisenberg's uncertainty principle; Electron diffraction experiment; Applications of uncertainty principle	1,2,3	
	1.2	Schrodinger's time dependent wave equation, time independent wave equation; Application of time-independent Schrodinger equation - Particle trapped in one dimensional box and Potential barrier (Tunnelling), Harmonic oscillator (qualitative)	1,2,3	
2	**Title**	**Physics of Semiconductors and Semiconductor devices**		**13**
	2.1	Conduction in metals and semiconductors; Fermi-Dirac distribution function and Fermi level in a conductor, insulator and semiconductor	5	
	2.2	Intrinsic and extrinsic semiconductors; intrinsic conductivity and extrinsic conductivity; Law of mass action, charge neutrality condition; intrinsic carrier concentration, electron and hole concentration; Extrinsic carrier concentration as a function of temperature; Effect of impurity concentration and temperature on the Fermi Level; Hall Effect and its applications. Drift and Diffusion current density	5	
	2.3	Formation of a P-N junction, depletion region and barrier potential; Energy band structure of P-N Junction (unbiased, forward-bias, reverse-bias); concept of carrier current densities in p-n junction in equilibrium, forward bias and reverse bias; Breakdown mechanism - Zener effect and avalanche	5,6	
	1.4	P-N junction devices: LED, Zener diode, photoconductors, photovoltaic solar cells and Bipolar Junction Transistors	5,6	
3	**Title**	**LASERS**		**06**
	3.1	Processes - Absorption of light, spontaneous emission, stimulated emission; Einstein's equations, Population inversion; metastable states; pumping and pumping schemes; optical resonance cavity	3,4	

	3.2	Ruby and Helium Neon laser, semiconductor laser; Applications of laser in industry, medicine and holography. (construction & reconstruction of holograms)	3,4	
4	**Self Study**	Interference of light in thin films having uniform thickness, Newton's rings, Applications of interference in anti-reflecting and highly reflecting thin films. Diffraction of light, Diffraction due to single slit, double slit and diffraction grating.		**05***
			Total (*Not included)	**28**

Laboratory Component

Sr. No.	**Title of the Experiment***
1	Determination of energy band gap of a semiconductor
2	Study of I-V characteristics of a Zener diode
3	Determination of the type of semiconductor sample, concentration of charge carriers and its mobility using Hall Effect
4	Determination of Planck's constant using photo vacuum tube
5	Measurement of ultrasonic velocity in liquid medium using ultrasonic interferometer
6	Determination of radius of curvature using Newton's Rings
7	Determination of thickness of a thin foil or wire using the interference pattern of a wedge-shaped film
8	Determination of wavelengths of a mercury source and resolving power of a plane diffraction grating
9	Study of single slit diffraction
10	Determination of grating element of a diffraction grating using a laser source
11	Determination of the numerical aperture of an optical fibre
12	Uses of a Cathode-Ray Oscilloscope

*Students will perform any 10 of the above experiments

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	A Textbook of Engineering Physics	Eleventh	Dr. M.N. Avadhanulu & Dr. P. G. Kshirsagar	S. Chand	2018
2	Engineering Physics	First	D. K. Bhttacharya & Poonam Tandon	Oxford University Press	2015

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Concepts of Modern Physics	Sixth	Arthur Beiser	McGraw Hill Education	2009
2	Modern Physics	Third	Serway, Moses and Moyer	Thomson Learning	2005
3	Fundamentals of Physics	Tenth	Halliday and Resnick	Wiley	2013
4	Solid State Physics	Eighth	S. O. Pillai	New Age International Publishers	2018
5	Solid State Electronic Devices	Seventh	Ben G. Streetman and Sanjay Kumar Banerjee	Pearson Education	2016
6	Lasers: Fundamentals and Applications	Second	Ghatak and Thyagarajan	Springer	2011

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(ESC)	Engineering Graphics	1	0	2	2	5	1	0	2	2
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AS104		Theory	20		20		60			100
		Laboratory	60		--		40			100

Pre-requisite Course Codes, if any.	Fundamentals up to 12th science
Course Objective: To develop technical drawing and visualization skills using instrumental drawing and soft tool, required for design and modeling, in Engineering Applications and Solutions.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
CO1	Construct basic engineering curves.
CO2	Draw projections of points and lines.
CO3	Draw projections of regular solids inclined to both the reference planes.
CO4	Read the 3-dimensional view and draw the orthographic projections.
CO5	Read the 3-dimensional view and draw the sectional orthographic projections.
CO6	Read the orthographic projections and draw isometric view.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**										**3**
CO2	**3**	**3**										**3**
CO3	**3**	**3**										**3**
CO4	**3**	**3**										**3**
CO5	**3**	**3**										**3**
CO6	**3**	**3**										**3**

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply √	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Unit1**	**Introduction to Engineering Drawing**	1,2	**4**
	1.1	Introduction to Drawing Instruments, Types of Lines, Dimensioning Systems and Scaling as per IS conventions. First angle method of projection only		
	1.2	Basic construction of Cycloid and Involutes.		
2	**Unit2**	**Projections of Points and Lines**	1	**4**
	2.1	Projection of points in all four quadrants		
	2.2	Projection of lines parallel to one principal reference plane.		
	2.3	Lines inclined to both the Reference Planes (Excluding Traces of lines).		
3	**Unit3**	**Projections of solids** (Regular solids like Prism, Pyramid, Cylinder, Tetrahedron, Hexahedron and Cone only)	1,2	**7**
	3.1	Projection of solid resting on plane (Single step projection)		
	3.2	Projection of solid such that base inclined to one reference plane (Two step projection)		
	3.3	Projection of solid such that base inclined to both reference planes (Three step projection/problem) (Exclude Spheres, Composite, Hollow solids and frustum of solids)		
4	**Unit4**	**Orthographic Projections**	1,2	**Lab Sessions**
	4.1	Orthographic views of a simple machine part as per the first angle method of projection recommended by I.S.		
	4.2	Full Sectional views of the Simple Machine parts.		
5	**Unit5**	**Isometric Projections and views**	2	**Lab Sessions**
	5.1	Isometric views (Natural scale only)		

6	**Self Study**	1.2 Construction of Engineering curves like ellipse, parabola, hyperbola, helix, other types of cycloid etc. by using different method of construction. 2.1 Projection of lines with traces, application-based problems on Projection of lines 3.1 Projections of cut solids with different cutting planes. 4.1 Solve more practice examples of orthographic views. Draw different views of a machine part/any object using third angle method of projection. (Axonometric view, oblique view, perspective etc.) 4.2 Half sectional orthographic views. 5.1 Development of surfaces of frustum of solid, and retaining part of the solid after cutting plane, reverse development of solid.	1,2, 3	**6***
Total (*Not included)				**15**

Laboratory Component (Minimum 5 sheets are expected)

Sr. No	**No of Sessions**	**Engineering AutoCAD Laboratory**
1	**2**	Introduction to Auto-CAD: -Basic Draw and Modify Commands. Knowledge of setting up layers, Dimensioning, Hatching, plotting, and Printing. **Auto-Cad Practice sheet-1**
2	**1**	**Auto-Cad Practice sheet-2**
3	**2**	**Introduction to Orthographic projections sheet-3**
4	**2**	**Orthographic projections sheet-4**
5	**2**	**Introduction to Sectional Orthographic projections sheet-5**
6	**2**	**Sectional Orthographic projections sheet-6**
7	**2**	**Introduction to Isometric Projection/View: -** Isometric View of blocks with plain and cylindrical surfaces is using plain/natural scale only. (Exclude Spherical surfaces). **Isometric Projection/View sheet-7**
8	**2**	**Isometric Projection/View sheet-8**
Total	**15**	

Text Books:

Sr. No	Title	Edition	Authors	Publisher	Year
1	Engineering Drawing	53rd	N D Bhatt	Charotar	2016
2	Engineering Drawing	3rd	Dhananjay A Jolhe	Tata McGraw Hill	2011

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	AutoCAD 2017	--	Sham Tickoo	DreamTech Press, Delhi	2017
2	Engineering Drawing and Graphics	Fifth	K Venugopal	New Age International	2011

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(ESC)	Basic Electrical Engineering	3	0	2	6	11	3	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
ET101		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	Basic concepts of electric charge, current, voltage and power
Course Objective: To impart a basic knowledge of electrical quantities, Circuits and components.	
Course Outcomes (CO):*At the End of the course students will be able to*	
ET101.1	Compute various electrical quantities of given dc circuit using circuit simplification techniques and various network theorems.
ET101.2	To expose the students to different terms and concepts in AC Circuits at fundamental frequency and to expose them to basics of effects of harmonics in the waveforms
ET101.3	To study the working principles of electrical machines and their applications
ET101.4	To expose the students the fundamental concepts in Controllable Switch and Modulation based Power Conversion
ET101.5	To study Electrical Parameters of the Batteries and their selection and design criteria for a specific application

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ET101.1												
ET101.2												
ET101.3												
ET101.4												
ET101.5												

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	**PEO2**	**PEO3**	**PEO4**	**PSO1**	**PSO2**	**PSO3**
ET101.1							
ET101.2							
ET101.3							
ET101.4							
ET101.5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs**
1	**Title**	**DC Circuits**	1,2	**10**
	1.1	Electrical circuit elements (R, L and C), Voltage and current sources, Equivalent resistance of circuits, Simplification using delta-star and star-delta transformation.		
	1.2	Kirchoff's current and voltage laws, Analysis of simple circuits with dc excitation. Mesh analysis, Superposition, Thevenin, Norton and Maximum Power Transfer Theorems		
	1.3	Time-domain analysis of first-order DC Transients in RL and RC circuits.		
2	**Title**	**AC Circuits**	1,2	**12**
	2.1	Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Harmonics, Total Harmonic Distortion, Power supplied by Harmonic voltages and currents, Power factor in case of non-sinusoidal waveforms.		
	2.2	AC Analysis of series and parallel RLC Circuits with Resonance, Concept of Bandwidth and Q-factor,		
	2.3.	Three-phase balanced circuits, voltage and current relations in star and delta connections.		
3	**Title**	**Electromagnetic and Electro-Mechanical Energy Converters**	1,2	**10**
	3.1	Magnetically Coupled Coils, Self and Mutual Inductance and Dot Convention		
	3.1	Single Phase Transformer: Principle of Operation, Equivalent Circuits		
	3.2	Single Phase Transformer: Efficiency and Regulation		
	3.3	Introduction to Three-phase Transformers and Applications		
	3.4	Fundamental Principles of Rotating Machines, Characteristics of Induction motor and DC motor		
4	**Title**	**Electric Power Converters**	1,2	**05**

	4.1	Fundamental Principles of Buck, Boost and buck-boost DC-DC converters and their Transfer Characteristics, Duty Ratio Control		
	4.2	Single-phase voltage source inverters and PWM		
5	**Title**	**Batteries: Electrical Characteristics and Applications**		**05**
	5.1	Introduction to type of Batteries, Generalized Battery parameters such as SoC, DoD, Energy and Power Densities, Battery C-rating, etc. Comparison of Batteries, Charging and Discharging Characteristic		
	5.2	Selection and Sizing of Battery Packs for Specific Applications		
6	**Self Study**	Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Elementary calculations for energy consumption and power factor improvement.		**6***
			Total (*Not Included)	**42**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
01	Introduction to Electrical Measuring instruments, Lamp Loads, Inductor Loads and Capacitor Bank
02	Verification of Star-Delta and Delta-star Transformation with Kirchhoff's Laws
03	Verification of Thevenin's Norton's and Maximum Power Transfer Theorem
04	Verification of DC Transient equations in RL and RC Circuits
05	Experimental study of single-phase AC circuit with R-L and R-C Load with Measurement of Power and Power factor
06	Experimental study of R-L-C series Resonance. To plot resonance curve, To compute Bandwidth and Q-factor
07	Experiment on Magnetic Circuit Fundamentals
08	Loading of a transformer: measurement of primary and secondary voltages and currents, and power. To compute efficiency and regulation.
09	Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
10	Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
11	Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform.
12	Demonstration of V/F control of Induction motor
13	Experimental study of charge and Discharge characteristics of a Lead-acid Battery
14	Introduction to L.T. Switch gear

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Basic Electrical Engineering	Third	D.P. Kothari and I. J.	Tata McGraw Hill	2010
2	Electrical Technology	Twenty Third	B.L.Theraja	S. Chand Publications	2003

Reference Books

Sr. No.	Title	Edition	Author	Publisher	Year
1	Basic Electrical Engineering	Second	D.C. Kulshreshtha	McGraw Hill	2019
2	Fundamentals of Electrical Engineering	Second	L.S. Bobrow	Oxford University Press	2011
3	Electrical and Electronics Technology	Third	E. Hughes	Pearson	2010
4	Electrical Engineering Fundamentals	Second	V.D. Toro	Prentice Hall India	1989
5	Elements of Power Electronics	Second	P. T. Krein	Oxford University Press	2015
6	Power Electronics: Converters, Application and Design	Second	Ned Mohan, T.M Undelands and W P Robbins	John Wiley and Sons. Inc.	1995
7	Electric Machinery	Sixth	A. E. Fitzgerald, C. Kingsley and S. D. Umans	McGraw-Hill	2003

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(ESC)	Problem Solving using OOP	2	0	4	3	7	2	0	4	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
CS102		Theory	--		--		--			--
		Laboratory	300		--		100			400

Pre-requisite Course Codes, if any.	Problem Solving using Imperative Programming
Course Objective: To learn problem solving using Object-Oriented programming paradigm	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS102.1	Apply concepts of object oriented programming using classes and objects
CS102.2	Apply Inheritance for a given scenario
CS102.3	Apply polymorphism for solving a given problem
CS102.4	Apply abstraction and exception handling to create efficient program.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS102.1	2	2	2									
CS102.2	2	2	2									
CS102.3	2	2	2									
CS102.4	2	2	2									

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	**PEO2**	**PEO3**	**PEO4**	**PSO1**	**PSO2**	**PSO3**
CS102.1	2(Comp)/ 2(IT)						
CS102.2	2(Comp)/ 2(IT)						
CS102.3	2(Comp)/ 2(IT)						
CS102.4	2(Comp)/ 2(IT)						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	**Understand**	**Apply** ✔	**Analyze**	**Evaluate**	**Create**

Theory (This course content delivery will be in C++/Java. Course Contents to be taken care accordingly)

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction and Encapsulation**		**8**
	1.1	Introduction to Object Oriented Programming, Procedural verses Object Oriented Programming, Principles, Benefits and applications of Object Oriented Programming.	1,2	
	1.2	Encapsulation: Problem solving with Objects and Classes		
	1.3	static data member and methods, constructors and their types. Types of functions and keywords, Strings, Arrays		
2		**Inheritance**		**6**
	2.1	Concept of Inheritance, parent class, derived class, base class and derived class constructor	1,2	
	2.2	Types of inheritance: single, multiple, multilevel, hierarchical, hybrid		
	2.3	Aggregation and Composition		
3		**Polymorphism**		**6**
	3.1	Static Polymorphism: Method overloading and Constructor overloading	1,2	
	3.2	Dynamic Polymorphism: Method overriding		
	3.3	Data conversion		
4		**Abstraction**		**2**
	4.1	Abstraction: abstract class	1,2	
5		**Exception Handling**		**6**
	5.1	try, throw, and catch exceptions	1,2	
	5.2	Function exception declaration		
6	**Self Study**	File Handling, $ STL, $pointers, $virtual functions @Multithreading, @Packages, @interface	1,2	**5***
Total				**28+ 5***

$ only for C++
@ only for Java

**** Language used: C++ for Etrx and Extc Branch**
**** Language used: C++/Java for IT and CE Branch**

aboratory Component

Sr. No.	Title of the Experiment
1	Program on Encapsulation: Write a program to demonstrate classes and objects
2	Program on Encapsulation: Write a program to demonstrate constructor
3	Program on Polymorphism: Implement a Program to demonstrate method overloading,
4	Program on Polymorphism: Implement a Program to demonstrate constructor overloading
5	Program on Polymorphism: Implement a Program to demonstrate method overriding
6	Program on Inheritance: Implement a Program to demonstrate single, multilevel Inheritance
7	Program on Inheritance: Implement a Program to demonstrate multiple Inheritance
8	Program on Abstraction: Implement a Program to demonstrate Abstraction using abstract class
9	Program on Abstraction: Implement a Program to demonstrate multithreading/ STL
10	Program to demonstrate File Handling

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Object Oriented Programming with C++	Sixth	E Balagurusamy	Tata McGraw Hill	2017
2	Oriented Programming in Turbo C++	Fourth	Robert Lafore	Galgotia	2001
3	Java -The Complete Reference	Tenth	Herbert Schildt	Tata McGraw-Hill	2017
4	Java Programming From the Ground Up	First	Ralph Bravaco,Shai Simoson	Tata McGraw-Hill	2009

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	The Compete Reference C++	Fourth	Herbert Schlitz	Tata McGraw Hill	2017
2	An introduction to Programming and Object Oriented Design using Java	Third	Jaime Nino, Frederick A. Hosch	Wiley Student Edition	2010

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(SBC)	Skill Shop	0	0	2	0	02	0	0	1	1
AS106		Examination Scheme								
		Component	ISE		MSE		ESE		Total	
		Theory	--		--		--		--	
		Laboratory	50		--		50		100	

Pre-requisite Course Codes, if any.	
Course Objective: To equip the students with the fundamental skills involved in the creation of simulated and physical design.	
Course Outcomes (CO):*At the End of the course students will be able to*	
AS106.1	Operate basic electronic equipment and instruments.
AS106.2	Make PCB designs in simulations.
AS106.3	Assemble, disassemble and troubleshoot computer hardware and network peripherals.
AS106.4	Fabricate basic jobs in traditional trades.
AS106.5	Design a 3D model and translate it to a 3D printed component.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS106.1												
AS106.2												
AS106.3												
AS106.4												
AS106.5												

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
AS106.1							
AS106.2							
AS106.3							
AS106.4							
AS106.5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

Lab Component

Trade No.	Unit No.	Topics	Ref.	Hrs.
1	Unit 1	**Electronic Components**	5	4
	1.1	**Introduction to Electronic Components** Exposure to usual electronic equipment/instruments such as Multi-meter, Oscilloscope, Function generator, IC tester and Power supply, Information about their front panels, Demonstrations on their working, Hands-on for measurement of component values and DC voltage using multi-meter, AC mains voltage/1 KHz Square wave/any small signal from function generator on Oscilloscope, Testing of sample digital ICs using IC tester. **OR** **Repairing of gadgets and appliances:** Elementary skills of repairing juicer, mixer, grinder, etc.		
2	Unit 2	**PCB Laboratory Exercises**	6	4
	2.1	Layout drawing, Positive and negative film making, PCB etching and drilling, Tinning and soldering technique.		
3	Unit 3	**Hardware and Networking**	7, 8	4
	3.1	Dismantling of a Personal Computer (PC), Identification of Components of a PC such as power supply, motherboard, processor, hard disk, memory (RAM, ROM), CMOS battery, CD drive, monitor, keyboard, mouse, printer, scanner, pen drives, disk drives etc.		
	3.2	Assembling of PC, Installation of Operating System and Device drivers, Boot-up sequence. Installation of application software (at least one).		
	3.3	Basic troubleshooting and maintenance.		
	3.4	Identification of network components: LAN card, wireless card, switch, hub, router, different types of network cables (straight cables, crossover cables, rollover cables) Basic networking and crimping.		
4	Unit 4	**Traditional Trades***	1, 2	4

		Carpentry Use and setting of hard tools like hacksaws, jack planes, chisels and gauges for construction of various joints, wood turning and modern wood turning methods. One carpentry job involving a joint and report on demonstration of a job involving wood turning required for successful completion of module. OR **Electrical board wiring** House wiring, staircase wiring, and wiring diagram for fluorescent tube light, Godown wiring and three phase wiring for electrical motors. OR **Sheet Metal Practice** Introduction to primary technology processes involving bending, punching and drawing various sheet metal joints, development of joints. Utility job in sheet metal required for successful completion of module.		
5	**Unit 5**	**3D Modeling and Printing**	3, 4	**4**
	5.1	Modeling approaches for ideation and creation. Developing a CAD file (.iges/.step/.dwg) of a 3D model and export it as an .stl file for the purpose of 3D printing. Importing the 3D .stl file to generate a .gcode file for 3D printing through slicing, using open source software.		
	5.2	Introduction to 3D printing: methodologies, best practices, material and model variation. Live printing sessions of generated .gcode files in real time with optimal parameters and troubleshooting.		
			Total	**20**

*** Students can opt for any one of the three trades from Unit 4.**

Text Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Workshop Manual	Sixth	Venkat Reddy	BS Publication	2008
2	Wiring Simplified: Based on 2017 National Electrical Code	Forty Fifth	Frederic P Hartwell, Herbert P. Richter, W.C. Schwan	Park Publishing	2017

Reference Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
3	Autocad 2017	First	ShyamTikoo	Dreamtech Press	2016
4	Ultimaker 2+ reference manual	-	-	Ultimaker	2017
5	Encyclopedia of Electronic Components	First	Charles Platt	O Reilly	2012
6	Printed Circuit Boards	First	Khandpur R.S.	Tata McGraw Hill	2005
7	Troubleshooting Your PC For Dummies	Second	Gookin Dan	For Dummies	2005
8	Networking For Dummies	Eighth	Lowe Doug	For Dummies	2007

Semester-III

Sem III									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	BSC	MA203	Probability and Statistics	3	0	0	5	08	3
1	BSC*	MA202	Foundation of Mathematics-I*	2	1	0	6	09	3
2	PC	CS201	Discrete Structures and Graph Theory	3	0	0	4	07	3
3	PC	CS202	Data Structures	3	0	2	5	10	4
4	PC	CS203	Computer Architecture and Organization	3	0	2	4	09	4
5	PC	CS204	Database Management Systems	3	0	2	5	10	4
6	ABL	SVXX/ STXX	SEVA II or III /SATVA II or III	0	0	0	3	03	1
7	HSSE	HSEX1	HSS-I	2	0	0	3	05	2
TOTAL				**17**	**0**	**6**	**29**	**52**	**21**

**Only for Lateral Entry Students*

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Discrete Structures and Graph Theory	3	0	0	4	7	3	0	0	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
CS201/IT201		Theory	75		75		150			300
		Laboratory	--		--		--			--

Pre-requisite Course Codes, if any.	
Course Objective: To teach students how to think logically and mathematically. It provides the mathematical foundation that is used in most areas of computer science.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS/IT201.1	Solve problems using set theory, logic and its various proof techniques.
CS/IT201.2	Apply the concepts of relations, functions, lattices and recurrence relations to solve problems
CS/IT201.3	Apply the concepts of graph, trees and their various types with their traversing techniques to solve problems.
CS/IT201.4	Apply the basics of coding theory and cryptography to solve real world problems.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS/IT201.1	3											
CS/IT201.2	3	2										
CS/IT201.3	3											
CS/IT201.4	3	2	2									2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	**PEO2**	**PEO3**	**PEO4**	**PSO1**	**PSO2**	**PSO3**
CS/IT201.1		2(IT)	2(COMP)				
CS/IT201.2		2(IT)	2(COMP)				
CS/IT201.3		2(IT)	2(COMP)				
CS/IT201.4		2(IT)	2(COMP)				

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	**Understand**	**Apply** ✔	**Analyze**	**Evaluate**	**Create**

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Set Theory, Logic and Proofs**	**1, 2**	
	1.1	Finite and infinite set, Union, Intersection, Disjoint, and Difference of two sets. Power Set, Partition of Sets, Ordered Sets, De Morgan's Laws, Principle of Inclusion Exclusion		**2**
	1.2	Predicates, Propositions, Conditional Propositions, Logical Connectivity, Proposition calculus, Universal and Existential Quantifiers, First order logic, Equivalence, Normal Forms, Introduction to proofs, Mathematical Induction, Strong Induction, Well-ordering principle, Logical inference		**6**
2	**Title**	**Relations, Functions and Lattices**	**1, 2**	
	2.1	Product Sets and Partitions, Paths in relations and Diagraphs, Properties of Relations, Closure of Relation, Equivalence Relations, Operations on Relations, Warshall's Algorithm, Partially Ordered Sets, External Elements of Partially Ordered Sets, Hasse Diagram		**8**
	2.2	Composition of Functions, Invertible Functions, Recursive Functions, Hashing, Pigeon hole Principle, Extended PHP		**3**
	2.3	Lattice, Sub lattice, Isomorphic Lattices, Properties of Lattice, Special Types of Lattices		**4**
	2.4	Recurrence Relations – Introduction, Linear Recurrence Relations with constant coefficients, Homogeneous solutions, Particular Solutions, Total Solutions, Solution by the method of Generating functions, solving Recurrence Relations		**5**
3	**Title**	**Graph Theory**	**1, 2**	**4**
	3.1	Concepts and terminologies, Graphs as Model (Konigsberg Bridge Problem)		
	3.2	Matrices, Isomorphism, Bipartite Graphs, Directed Graphs		
	3.3	Minimal Spanning Trees-Prim's Algorithm and Kruskal's Algorithm		
4	**Title**	**Graph connectivity**	**1, 2**	**6**
	4.1	Cycles – Transport Networks, Max Flows, Matching Problems, Maximum Bipartite Matching, Perfect Matching		
	4.2	Euler Paths- Circuits, Hamiltonian Paths- Circuits		

	4.3	Coloring Graphs, Chromatic Polynomial, Planer Graphs		
5	**Title**	**Coding Theory**	**1, 2**	**4**
	5.1	Hamming Code, Minimum Distance		
	5.2	Number Theory, Modular Arithmetic and applications to cryptography; Diffie-Hellman Algorithm		
6	**Self-Study**	Algebraic Structures - Semi group, Monoids, Groups, Cyclic groups, Abelian groups, Normal Subgroups	**1, 2**	**5***
			Total (*Not included)	**42**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Discrete Mathematics and it's applications	Seventh	Kenneth H. Rosen	Tata McGraw-Hill	2013
2	Discrete Mathematical Structures	Sixth	Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman	Pearson Education	2015

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Elements of Discrete Mathematics	Fourth	C. L. Liu	Tata McGraw-Hill	2012
2	Introduction to graph Theory	Second	Douglas B. West	Pearson Education	2015
3	Discrete Mathematical Structures with Applications to Computer Science	First	Jean-Paul, Tremblay R. Manohar	Tata McGraw-Hill	1987

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Foundations of Mathematics-I	2	1	0	0	3	2	1	0	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
MA202		Theory	75		75		150			300
		Laboratory	--		--		--			--

Pre-requisite Course Codes, if any.	-
Course Objective: To develop basic foundation of mathematical skills.	
Course Outcomes (CO):*At the End of the course students will be able to:-*	
MA202.1	Differentiate a function of one variable and partially differentiate a function of more than one variable.
MA202.2	Apply the concept of partial differentiation to find extreme values of a given function.
MA202.3	Find nth order derivative of a given function.
MA202.4	Expand a given function as a power series.
MA202.5	Perform operations on matrices and find inverses and determinants of them.
MA202.6	Perform vector operations and compute dot products and cross products between them.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MA202.1	2											
MA202.2	2											
MA202.3	2											
MA202.4	1											
MA202.5	1											
MA202.6	1											

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	**PEO2**	**PEO3**	**PEO4**	**PSO1**	**PSO2**
MA202.1						
MA202.2						
MA202.3						
MA202.4						
MA202.5						
MA202.6						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember ✔	**Understand** ✔	**Apply** ✔	**Analyze**	**Evaluate**	**Create**

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref**	**Hrs.**
1	**Title**	**Differential Calculus**	1,2	**18**
	1.1	Partial fractions. Derivatives of standard functions, product and quotient rule for differentiation.		04
	1.2	Partial derivatives of first and higher order, composite differentiation		03
	1.3	Application of partial derivatives: Local Maxima and Minima of functions of two variables.		02
	1.4	Successive Differentiation: Proofs of nth derivatives of standard functions. Use of partial fractions to calculate nth derivatives of given functions. Leibnitz theorem for nth derivative of product of two functions.		05
	1.5	Infinite series: expansion of functions in powers of x using maclaurin series. Taylor's series.		04
2	**Title**	**Matrices**	1,2	**07**
	2.1	Addition and scalar multiplication of matrices. Matrix multiplication, types of matrices.		03
	2.2	Elementary row transformations, finding inverses using matrices, determinants and its properties		04
3	**Title**	**Vectors**	1,2	**03**
	3.1	Vector definition, addition, scalar multiplication, dot product of two vectors, angle between two vectors, cross product.		03
			Total	**28**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Higher Engineering Mathematics	Forty Forth	Dr. B. S. Grewal	Khanna Publications	2020

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Advanced Engineering Mathematics	Tenth	Erwin Kreysizg	John Wiley & Sons	2011
2	Advanced Engineering Mathematics	Twenty Eighth	H.K.Dass	S. Chand Publications	2014

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Probability and Statistics	3	0	0	5	8	3	0	0	3
MA203		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	75		75		150			300
		Laboratory	--		--		--			--

Pre-requisite Course Codes, if any.	-
Course Objective: To give an exposure to the students the basic concepts of Probability and Statistical methods and their application.	
Course Outcomes (CO):*At the End of the course students will be able to*	
MA203.1	Familiarize with basic probability axioms, rules and their applicability.
MA203.2	Identify the characteristics of various discrete and continuous distributions.
MA203.3	Find unbiased and efficient estimates using estimation theory.
MA203.4	Test the hypothesis for means and variances using‘t’& F; chi-square distribution tests.
MA203.5	Find Correlation and Regression and fit different types of curves.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MA203.1	2											
MA203.2		2										
MA203.3		2										
MA203.4		2										
MA203.5		2										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
MA203.1	2						
MA203.2	2						
MA203.3	2						
MA203.4	2						
MA203.5	2						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✔	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Probability and Random Variables**	**1, 2**	**12**
	1.1	Classical, relative frequency and axiomatic definitions of probability, addition rule and multiplication rule. Conditional Probability, Bayes' theorem and independence.		04
	1.2	Discrete, continuous and mixed random variables, probability mass function(PMF), Probability Density Function(PDF) and cumulative distribution function(CDF). Joint Distributions: Joint, marginal and conditional distribution.		04
	1.3	Mathematical expectation, moments, moments generating function, Chebyshev's inequality.		04
2	**Title**	**Probability Distributions**	**1, 2**	**12**
	2.1	Standard discrete distributions: Bernoulli, Binomial, Poisson and Geometric distributions, Probability density function, Cumulative distribution function, Expectation and Variance,		06
	2.2	Standard continuous distributions – Uniform, Normal, Exponential, Joint distribution and Joint density functions		06
3	**Title**	**Test of Hypothesis and Significance**	**1, 2**	**12**
	3.1	Statistical hypothesis, Null and Alternate hypothesis, test of hypothesis and significance, Type I and Type II errors, Level of Significance, Tests involving the Normal distribution, One-Tailed and Two-Tailed tests, P value.		03
	3.2	Special tests of significance for Large samples and Small samples (F, chi-square, z, t- test), ANOVA.		09
4	**Title**	**Correlation and Regression**	**1, 2**	**06**
	4.1	Correlation, Rank correlation, Regression Analysis, Linear and Non-linear Regression, Multiple regressions, Curve fitting by method of least squares, fitting of straight lines, Polynomials, Exponential curves.		
5	**Self Study**	1. Applicability of Bayes theorem 2. Proofs for mean & variance for all distribution: included in module 2 3. Examples to test goodness of fit using Chi-square		01* 02* 02*
			Total	**42**

*** Not included in Total 42 hrs.**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Introduction to Probability and Statistics for Engineers and Scientists	Fourth	Sheldon M. Ross	Academic Foundation	2011
2	Probability and Statistics for Engineers and Scientists	Eighth	E. Walpole, R. H. Mayers, S. L. Mayers and K. Ye	Pearson Education	2007

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Probability and Statistics in Engineering	Fifth	Douglas C. Montgomery	Wiley India	2012
2	Probability & Statistics	Third	Spiegel, M. R., Schiller, J. and Srinivasan, R. A.	Tata McGraw Hill	2010

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Data Structures	3	0	2	5	10	3	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
CS202/IT202		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	1. Problem solving using imperative programming
Course Objective: To introduce the fundamentals and abstract concepts of Data Structures for Problem Solving.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS/IT202.1	Apply various operations of linear and non-linear data structures to given problems.
CS/IT202.2	Apply the concepts of Trees and Graphs to a given problem.
CS/IT202.3	Apply various operations of heap data structures.
CS/IT202.4	Apply the concepts of hashing on a given problem

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS/IT202.1	3		3						3	3	3	
CS/IT202.2	3		3						3	3	3	
CS/IT202.3	3		3						3	3	3	
CS/IT202.4	3		3						3	3	3	

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	**PEO2**	**PEO3**	**PEO4**	**PSO1**	**PSO2**	**PSO3**
CS/IT202.1		1(IT)	1(CS)			1(CS)	
CS/IT202.2		1(IT)	1(CS)			1(CS)	
CS/IT202.3		1(IT)	1(CS)			1(CS)	
CS/IT202.4		1(IT)	1(CS)			1(CS)	

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	**Understand**	**Apply** ✔	**Analyze**	**Evaluate**	**Create**

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Introduction to Data Structures**		
	1.1	Concept of Linear and Non linear Data Structures	1,2	**1**
	1.2	Stack: Stack as ADT, operations on stack,, Applications of Stacks	1,2	**4**
	1.3	Queue: Queue as ADT, Operations on Queue,, Applications of Queue , Types of Queue-Circular and Priority Queue	1,2	**4**
	1.4	Linked List: Linked List as ADT, Operations on Singly Linked List. Types of linked list- Linear and circular linked lists, Doubly Linked List, Circular Linked List and its operations, Generalized Linked List (GLL) concept , Applications of linked List and Generalized Linked List (GLL).	1,2	**6**
2	**Title**	**Trees**		
	2.1	Trees as ADT, General tree v/s Binary Tree Terminology, Traversal of Binary Tree, Operations on Binary tree, Binary Search Tree and its operations, Expression Tree	1,2	**5**
	2.2	AVL Trees- Properties of AVL trees, Rotations, Insertion, and Deletion	1,2	**4**
	2.3	Introduction to B tree- Insertion , Deletion.	1,2	**3**
3	**Title**	**Graphs**		
	3.1	Graph as ADT, Introduction To Graph, Representation of Graph- Adjacency Matrix, Adjacency List, Graph Traversal Technique	1,2	**3**
4	**Title**	**Heap Structure**		
	4.1	Heap as ADT, Introduction to Heap Structures, Min Heap, Max Heap, Construction of Heap	1,2	**3**
	4.2	Fibonacci heaps- Structure of Fibonacci heaps, Mergeable-heap, operations, Decreasing a key and deleting a node	1,2	**5**
5	**Title**	**Hashing**		
	5.1	Introduction to Hash Table, Hash functions, Collision Resolution Technique.	1,2	**4**
6	**Self Study**	**Optimal Binary Search Tree and Red-Black Trees**	**1,2**	**5***
			Total	**42**

Laboratory Component, if any (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Implement a given problem statement using Stack.
2	Implement a given problem statement using Queue
3	Implement a given problem statement using Linked List.
4	Implement a given problem statement using Doubly Linked List.
5	Implement a given problem statement using Binary Trees.
6	Implement insertion of node in AVL tree.
7	Implementation of expression tree
8	Implement Operations of Heap Structures.
9	Implement hash functions with different collision resolution techniques.
10	Apply Graph Traversal Technique on a given problem statement to solve the problem

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Introduction to Algorithms	Third	Thomas H. Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein	MIT Press	2009
2	Fundamentals of Computer Algorithms	Second	Horowitz E, Sahni S and S.Rajasekaran	Galgotia Publications	2010

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Classic Data Structures	Second	Samanta Debasis	PHI	2009
2	Data Structures With C	First	Seymour Lipschutz	Schaum's Outline Series	2010

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Computer Architecture and Organization	3	0	2	4	9	3	0	1	4
CS203/IT203		Examination Scheme								
		Component	ISE		MSE		ESE		Total	
		Theory	75		75		150		300	
		Laboratory	50		--		50		100	

Pre-requisite Course Codes, if any.	Digital Circuits & Systems, Any Programming Language
Course Objective: Imparting concepts of each component of computer architecture thoroughly with practical aspects including memory systems and I/O communications with interfacing	
Course Outcomes (CO): ***At the End of the course students will be able to***	
CS/IT203.1	Explain basic computer structure and compare computer architecture models
CS/IT203.2	Design algorithms to solve ALU operations and memory mapping techniques
CS/IT203.3	Comprehend processor architecture with various design methods of CPU with comparative analysis
CS/IT203.4	Illustrate memory systems with design and analysis of mapping techniques for cache and virtual memory
CS/IT203.5	Analyze different parallel processing and pipelining concepts with pipelining hazards
CS/IT203.6	Comprehend different types of I/O buses , compare and contrast different types of data transfer methods and arbitration techniques

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS/IT203.1	3											
CS/IT203.2		3			3			3		3		
CS/IT203.3	3	2										
CS/IT203.4		2	1									
CS/IT203.5		2	1									
CS/IT203.6	3											

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS/IT203.1							
CS/IT203.2							
CS/IT203.3							
CS/IT203.4							
CS/IT203.5							
CS/IT203.6							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✔	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Overview of Computer Architecture and Organization**		**5**
	1.1	Introduction of Computer Organization and Architecture, Basic organization of computer and block level description of the functional units, Evolution of x86 Computers, Von Neumann model, Harvard Model, Embedded system	1	
	1.2	Performance Issues: Designing for performance, Amdahl's Law, Multi-core, GPGPU	1	
2	**Title**	**Data Representation and Arithmetic Algorithms**		**6**
	2.1	Number representation: Floating-point representation, Floating point arithmetic, IEEE 754 floating point number representation	2,3	
	2.2	Integer Data computation: Addition, Subtraction. Multiplication: Signed multiplication, Booth's algorithm.	2,3	
	2.3	Division of integers: Restoring and non-restoring division	2,3	
3	**Title**	**Processor Organization and Control Unit**		**9**
	3.1	CPU Architecture, Register Organization Instruction formats, basic instruction cycle. Instruction interpretation and sequencing, Case Study of 8086 architecture and Register Organization	1,2,4	
	3.2	Control Unit: Soft wired (Micro-programmed) and hardwired control unit design methods. Microinstruction sequencing and execution. Micro operations	2,4	
	3.3	RISC and CISC: Introduction to RISC and CISC architectures and design issues.	2,4	
4	**Title**	**Memory Organization**		**11**
	4.1	Introduction to Memory and Memory parameters. Classifications of primary and secondary memories. Types of RAM and ROM, Allocation policies, Memory hierarchy and characteristics.	1,2	
	4.2	Cache memory: Concept, architecture (L1, L2, L3), mapping techniques. Cache Coherency, Interleaved and Associative memory.	1,2	
	4.3	Virtual Memory: Concept, Segmentation and Paging, Page replacement policies	1,2,4	
5	**Title**	**I/O Organization and Introduction to Parallel Processing**		**11**

	5.1	Buses: Types of Buses, Bus Arbitration, BUS standards	2	
	5.2	I/O Interface, I/O channels, I/O modules and IO processor, Types of data transfer techniques: Programmed I/O, Interrupt driven I/O and DMA.	1,2	
	5,3	Introduction to parallel processing concepts, Flynn's classifications, pipeline processing, Pipeline stages, Pipeline Hazards	1,2,4	
6	**Self Study**	Comparative Study of microprocessors and micro architectures with respect to their important features. 8086 instructions and assembler directives with addressing modes with memory interfacing techniques. Cache memory protocol and virtual memory concepts in Pentium processors. Vector and Array Processors with VLIW architecture.	Ref. 2,5,6	**6***
			Total (* Not included)	**42**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No.	**Title of the Experiment**
1	Implement various Arithmetic Operations through Assembly Language Programming for microprocessor 8086 (MASM)
2	Simulate the operation of COPY and PASTE in 8086 (MASM)
3	Implement various String Operations in 8086 through the utilities provided by DOS interrupts (MASM)
4	Generation of alphabetic arrangement of a given string in 8086 (MASM)
5	Design password application (generation and detection) in 8086 (MASM/C)
6	Design of Carry Look Ahead Adder
7	Implement Booth's Multiplication Algorithm
8	Implement Division Algorithm (Non-Restoring and Restoring)
9	Implement Mapping techniques of Cache memory
10	Implement Page Replacement Policies

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Computer Organization	Fifth	Carl Hamacher, Zvonko Vranesic, Safwat Zaky	Tata McGraw-Hill	2002
2	Computer Organization and Architecture: Designing for Performance	Eighth	William Stallings	Pearson	2010
3	Computer System Architecture	Third	M, Morris Mano	Pearson	2007
4	Computer Architecture & Organization	Third	John P. Hayes	McGraw-Hill	1998

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Structured Computer Organization	Sixth	Andrew S. Tanenbaum	Pearson	2013
2	Microprocessor and Interfacing: Programming & Hardware	Third	Douglas V Hall	Tata-McGraw Hill	2012
3	Computer Architecture and Organization: Design Principles and Applications	Second	B. Govindarajulu	McGraw Hill	2017
4	Programmer's reference Manual for IBM Personal Computers	First	Steven Armburst	McGraw Hill	1986
5	Pentium Processor System Architecture	Second	Don Anderson, Tom Shanley, MindShare Inc, MindShare, Inc	Addison-Wesley Professional	1995
6	Modern Processor Design: Fundamentals of Superscalar Processors	Second	John Paul Shen , Mikko H. Lipasti	Waveland Press Inc.	2013

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Database Management systems	3	0	2	5	10	3	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
CS204/IT204		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	-
Course Objective: To efficiently and effectively Design, develop, maintain and retrieve the Information from DBMS.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
CS/IT204.1	Demonstrate understanding of given system to construct a database model.
CS/IT204.2	Apply various Relational and SQL commands on the populated database.
CS/IT204.3	Examine the functional dependencies to make a normalized database system.
CS/IT204.4	Examine transaction processing techniques on a database.
CS/IT204.5	Illustrate query processing and optimization method on a database.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS/IT204.1	1	2	2	2	2	1		1	2			2
CS/IT204.2	2	2	2		2							
CS/IT204.3	1	2	2		2							
CS/IT204.4	1	2			2							
CS/IT204.5	2	2										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	**PEO2**	**PEO3**	**PEO4**	**PSO1**	**PSO2**	**PSO3**
CS/IT204.1					3(IT)	3(CS)	
CS/IT204.2							
CS/IT204.3							
CS/IT204.4							
CS/IT204.5						2(IT)	

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	**Understand**	**Apply**	**Analyze** ✔	**Evaluate**	**Create**

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Introduction: Database Concepts and ER Modeling**	1,2	**09**
	1.1	Introduction to basic concept of Database, Characteristics of databases, File system V/s Database system, Users of Database system, Database Administrator, Data Independence, Codd's Rule, DBMS system architecture.		
	1.2	Introduction to ER model, Benefits of Data Modeling, Types of data Models, Phases of Database Modeling, The Entity-Relationship (ER) Model, Extended Entity-Relationship (EER) Model		
2	**Title**	**Relational Algebra and SQL**	1,2	**16**
	2.1	Introduction, Mapping the ER and EER Model to the Relational Model, Relational Algebra: Overview, Basic Operators, Extended Operators		
	2.2	Overview of SQL, Data Definition Commands, Data Manipulation commands, Data Control commands, Set operations, aggregate function, null values, Views in SQL, Subquery, Trigger, stored procedure		
3	**Title**	**Normalization**	1,2	**06**
	3.1	Design guidelines for relational schema, Functional dependencies		
	3.2	Normal Forms- 1NF, 2 NF, 3NF, BCNF and 4NF,5NF		
4	**Title**	**Transaction Processing and Recovery**	1,2	**07**
	4.1	Transaction concept, Transaction states, ACID properties, Implementation of atomicity and durability, Concurrent Executions, Serializability, Recoverability, Lock-based, Timestamp-based, Validation-based protocols.		
	4.2	Shadow paging, Deadlock handling.		
5	**Title**	**Introduction to Query Processing and Query Optimization**	1,2	**04**
	5.1	Basics of Query Processing, Measures of Query Cost		
	5.2	Query Optimization: Equivalence Rules, Pictorial representations		
6	**Self Study**	1. Relational Calculus-Information retrieval 2. NO SQL-Data type, Database creation, Basic command for creation, updating and querying the database, Mongo dB	1,2	**5***
			Total (*Not included)	**42**

Laboratory Component:
Assign a case study for group of 2/3 students and each group will perform following experiments on the case study.

Exp No.	Title of the Experiment
1	Formulate a case study and create an E-R Diagram. Mapping of E-R model to Relational Model.
2	To create a database and populate using SQL commands (With constraints) ● Data Definition Language- Create, Alter, Drop, Rename, Truncate ● Data Manipulation Language- Insert, Update, Delete, Select ● Constraints-Not Null, Unique Key, Primary Key, Foreign Key, Check, Dropping a Constraint.
3	To perform DCL, TCL commands ● Data Control Language: Grant, Revoke, Roles ● Transaction Control Language: Commit, Rollback, Save point
4	To perform Date, Time, Arithmetic and Set operation on database.
5	To perform Aggregate function and Group by- Having clause on database
6	To perform Join operations on database. ● Equijoins, Non-Equijoins, Self Joins, Outer Join, cross Join
7	To retrieve a data using Subquery.
8	To Create a different view of database.
9	To examine integrity of database using Triggers.
10	To improve performance of system using stored procedure.

Textbooks

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Database System Concepts	Seventh	Korth, Slberchatz, Sudarshan	McGraw – Hill	2019
2	Fundamentals of Database Systems	Sixth	Elmasri and Navathe	PEARSON Education	2011

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Database Management Systems	Third	Raghu Ramkrishnan and Johannes Gehrke	TMH	2003
2	Database Management Systems	First	G. K. Gupta	McGraw – Hill.	2018
3	SQL, PL/SQL programming language of ORACLE	Forth	Ivan Bayross	BPB	2010

Semester-IV

Sem IV									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	BSC	MA201	Linear Algebra	2	0	2	5	09	3
1	BSC*	MA204	Foundation of Mathematics-II	3	0	0	6	09	3
2	PC	CS205	Design and Analysis of Algorithms	3	0	2	5	10	4
3	PC	CS206	Operating Systems	3	0	2	5	10	4
4	PC	CS207	Computer Communications and Networks	3	0	2	5	10	4
5	SBC	CS208	Mini Project-I	0	0	0	4	04	2
6	ABL	SVXX/STXX	SEVA II or III /SATVA II or III	0	0	0	3	01	1
7	HSSE	HSEX2	HSS-II	2	0	0	3	05	2
8	SBC	AS201	Professional Communication Skills	1	0	2	2	05	2
9	S/M	SCX1/MNX1	SCOPE-I/Minor-I						3
TOTAL				**14**	**0**	**10**	**32**	**54**	**22**

**Only for Lateral Entry Students*

Summer term for HSC students									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	MLC	AS202	Constitution of India	1	0	0	05	06	NC

Summer term (For Lateral Entry Students)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	BSC	MA201	Linear Algebra	2	0	2	5	09	3
1	BSC	MA203	Probability and Statistics	3	0	0	5	08	3
2	MLC	AS202	Constitution of India				06	06	NC

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Linear Algebra	2	0	2	5	9	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
MA201		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	Engineering Calculus/Foundation of Mathematics-I and Differential Equations and Complex Analysis/Foundation of Mathematics-II
Course Objective: To develop mathematical skills for solving engineering problems.	
Course Outcomes (CO):*At the End of the course students will be able to:*	
MA201.1	Solve a homogeneous and non-homogeneous system of linear equations using rank of a matrix.
MA201.2	Solve system of linear equations by Numerical Methods.
MA201.3	Solve equations in real life problems and to encode and decode messages using the concept of matrices.
MA201.4	Identify whether given structures are vector spaces and subspaces and construct a basis for them.
MA201.5	Show if a given matrix is diagonalisable or not.
MA201.6	Apply concepts of eigenvalues and eigenvectors to calculate functions of a square matrix, google page rank vector and solve systems of differential equations using diagonalisation of matrices.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MA201.1	3											
MA201.2	3											
MA201.3	3	1										
MA201.4	3											
MA201.5	3											
MA201.6	3	1										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
MA201.1							
MA201.2							
MA201.3							
MA201.4							
MA201.5							
MA201.6							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember✔	**Understand**✔	**Apply**✔	**Analyze**	**Evaluate**	**Create**

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref**	**Hrs.**
1	**Title**	**Basics of matrices**	**3,5**	**03**
	1.1	Revision of basic matrices and types of matrices.		01
	1.2	Row echelon form, Reduced Row Echelon form, Rank of a matrix.		02
2	**Title**	**Linear equations & its solutions**	**1,2,3,5**	**07**
	2.1	Consistency and solution of simultaneous linear homogeneous and non-homogeneous equations.		02
	2.2	Application of solving systems of equations in traffic control.		01
	2.3	Solution of system of linear algebraic equations, by (1) Gauss Elimination Method (2) Gauss Jordan method (3) Gauss Jacobi Iteration method (4) Gauss Seidel Method. (5) LU Decomposition -Crout's method		04
3	**Title**	**Vector spaces (over field of real numbers)**	**1,2,5**	**08**
	3.1	Vector space, subspace, span, linear dependence and independence of vectors, basis, dimension, orthogonal projection & gram-Schmidt process. Null space, row space, column space, Rank-Nullity theorem (only statement). Least square method.		08
4	**Title**	**Encoding & decoding using Matrices.**	**4**	**02**
	4.1	Application of matrices to Coding and Decoding		02
5	**Title**	**Eigenvalues and Eigenvectors**	**1,2,3,5**	**08**
	5.1	Eigenvalues, Eigenvectors and its properties. Cayley Hamilton theorem and its applications. Diagonalisation of matrices. Derogatory and Non-derogatory matrices.		04
	5.2	Application to find google page rank. Functions of a square matrix. Solving system of differential equations using diagonalisation.		04
6	**Self Study**	1.2 Normal form. 2.2 Forming equations using KVL for circuits and solving them using matrices. 3.1 Singular Value Decomposition. 5.1 Additional properties with proofs of eigenvalues and eigenvectors.	**1,2,3,5**	05
			Total	**28***

***Total of 28 hours does not include the self-study hours.**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Introduction to Scilab (getting started) and its benefits to use as a mathematics tool.
2	Basic commands of Scilab and vectors & matrix operations.
3	Conditional branching and iterations using Scilab.
4	Solution of linear equations using row-echelon and inverse of a matrix.
5	Solutions of linear equations using Gauss Elimination method.
6	Solutions of linear equations using Gauss Jordan method.
7	Solutions of linear equations using Gauss-Jacobi method.
8	Solutions of linear equations using Gauss-Seidel method.
9	Solutions of linear equations using Crout's method.
10	To find Eigenvalues and Eigenvectors using Scilab

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Linear Algebra and its applications	Fourth	Gilbert Strang	Cengage	2014
2	Higher Engineering Mathematics	Forty Fourth	Dr. B. S. Grewal	Khanna Publications	2020

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Linear Algebra and its applications	Third	David. C. Lay	Pearson Education	2006
2	Elementary Linear Algebra Application Version	Sixth	H Anton and Crorres	John Wiley and Sons	2010
3	Advanced Engineering Mathematics	Twenty Eighth	H.K Das	S.Chand	2014
4	Hill Ciphers	First	Jonaki B Ghosh	At Right Angles	2015
5	Advanced Engineering Mathematics	Tenth	Erwin Kreysizg	John Wiley & Sons	2011

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Foundations of Mathematics-II	2	1	0	0	3	2	1	0	3
		Examination Scheme								
MA204		Component	ISE		MSE		ESE		Total	
		Theory	75		75		150		300	
		Laboratory	--		--		--		--	

Pre-requisite Course Codes, if any.	Foundations of Mathematics-I
Course Objective: To develop basic foundation of mathematical skills.	
Course Outcomes (CO):*At the End of the course students will be able to: -*	
MA204.1	Integrate a function of one variable using various techniques
MA204.2	Sketch basic curves and solve double and triple integrals.
MA204.3	Solve basic problems using properties of complex numbers.
MA204.4	Solve differential equations of first order.
MA204.5	Apply the techniques of solving first order differential equations to electrical engineering problems.
MA204.6	Solve differential equations of higher order

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MA204.1	1											
MA204.2	1											
MA204.3	1											
MA204.4	2											
MA204.5	1	1										
MA204.6	2											

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2
MA204.1						
MA204.2						
MA204.3						
MA204.4						
MA204.5						
MA204.6						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember ✓	**Understand** ✓	**Apply** ✓	**Analyze**	**Evaluate**	**Create**

Theory Component

Module No.	Unit No.	Topics	Ref	Hrs.
1	**Title**	**Integral Calculus**	1,2	**13**
	1.1	Formulae for integral of standard functions, integration by parts, integration by method of substitution.		04
	1.2	Gamma functions, Beta functions. Differentiation under Integral sign with constant limits and one parameter.		04
	1.3	Standard curves (lines, circles, parabolas, ellipses). Concept of double integration. Evaluation of double and triple integrals.		05
2	**Title**	**Complex Numbers**	1,2	**03**
	2.1	Operations on complex numbers, polar form of a complex number, properties of a complex number.		03
3	**Title**	**Differential Equations**	1,2	**12**
	3.1	Exact differential equations. Linear differential equations of the first order and equations reducible to linear.		04
	3.2	Solving differential equations of first order in electrical networks.		01
	3.3	Linear differential equations with constant coefficients: complementary function and particular integral.		07
Total				**28**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Higher Engineering Mathematics	Forty Fourth	Dr. B. S. Grewal	Khanna Publications	2020

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Advanced Engineering Mathematics	Tenth	Erwin Kreysizg	John Wiley & Sons	2011
2	Advanced Engineering Mathematics	Twenty Eighth	H.K.Dass	S.Chand	2014

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Design and Analysis of Algorithms	3	0	2	5	10	3	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
CS205/IT205		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	Advanced Data Structures
Course Objective: 1. To teach paradigms and approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice. 2. To make students understand how the worst-case time complexity of an algorithm is defined, how asymptotic notation is used to provide a classification of algorithms.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS/IT205.1	Analyze time and space complexity of an algorithm.
CS/IT205.2	Apply divide and conquer strategy to solve problems.
CS/IT205.3	Apply the concept of dynamic programming and greedy approach to solve problems.
CS/IT205.4	Apply the idea of backtracking, branch and bound strategy to solve problems.
CS/IT205.5	Apply various string matching algorithms.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS/IT205.1	3	2						1		1		1
CS/IT205.2	3	2	2	1				1	1	1		1
CS/IT205.3	3	2	2	1				1	1	1		1
CS/IT205.4	3	2	2	1				1	1	1		1
CS/IT205.5	3	2	2					1	1	1		1

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	**PEO2**	**PEO3**	**PEO4**	**PSO1**	**PSO2**	**PSO3**
CS/IT205.1							
CS/IT205.2	1(CS)	1(IT)	1(CS)		1(IT)	1(CS)	
CS/IT205.3	1(CS)	1(IT)	1(CS)		1(IT)	1(CS)	
CS/IT205.4	1(CS)	1(IT)	1(CS)		1(IT)	1(CS)	
CS/IT205.5	1(CS)	1(IT)	1(CS)		1(IT)	1(CS)	

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	**Understand**	**Apply**	**Analyze** ✔	**Evaluate**	**Create**

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Introduction to Analysis of algorithm**		**12**
	1.1	Role of Algorithms in Computing, Performance analysis-space and time complexity, Growth of Functions: Asymptotic Notation, Standard Notation and Common Functions, Analysis of sorting algorithms Such as Selection sort and insertion sort.	1,2	
	1.2	Divide and Conquer Approach – General Method, Analysis of Merge Sort, Analysis of Quick sort, Analysis of Binary search, Finding the maximum and minimum, Strassen's matrix multiplication.	1,2	
	1.3	Recurrences: The substitution method, Recursion tree method, Master method and Proof.	1	
2	**Title**	**Dynamic Programming and Amortized Analysis**		**12**
	2.1	Dynamic Programming: Assembly-line scheduling, Matrix Chain Multiplication, Longest common subsequence.	1	
	2.2	Amortized analysis- Aggregate analysis, accounting and Potential Method, Dynamic Table.	1	
3	**Title**	**Greedy Approach**		**5**
	3.1	Greedy Approach: Basic strategy, application to job sequencing with deadlines problem, single source shortest path-Dijkstra's algorithm.	1,2	
	3.2	Knapsack problem, Minimum cost spanning trees-Kruskal and prim's algorithm.	1,2	
4	**Title**	**Backtracking and Branch-and-bound**		**5**
	4.1	Backtracking: General method, 8 queen problem (N-queen problem), Sum of subsets, Graph coloring.	2	
	4.2	Branch and Bound: 0/1 knapsack problem, Travelling salesman problem, 15 puzzle problem.	2	
5	**Title**	**Approximation and String Matching algorithms**		**8**
	5.1	**Approximation algorithms:** The vertex-cover problem, The traveling-salesman problem, The set covering problem	1	

	5.2	**String Matching algorithms:** The naïve string matching Algorithms, The Rabin Karp algorithm, String matching with finite automata, The Knuth-Morris-Pratt algorithm	1	
6	**Self Study**	**NP-complete problems:** Basic concepts, Non-deterministic Algorithms, NP-hard and NP-complete, Cook's Theorem, NP-Hard graph and scheduling Problems. NP-completeness and reducibility, decision and optimization problems, polynomial reduction	1,2	**5***
Total				**42**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No.	**Title of the Experiment**
1	Experiment on finding the running time of an algorithm.
2	Experiment based on divide and conquers approach.
3	Experiment on Recurrence relation.
4	Experiment using dynamic programming approach
5	Experiment based on greedy approach
6	Experiment based on graph Algorithms
7	Experiment using Backtracking strategy
8	Experiment using branch and bound strategy
9	Experiment based on Approximation Algorithms
10	Experiment on string matching algorithms.

Text Book(s):

Sr. No.	**Title**	**Edition**	**Authors**	**Publisher**	**Year**
1	Introduction to Algorithms	Third	Thomas H. Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein	MIT Press	2009
2	Fundamentals of Computer Algorithms	Second	Horowitz E, Sahni S and S. Rajasekaran	Galgotia Publications	2010

Reference Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	The Design and analysis of algorithms	First	**Alfred V. Aho, John E. Hopcroft** and **Jeffrey D. Ullman**	Pearson Education India	2006

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Operating Systems	3	0	2	5	10	3	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
CS206/IT206		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	Computer Architecture and Organization
Course Objective: To understand structure of OS, process synchronization ,memory management and file system.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS/IT206.1	Comprehend the primitive concepts of Operating System services and System Programming functionality.
CS/IT206.2	Articulate process scheduling algorithms in effective execution of processes.
CS/IT206.3	Acquaint with efficient process synchronization techniques in effective execution of programs.
CS/IT206.4	Analyze virtual memory management algorithms in effective allocation of main memory usage.
CS/IT206.5	Evaluates various algorithms of File Storage & I/O management for performance and quality criterion.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS/IT206.1	1											1
CS/IT206.2	2	2	2	2					2			2
CS/IT206.3	2	2	2	2					2			2
CS/IT206.4	2	2	2	2					2			2
CS/IT206.5	2	2	2	2					2			2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS/IT206.1							
CS/IT206.2							
CS/IT206.3						2(CS)	
CS/IT206.4							
CS/IT206.5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply✔	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Introduction to System Software and Operating Systems**		**8**
	1.1	**System Software** – Introduction, Goal, Systems Programs and Systems Programming, Views of Systems Software. **Linkers and Loader** – Relocation and Linking Concepts, Design of Linker, Self-Relocating Programs, Linking of Overlay Structured Programs, Dynamic Linking, Loaders.	1	
	1.2	**Operating Systems** – Introduction, Structure and Principles of Operations of Operating Systems, Classes of Operating Systems, Batch Processing Systems, Multi programming Systems, Time Sharing Systems, Real Time Operating Systems.	1	
2	**Title**	**Process Management**		**8**
	2.1	**Processes and Threads** – Process Concept, Process Scheduling, Operations on Processes, Multi core Programming, Multi threading Models, Thread Libraries, Implicit Threading, Threading Issues, Operating-System Examples	2	
	2.2	**UNIX Process and Threads –** Process Abstraction, Process Creation using fork and exec, invoking new process, process termination, awaiting process termination, User and Kernel Threads.	3	
3	**Title**	**Process Coordination**		**12**
	3.1	**Process Synchronization** - Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization Examples	2	
	3.2	**CPU Scheduling** - Scheduling Criteria, Scheduling Algorithms, Real-Time CPU Scheduling, Operating-System Examples. **Deadlock** - Characterization, Methods for Handling Deadlocks, Detection, Prevention, Avoidance, Recovery methods for Deadlock.	2	
	3.3	**UNIX IPC –** Universal IPC Facilities, System V IPC, Message, Ports, Message Passing, Port Operations.	3	
4	**Title**	**Memory management**		**6**
	4.1	**Memory Management Strategies** - Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table.	2	
	4.2	**Virtual Memory Management** - Demand Paging, Allocation of Frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory, Operating-System Examples.	2	
5	**Title**	**File Management**		**8**

	5.1	**Storage Management** - Disk Structure, Disk Scheduling, Disk Management	2	
	5.2	**File-System Implementation** - File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management	2	
	5.3	**UNIX Internal File Representation -** Inodes, Structure of Regular File, Directories, Path Name to Inode Conversion, Super Block, Inode Assignment, Allocation of Disk blocks, Other File Types.	4	
6	**Self Study**	1) Explore Features, characteristics and CPU scheduling of Real-Time Operating System along an example 2) Explore the requirements of Kernel, CPU Scheduling, Disk Scheduling for Multimedia Systems 3) Explore all UNIX System Calls for File System.	2,4	**5***
			Total (*Not included)	**42**

List of Experiments for Operating System Laboratory

Sr. No.	Title of the Experiment
1	Installation of Linux OS on Virtual Machine.
2	Write a program for creating a static/dynamic link library for complex number operations and then test this library through linuxld linker.
3	Write a program which creates exactly 16 copies of itself by calling fork() only twice within a loop. The program should also print a tree of the pids.
4	Write a program to simulate the following non-preemptive CPU scheduling algorithms to find turnaround time and waiting time. a) FCFS b) SJF c) Round Robin d) Priority
5	The program r.c initializes *n* number of semaphores. It first assign count equal -1, which is then used by process p and q. This count is protected by semaphore. It also allocates shared memory of size 40 ints. It waits for process p and q to enter all n1 and n2 elements through different terminals. This program r.c sorts shared data in ascending order. It waits to finish p and q. At end, The program r.c detaches and deletes *n* semaphores and print the sorted list.
6	Write a multithreaded program for preventing race conditions and deadlock avoidance for the banker's algorithm as follows. Several customers' request and release resources from the bank. The banker will grant a request only if it leaves the system in a safe state. A request that leaves the system in an unsafe state will be denied.
7	Write a program which acts as a chat application between two users on the same computer using shared memory.
8	Assume that a system has a 32-bit virtual address with a 4-KB page size. Write a C program that is passed a virtual address (in decimal) on the command line and have it output the page number and offset for the given address. As an example, your program would run as follows: ./a.out 19986 Your program would output: The address 19986 contains: page number = 4 offset = 3602 Writing this program will require using the appropriate data type to store 32 bits. We encourage you to use unsigned data types as well.
9	Write a program to simulate disk scheduling algorithms a) FCFS b) SCAN c) C-SCAN
10	Write a program to prevent destructive update of files by locking as follows: Suppose the inode contains a new permission setting such that it allows only one process at a time to open the file for writing, but many processes can open the file for reading.

Note – Implement all programs in C language under Linux OS environment

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	System Programming	First	D M Dhamdhere	Tata McGraw-Hill Education	2011
2	Operating System Concepts	Ninth	Abraham Silberschatz, Peter B Galvin, Greg Gagne	Wiley	2012
3	UNIX Internals: The New Frontiers	First	UreshVahalia	Prentice Hall	1995
4	Design of the UNIX Operating Systems	First	Maurice J. Bach	Prentice-Hall	1990

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Operating Systems: Internals and Design Principles	Eighth	William Stallings	Pearson	2014
2	Modern Operating Systems	Fourth	Andrew S. Tanenbaum, Herbert Bos	Pearson	2014

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Computer Communications and Networks	3	0	2	5	10	3	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
CS207/IT207		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective: Understand the state-of-the-art in network protocols, architectures and applications.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
CS/IT207.1	Describe the fundamental concepts of Data Communication.
CS/IT207.2	Distinguish the different layers of the OSI model and TCP/IP.
CS/IT207.3	Identify the different types of protocols and their functions within a network.
CS/IT207.4	Apply the knowledge of sub netting, routing mechanisms and Software Defined Networking.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS/IT207.1	2	1						1	1			2
CS/IT207.2	2	2						1	1			2
CS/IT207.3	2	2						1	1			2
CS/IT207.4	2	2						1	1			2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	**PEO2**	**PEO3**	**PEO4**	**PSO1**	**PSO2**	**PSO3**
CS/IT207.1	3(CS)/2(IT)				1(IT)		
CS/IT207.2	3(CS)/2(IT)				1(IT)		
CS/IT207.3	3(CS)/2(IT)				1(IT)		
CS/IT207.4	3(CS)/2(IT)				1(IT)		

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	**Understand**	**Apply** ✔	**Analyze**	**Evaluate**	**Create**

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Computer Communication and The Internet**	1,2	**10**
	1.1	Internet: A Nut and Bolts Description, A Services Description, Protocol. The Network Edge: Access Network, The Network Core: Packet Switching, Circuit Switching, A Network of Networks	1,2	
	1.2	Delay, Loss, Throughput in Packet Switched Networks: Overview of Delay in Packet Switched Networks, Queuing Delay and Packet Loss, End to End Delay, Throughput in Computer Networks.	1,2	
	1.3	Protocol Layers and their Service Models: Layered Architecture and their Encapsulation.	1,2	
	1.4	Data and Signals: Analog and Digital, Periodic analog signals, Digital signals, Transmission impairment.	2	
	1.5	Digital Transmission: Digital-to-Digital conversion, Analog-to-Digital conversion. Transmission modes, Analog Transmission: Digital-to-Analog conversion, Analog-to-Analog conversion.	2	
2	**Title**	**Application Layer**	1,2	**6**
	2.1	Principles of Network Applications: Network Applications Architecture, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the Internet, Application Layer Protocols.	1,2	
	2.2	The Web and HTTP: Overview of HTTP, Non Persistent and Persistent Connections, HTTP Message Format, User Server Interaction: Cookies, Web Catching, The Conditional Get.	1,2	
	2.3	File Transfer Ftp: Ftp Commands and Replies. FTP, SMTP, Mail Access Protocol (IMAP, POP), DNS	1,2	
3	**Title**	**Transport Layer**	1,2	**8**
	3.1	Introduction and Transport-Layer Services: Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet	1,2	
	3.2	Multiplexing and Demultiplexing	1,2	
	3.3	Connection less Transport - UDP: UDP Segment Structure, UDP Checksum	1,2	
	3.4	Principles of Reliable Data Transfer: Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N (GBN), Selective Repeat (SR),	1,2	

	3.5	Connection-Oriented Transport - TCP: The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management	1,2	
	3.6	Principles of Congestion Control: The Causes and the Costs of Congestion, Approaches to Congestion Control.	1,2	
4	**Title**	**The Network Layer**	1,2	**10**
	4.1	Introduction: Forwarding and Routing, Network Service Models.	1,2	
	4.2	Virtual Circuit and Datagram Networks: Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks.	1,2	
	4.3	Router: Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane.	1,2	
	4.4	The Internet Protocol (IP): Forwarding and Addressing in the Internet, Datagram Format, IPv4 Addressing, Internet Control Message Protocol (ICMP), IPv6	1,2	
	4.5	Routing Algorithms: The Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm, Hierarchical Routing	1,2	
	4.6	Software Defined Networking: Introduction and Overview	R3	
5	**Title**	**The Link Layer: Links, Access Networks, and LANs**	1,2	**8**
	5.1	Introduction to the Link Layer: The Services Provided by the Link Layer, Implementation of the Link Layer	1,2	
	5.2	Error-Detection and Correction Techniques: Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC)	1,2	
	5.3	Multiple Access Links and Protocols: Channel Partitioning Protocols, Random Access Protocols, Taking-Turns Protocols.	1,2	
6*	**Title**	**Self Study Topic**	1,2	**5***
	6.1	Transmission Media: Guided media, Unguided media: Wireless	1,2	
	6.2	ARP and RARP usage	1,2	
	6.3	Multicast routing and Broadcast routing	1,2	
	6.4	Routing in the Internet: Intra-AS Routing in the Internet: RIP, Intra-AS Routing in the Internet: OSPF, Inter-AS Routing: BGP	1,2	
	6.5	Network Function Virtualization	R3	
Total				**42**

***This module hrs. not included in Total 42 hrs**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Use and interpret basic Networking Utilities
2	Describe various Network Topology and Networking Hardware
3	Experiment with Packet Tracers/Analyzers
4	Implement Web server and DHCP server for given scenario
5	Implement TELNET and FTP server for given scenario
6	Implement SMTP server for given scenario
7	Implement DNS server for given scenario
8	Develop client-server model using Socket Programming for given scenario
9	Illustrate basic Mininet operations for Software Defined Networking
10	Implement in Mininet to control switch manually

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Computer Networking: Top Down Approach	Sixth	James Kurose and Kieth Ross	Pearson	2013
2	Data Communication and Networking	Second	Behrouz Forouzan	McGraw Hill	2000

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Computer Networks	Fifth	Andrew Tanenbaum	Pearson	2013
2	Computer Networks	Third	Larry L. Peterson and Bruce Davie	Morgon Huffman	2003
3	SDN and NFV Simplified	First	Jim Doherty	Addison Wesley	2016

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(SBC)	Professional Communication Skills	1	0	2	2	5	1	0	1	2
AS201		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	--		--		--			--
		Laboratory	200		--		--			200

Pre-requisite Course Codes, if any.	
Course Objective: To demonstrate the desired spoken and written communication skills required in early professional life, with focus on job placements.	
Course Outcomes (CO):*At the End of the course students will be able to*	
AS201.1	Demonstrate the spoken and written skills for job placements.
AS201.2	Draft professional documents.
AS201.3	Design written communication for social media.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS201.1										2		
AS201.2										2		
AS201.3										2		

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
AS201.1							
AS201.2							
AS201.3							

BLOOM'S Levels Targeted (Pl. appropriate)

Remember	Understand	Apply ✓	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	L Hrs.	P Hrs
1.	Title	**Placement Skills**		6	12
	1.1	Resume Writing & Cover Letter			
	1.2	Group Discussion			
	1.3	Case Studies/Pitching a startup			
	1.4	Team Building Skills/Work			
	1.5	Interview Skills			
2	Title	**Corporate Communication**		6	12
	2.1	Presentation Skills			
	2.2	Meeting: Notice, Agenda, Minutes			
	2.3	Proposal Writing			
	2.4	Report Writing: Informative, Analytical report			
3	Title	**Research Writing**		2	4
	3.1	Sourcing information through digital media			
	3.2	Written communication using social media: Blog			
4	Self Study	**Research Paper, News Analysis**			6*
			Total	42 hrs	

***Not included in the total**

List of ISEs

Sr. No.	Title of the Experiment
1	Resume
2	Cover Letter
3	GD
4	Mock Interview
5	Presentation
6	Blog Writing
7	Team Building Activity
8	Minutes of the Meeting/Notice & Agenda
9	Proposal Writing
10	Report Writing

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Interpersonal Skills at Work	2002	John Hayes	McGraw Hill Education	2002
2	Campus Placement: A Comprehensive Guide	2016	Ankur Malhotra	McGraw Hill Education	2016

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	If I Understood You, Would I Have This Look on My Face? My Adventures in the Art and Science of Relating and Communicating	FIRST	Alan Alda	Random House	2017
2	Handbook for Writing Proposals	SECOND	Robert J. Hamper, Sue Baugh	McGraw Hill Education	2010
3	Effective Communication Skills for Scientific and Technical Professionals	2000	Harry Chambers	Paperback Basic Books	2000
4	The Art Of Writing Together	2008	William Issac	Crown Business	2008
5	Communication Skills	2011	Meenakshi Raman, Sangeeta Sharma	Oxford, India	2011

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned				
		L	T	P	O	E	L	T	P	O	Total
(SBC)	Mini Project-I	0	0	0	4	4	0	0	0	2	2
		Examination Scheme									
CS208/IT208		Component			ISE		MSE		ESE		Total
		Theory			--		--		--		--
		Laboratory			100		--		100		200

Pre-requisite Course Codes, if any.	
Course Objective: To develop the skills of Planning and Designing the working model for solving the real world Problem.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS/IT208.1	Discover potential research areas for addressing societal issues
CS/IT208.2	Conduct a survey of basic and contemporary literature in the preferred field of study.
CS/IT208.3	Formulate and propose a plan for creating a solution for the research plan identified.
CS/IT208.4	Exercise the team building, communication and management for design and implementation of projects.
CS/IT208.5	Compare and contrast the several existing solutions for research challenge
CS/IT208.6	Report and present the findings of the study conducted in the preferred domain.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS/IT208.1	2	2				2		3	3	3		2
CS/IT208.2	2	2				2		3	3	3		2
CS/IT208.3	2	3					2	3	3	3		2
CS/IT208.4	2		3	1	2			3	3	3	3	2
CS/IT208.5	2	2		2				3	3	3		2
CS/IT208.6	2	2						3	3	3		2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS/IT208.1	2(IT)/2(CS)	2(IT)/2(CS)	2(IT)/2(CS)	2(IT)	2(IT)	2(IT)/2(CS)	2(IT)
CS/IT208.2	2(IT)/2(CS)	2(IT)/2(CS)	2(IT)/2(CS)	2(IT)	2(IT)	2(IT)/2(CS)	2(IT)
CS/IT208.3	2(IT)/2(CS)	2(IT)/2(CS)	2(IT)/2(CS)	2(IT)	2(IT)	2(IT)/2(CS)	2(IT)
CS/IT208.4	2(IT)/2(CS)	2(IT)/2(CS)	2(IT)/2(CS)	2(IT)	3(IT)	2(IT)/2(CS)	2(IT)
CS/IT208.5	2(IT)/2(CS)	2(IT)/2(CS)	2(IT)/2(CS)	2(IT)	2(IT)	2(IT)/2(CS)	2(IT)
CS/IT208.6	2(IT)/2(CS)	2(IT)/2(CS)	2(IT)/2(CS)	2(IT)	2(IT)	2(IT)/2(CS)	2(IT)

BLOOM'S Levels Targeted (Pl. appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✔

Mini-project is an opportunity to make a difference in the experience of education in its own way. It is an attempt of scientific study of the problem in surrounding in order to guide, correct and evaluate the actions and decisions about it. It is based on a small project correlating scientific knowledge and day to day experience which encourages development of scientific attitude to solve real life problems among students.

The Objectives of Action Research are:

- ✓ To make students sensitive towards societal issues
- ✓ To learn scientific principles from day-to-day experiences
- ✓ To develop psycho-technological skills through observation, classification, statement of hypothesis etc.
- ✓ Development of communication, organizational skills and maturity through discussion, presentation etc.
- ✓ To develop ability to correlate science, technology and society
- ✓ To apply engineering knowledge and propose innovative, sustainable solutions to the real-life challenges

Steps for Implementation (ISE: 2 Phases) and ESE

- ✓ Keen observation of the surrounding/society
- ✓ Identification of the problem
- ✓ Analysis of the problem
- ✓ Collection of relevant information by formulating research questions
- ✓ Suggesting plan of action
- ✓ Conducting experiments
- ✓ To draw conclusion
- ✓ To find the possible solution to rectify the problem
- ✓ To execute experiments and remedial measures wherever possible

Students can seek guidance from teachers, other experts and make effective use of other sources of information available around them. Students must ensure that problem to be solved in manageable in one semester.

Criteria of a good project:

- ✓ Appropriate idea, clear understanding, and proper presentation of the concept
- ✓ Quality of work
- ✓ Project plan and its execution
- ✓ Credibility of the work
- ✓ Probable impact of the work on the attitude of students and society
- ✓ Scientific attitude, creativity and novelty reflected in project work and analysis of the situation
- ✓ Utility and innovation of the remedial measures
- ✓ Desirability, Feasibility and Viability in real life

The H/W and S/W resources required to complete the Mini-Project-I may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be on

- Learning additional skills
- Development of ability to define and design the problem and lead to its accomplishment with proper planning
- Learn the behavioral discipline by working in a team. The team may be maximum three (03) students.

Evaluation:

Project report should contain project title, student details, certificate and acknowledgements. Other sections of the report shall be decided by the department based on projects. But it must have introduction, necessity of project, objectives, hypothesis, plan, observations, analysis of results, conclusion and references along with other sections related to technology. The ISE and ESE evaluation will be carried out based on the rubrics framed by the Department. The ESE marks will be based on final demonstration of the project and viva based on it and report/poster/technical paper of the project in the standard format provided by the Department.

Semester V

Sem V									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	PC	AI301	Theory of Computation	3	0	0	6	9	3
2	PC	AI302	Fundamentals of signal & Image Processing	3	0	2	5	10	4
3	PC	AI 303	Fundamentals of AI	3	0	2	5	10	4
4	PC	AI304	Neural Network & Fuzzy Logic	3	0	2	5	10	4
5	SBC	AI 305	Internet Technology Lab	1	0	2	5	08	2
7	HSSE	HSEX3	HSS-III	2	0	0	3	05	2
8	ABL	SVXX/STXX	SEVA II or III /SATVA II or III	0	0	0	3	3	1
9	S/M	SCX2/MNX2	SCOPE-II/Minor-II						3
TOTAL				**15**	**0**	**8**	**29**	**52**	**20**

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Theory of Computation	3	0	0	6	9	3	0	0	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AI301		Theory	75		75		150			300
		Laboratory	--		--		--			--

Pre-requisite Course Codes, if any.	CS201/IT201: Discrete Structures and Graph Theory
Course Objective: To give an overview of the theoretical foundations of computer science from the perspective of formal languages which provides the mathematical foundation of formal models of computation, and fundamentals of formal grammars and languages that is used in most areas of computer science.	
Course Outcomes (CO): ***At the end of the course students will be able to***	
AI301.1	Design finite automaton for a regular expressions and languages.
AI301.2	Apply the properties of regular languages.
AI301.3	Construct the grammar for a language and convert it into normal forms.
AI301.4	Design and Evaluate Pushdown Automata and Turing Machine for a language.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AI301 1	3	3	2		1				1	1		
AI301.2	3	2							1	1		
AI301.3	2	3			1				1	1		
AI301.4	2	2	2		1				1	1		

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
AI301.1							
AI301.2							
AI301.3							
AI301.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create
			✓		

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Sets, Relations and Languages**	1,5	**3**
	1.1	Relations and functions		
	1.2	Alphabets and languages		
	1.3	Types of proof		
2	**Title**	**Finite Automata**	1,3,5	**7**
	2.1	Regular languages and regular expressions		
	2.2	Finite Automata, Nondeterministic Finite Automata, Nondeterministic Finite Automata with **ϵ**-transitions		
	2.3	Kleene's theorem		
	2.4	NFA to DFA Conversion		
	2.5	Finite Automata with output (Moore and Mealy Machine)		
3	**Title**	**Regular Languages**	1,4	**6**
	3.1	The pumping lemma for regular languages, Applications of the pumping lemma		
	3.2	Closure properties for regular languages		
	3.3	Equivalence and minimization of automata: Testing equivalence of states, Minimization of DFA's		
4	**Title**	**Context-Free Grammars and Languages**	1,5	**5**
	4.1	Context free grammars: Definition of context free grammars, Derivations using a grammar, The language of a grammar, Sentential forms		
	4.2	Parse trees: Constructing parse trees, From inferences to trees, From trees to derivations, From derivations to recursive inferences		
	4.3	Ambiguity in grammars and languages: Ambiguous grammars, Removing ambiguity from grammars		
5	**Title**	**Pushdown Automata**	1,2	**6**
	5.1	Definition of the pushdown automaton: The formal definition of pushdown automata, A graphical notation for PDA's, Instantaneous descriptions of a PDA		

	5.2	The languages of a PDA: Acceptance by final state, Acceptance by empty stack, From empty stack to final state, From final state to empty stack		
	5.3	Equivalence of PDA's and CFG's: From grammars to pushdown automata, From PDA's to Grammar		
	5.4	Deterministic pushdown automata: Definition of a deterministic PDA, Regular languages and deterministic PDA's, DPDA's and context free languages		
6	**Title**	**Properties of Context-Free Languages**	1,2,3	**5**
	6.1	Eliminating useless symbols, Computing the generating and reachable symbols, Chomsky normal form, Greibach normal form		
	6.2	The Pumping lemma for context free languages: Applications of the pumping lemma for CFL's		
7	**Title**	**Introduction to Turing Machines**	1,2,	**6**
	7.1	Turing machines: Formal definition of a Turing machine, Examples of Turing machines		
	7.2	Halting Problem, Post Correspondence Problem (PCP)		
	7.3	Variants of Turing machines: Multitape Turing Machines		
	7.4	Church-Turing hypothesis		
8	**Title**	**Recursively Enumerable Languages**	3	
	8.1	Recursively Enumerable and recursive		**4**
	8.2	Enumerating a language		
	8.3	Context sensitive languages and the Chomsky hierarchy		
	Self Study	**Tractable and Intractable Problems:** Tractable and Possibly Intractable Problems: P and NP, Polynomial-Time Reductions and NP-Completeness, Cook's Theorem	3	**5***
Total (*Not included)				**42**

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Introduction to Automata Theory, Languages, and Computation	Third	John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman	Pearson	2008
2	Introduction to the Theory of computation	Third	Michael Sipser	Cengage	2013

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
3	Introduction to Languages and the Theory of Computation	Fourth	John C. Martin	McGraw-Hill	2010
4	Elements of the Theory of Computation	Second	Harry R. Lewis, Christos H. Papadimitriou	Pearson	2015
5	Automata and Computability	--	Dexter C. Kozen	Springer	1997

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Fundamentals of Signal & Image Processing	3	0	2	5	10	3	0	1	4
		Examination Scheme								
AI302		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective:	
Course Outcomes (CO): ***At the End of the course students will be able to***	
AI302.1	Interpret DT signal and perform signal manipulation in Time Domain.
AI302.2	Evaluate the techniques for enhancing and segmenting Images.
AI302.3	Categorize various compression techniques and standards for Images.
AI302.4	Apply signal and image processing algorithms in practical applications.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AI302.1	2	2										
AI302.2			3									
AI302.3			3									
AI302.4		2										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
AI302.1				3			
AI302.2				3	3		
AI302.3				3	3		
AI302.4				3			

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze ✓	Evaluate ✓	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Discrete-Time Signal**	T1,T2	**10**
	1.1	Introduction: Signals, Systems, and Signal, Continuous Time signal, Discrete - Time signal and representation, Digital signal, The Sampling theorem, Some elementary discrete time signals, Classification of Discrete - Time Signals, Modifications of Discrete - Time Signals.	T1,T2	
	1.2	Operations on Discrete - Time Signals: Linear Convolution, Circular Convolution, Matrix Representation of Circular Convolution, Linear Convolution using Circular Convolution, Auto and Cross Correlation.	T1,T2	
	1.3	Discrete - Time systems: Static and dynamic, time variant and time invariant, linear and nonlinear, causal and non causal. Representation of system using impulse response, Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) system, Response of the FIR system using convolution.	T1,T2	
2	**Title**	**Discrete Fourier Transform**	T1,T2	**10**
	2.1	Introduction to DTFT, Relation between DFT and DTFT, DFT of DT signal, Inverse DFT. Properties of DFT, Computations in DFT	T1,T2	
	2.2	Fast Fourier Transform (FFT): Need of FFT, Radix-2 DIT-FFT algorithm, Flow graph for N=4 and 8 using Radix-2 DIT-FFT, Inverse FFT algorithm, Computations in FFT, Linear FIR filtering using Overlap Add Algorithm and Overlap Save Algorithm and implementation using FFT.	T1,T2	
3	**Title**	**Image Enhancement and Segmentation**		**10**
	3.1	Point Processing, Histogram processing, Smoothing and Sharpening Filters.	T4	
	3.2	Detection of discontinuities, Edge linking and Boundary detection, Hough transform, Thresholding, Region oriented segmentation	T4	
4	**Title**	**Morphological Image Processing**		**06**
	4.1	Image Morphology: Structuring Element, Erosion & Dilation, Opening & Closing, Hit and Miss Transform, Region filling.	T4	
5	**Title**	**Image Compression**		**06**

	5.1	Redundancies, Lossy and Lossless Compression	T4	
	5.2	RLE, Huffman Coding, Arithmetic Coding, LZW, Predictive Coding and JPEG		
6	**Self Study***	Multi-rate Signal Processing: Up sampling and Down sampling, Carl Correlation Coefficient for measurement of degree of similarity between two signals. Object Representation and Object Detection, Object Recognition, Applications of Image Processing		**06**
			Total	**42**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	Title of the Experiment	Marks
1	Signal Operations	5
2	Discrete Convolution	5
3	Discrete Correlation	5
4	Discrete Fourier Transform	5
5	Image Enhancement using Point Processing Operations.	5
6	Smoothing and Sharpening of Images.	5
7	To enhance Image using Histogram equalization.	5
8	To segment Image using Image Segmentation.	5
9	To perform morphological operations on Image	5
10	To implement compression of the Image.	5

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Digital Signal Processing : Principles, Algorithms and Applications	Fourth edition	Proakis Manolakis	Pearson Education, ISBN 81-317-1000-9	2007
2	Digital Signal Processing	First edition	S. Salivahanan, A. Vallavaraj, C. Gnanapriya	TataMcgraw Hill ISBN 978-0-07-066924-6	2010
3	Digital Signal Processing: A Computer Science Perspective	First Edition published on 25th Sept, 2000	Jonathan (Y) Stein	Copyright © 2000 John Wiley & Sons, Inc Print ISBN:9780471295464 |Online ISBN:9780471200598 |DOI:10.1002/047120059X	2000
4	Digital Image Processing	3rd	Rafael C. Gonzalez and Richard E. Woods	Pearson Education	2010

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Digital Signal Processing: A Practical Approach		Emmanuel C. Ifeachor, Barrie W. Jervis	Pearson Education ISBN 0-201-59619- 9	2001
2	Digital Signal Processing	Sixth Edition	P. Ramesh Babu	Scitech Publication	2014
3	Handbook on Image and Video Processing	--	A.I.Bovik	Academic Press	2009

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Fundamentals of AI	3	0	2	5	10	3	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AI303		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
AI303.1	Illustrate the building blocks of AI as presented in terms of intelligent agents
AI303.2	Analyze the real-time problem as per appropriate search method in AI
AI303.3	Choose an appropriate problem-solving method and knowledge-representation scheme for a given problem to solve
AI303.4	Develop simple intelligent systems or classical toy problems using different AI techniques

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AI303.1	2	3			2						2	
AI303.2	2	3	2	2							2	
AI303.3	2	3	2	2						1	2	
AI303.4	2	3	2	2	2					2	2	2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
AI303.1							
AI303.2							
AI303.3							
AI303.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Introduction to Artificial Intelligence**	T1, T2	**4**
	1.1	Definition of AI, History, and Future of AI, Problem-solving Approach to Typical AI Problem.		
	1.2	Intelligent Agents and Environment the structure of an agent, Types of Agents, Environments and Its Properties, PEAS Representation for an Agent		
2	**Title**	**Problem-Solving using Searching**		
	2.1	**Uninformed search techniques:** Depth First Search, Breadth First Search, Uniform Cost Search,	T1, T2	**12**
	2.2	Depth Limited Search, Iterative Deepening, Bidirectional Search, Comparing Different Techniques		
	2.3	**Informed Search Methods:** Heuristic functions, Best First Search, A*, IDA*, SMA*, Hill Climbing, Simulated Annealing, Genetic Search	T1, T2	
	2.4	**Adversarial Search:** Game playing, Min-max search procedure, Alpha-beta pruning, Waiting for Quiescence		
	2.5	Crypto Arithmetic Problems, Backtracking for Constraint Satisfaction Problem, Performance Evaluation		
3	**Title**	**Knowledge Representation and Reasoning**	T1	**10**
	3.1	Knowledge-based agents, Wumpus world. Propositional Logic: Representation, Inference, Reasoning Patterns, The resolution, Forward and Backward Chaining.		
	3.2	First-order Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining.		
	3.3	Basics of PROLOG: Representation, Structure, Backtracking. Expert System: A case study of Expert System in PROLOG		
4	**Title**	**Learning & Planning**	T1	**08**

	4.1	What is Learning, Types of Learning (Rote, Direct instruction Analogy, Induction, Deduction),		
	4.2	Planning: Block world, strips, Implementation using goal stack,		
	4.3	Non-linear planning with goal stacks, Hierarchical planning, and Least commitment strategy.		
5	**Title**	**Uncertain Knowledge and Reasoning**	T1	**08**
	5.1	Quantifying Uncertainty, Representing Knowledge in an Uncertain Domain		
	5.2	Conditional Probability, Joint Probability		
	5.3	Bayes Theorem, Belief Networks, Simple Inference in Belief Networks		
6	**Self Study**	Case study on Applications of AI like Digital Biology, Cognitive Robotics, Natural Language Processing, Biometrics, Cyber Security,		**05**
Total				**42**

Laboratory Components, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	Title of the Experiment
1	Problem formulation and implementation of an Intelligent Agent.
2	Implement a given problem using the Uninformed searching technique
3	Implement a given problem using the Informed searching technique
4	Implement hill climbing algorithm to solve 8 puzzle problems
5	Implement Simulated Annealing
6	Implement any 2 Player game using Game playing algorithms
7	To design and implement an intelligent system, incorporating the matching algorithm and the rule language. 1. It should provide a fact base updating function. 2. It should provide a function that checks the rules' LHS and returns which rules were matched. 3. It should support firing RHS according to matches. Using SWISH Prolog or Java or Python or any other open-source tool
8	Implement an Expert system using Prolog
9	Implement constraint satisfaction problem
10	Implement inference using Bayes theorem

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Artificial Intelligence: A Modern Approach	4th Edition	Stuart Russell and Peter Norvig	Prentice-Hall	2009
2	Artificial Intelligence	3rd Edition	Elaine Rich and Kerin Knight	McGraw Hill.	2008

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	The Sciences of the Artificial	3rd Edition	Herbert A. Simon	MIT Press	1998
2	Artificial Intelligence: Structures and Strategies for Complex Problem Solving	4th Edition	George F Luger	Pearson Edu.	2011

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Neural Network and Fuzzy Logic	3	0	2	5	10	2	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AI304		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any. Mathematics	
Course Objective: This course introduces fundamental concepts of Neural networks and Fuzzy Logic. Students will be able to understand the design of an expert system using neural networks and Fuzzy logic system for implementation of real-world applications.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
AI304.1	Identify the various characteristics of Neural Network techniques in building intelligent machines
AI304.2	Apply the supervised and unsupervised Neural Network Learning algorithm to solve real world engineering problems.
AI304.3	Design an associative memory network for real world problems
AI304.4	Design Fuzzy Logic Controller System
AI304.5	Analysis Working of NN-FL Hybrid System

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AI304.1	2	2	--	2	--	--	--	--	--	--	--	--
AI304.2	2	2	2	2	2	--	--	--	1	1	--	--
AI304.3	2	2	2	2	2	--	--	--	1	1	--	--
AI304.4		2	2	2	2	--	--	--	--	--	--	--
AI304.5		2	2	2	2	--	--	--	--	--	--	--

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	**PEO2**	**PEO3**	**PEO4**	**PSO1**	**PSO2**	**PSO3**
AI304.1	--	--	--	--	--	--	--
AI304.2	--	--	--	--	--	--	--
AI304.3	--	--	--	--	--	--	--
AI304.4	--	--	--	--	--	--	--
AI304.5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	**Create**

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Neural Network**s	T1, T2 T3, R1	**12**
	1.1	**Basics of Neural Networks:** Introduction to Neural Networks, Biological Neural Networks, Models of ANN, terminologies in ANN, Activation functions and its types		
	1.2	McCulloch Pitt model, Linear separability, Hebb Network		
	1.3	S**upervised Learning algorithms:** Perceptron (Single Layer, Multi layer),, Adaline, Delta learning rule, Back Propagation algorithm.		
	1.4	**Un-Supervised Learning algorithms:** Hebbian Learning, Winner take all, Self-Organizing Maps KSOFMN , Learning Vector Quantization.		
2	**Title**	**Associative Memory Networks**	T2, T3,T4	**6**
	2.1	Autoassociative and Heteroassociative Memory Network,BAM, Hopfield network.		
3	**Title**	**Fuzzy Logic, Classical Set and Fuzzy Relations**	T2, T3,T4, R1, R3	**12**
	3.1	Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Functions, Classical and Fuzzy set operations, and properties of classical and Fuzzy sets.		
	3.2	Classical and Fuzzy Relations**:** Cartesian product of relation, Fuzzy Max-Min and Max-Product Composition, Fuzzy extension principle		
4	**Title**	**Fuzzy control system design**	T2, T3 T4	**8**
	4.1	Fuzzy Inference System(FIS),Types of FIS, Fuzzy Systems- fuzzification, defuzzification methods, and design of fuzzy controllers.		
5	**Title**	**Neuro-Fuzzy Hybrid model**	T2, R2	**4**
	5.1	Introduction of Neuro-Fuzzy Systems, Architecture of Neuro-Fuzzy Networks(ANFIS and CANFIS)		
6	**Self Study**	Adaptive Resonance Theory, Genetic, CNN. Transfer Learning	-	**5**
			Total	**42**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	Title of the Experiment
1	To implement Transfer/Activation Functions for a given problem statement. i) A symmetric hard limit transfer function. ii) A Binary step activation function. iii) A Bipolar step activation function. iv) A saturating linear transfer function. v) A hyperbolic tangent sigmoid (tansig) transfer function. vi) A log-sigmoid transfer function
2	To design ANN to implement logic gates.
3	To implement Hebb Network for a given problem statement.
4	To design and implement ANN for a given problem statement: 1. Design a perceptron using Joone Editor. 2. Write a program using Single Layer perceptron
5	To implement the Supervised Learning algorithm.
6	To implement the Unsupervised Learning algorithm
7	To implement Associative Memory Network for a given problem statement
8	To implement Fuzzy Sets and Fuzzy Relations for a given problem statement
9	To design and implement Fuzzy Logic controller for a given problem statement
10	To design and implement ANFIS model for a given problem statement

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
T1	Introduction to Artificial Neural Systems	1st	Jacek M. Zurada	Jaico Publisher	1994
T2	Principles of Soft Computing	3rd	Sivanandan and Deepa	Pearson Edition	2019
T3	Fuzzy logic with engineering applications	3rd	Ross, Timothy J	John Wiley & Sons	2011
T4	Neural Networks, Fuzzy Logic and Genetic Algorithms	Kindle	S.Rajasekaran and G.A.VijayalakshmiPai	PHI Learning	2013

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
R1	Neural Network Design	2nd	Hagan, Demuth, Beale	CENGAGE Learning	2014
R2	Neuro-Fuzzy and Soft Computing	1st	J.-S.R.Jang .	Pearson	1996
R3	Introduction to Soft Computing	1st	Sameer Roy	Pearson	2013

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(SBC)	Internet Technology Lab	1	0	2	6	8	1	0	1	2
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AI305		Theory	--		--		--			--
		Laboratory	100		--		100			200

Pre-requisite Course Codes, if any.	CS208
Course Objective:	
Course Outcomes (CO): ***At the End of the course students will be able to***	
AI305.1	Develop a sophisticated web UX
AI30.25	Create, integrate and test REST based web services
AI305.3	Design secured web application/ web services
AI305.4	Demonstrate behavior of web crawlers and testing of web application

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AI305.1					3							
AI30.25					3							
AI305.3					3							
AI305.4					3							

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
AI305.1							
AI30.25							
AI305.3							
AI305.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✔

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Designing UI**		**2**
	1.1	Fundamentals of UX Design, Defining UX Solutions, Design Communication and Visualizing Ideas	1	
2		**Web content management system**		**1**
	2.1	Introduction to Web CMS, different types of Web CMS	2	
3		**Web services**		**2**
	3.1	Introduction to web service, REST architecture	3	
4		**Web mashups**		**1**
	4.1	Introduction to web mashups, server side mashups, client side mashups	2	
5		**Secured Web application**		**2**
	5.1	Introduction to Web Tokens, Auth2.0, OAuth, Access token	2	
6		**Integration of web services**		**2**
	6.1	Introduction to Mule ESB, Introduction to Anypoint studio, Integrating Web Services using Any point studio	4	
7		**Web crawlers**		**2**
	7.1	Introduction to web crawler, role of crawler in the internet, concept of page ranking	3	
8		**Testing web applications**		**2**
	8.1	Introduction to different types of testing, manual testing, automated testing, performance testing and functional testing, open source tools used for testing	2	
Total				**14**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	Title of the Experiment
1	Design web pages using HTML, CSS and javascript
2	Create a website using web CMS (Node Js/Angular Js/React Js/Flask/Django/Wordpress/Joomla etc.)
3	Design UX for a given problem definition by using open source UX tools
4	Create a Restful webservice to demonstrate different HTTP methods
5	Testing of restful web service using Postman/ARC
6	Create a web mashup of web services using open source framework
7	Design secured Web application using web token
8	Integration of web services using open source integration tools like Mulesoft
9	Demonstrate the behavior of Web Crawlers/ spiders (use XPATH,CSS PATH),extract information and store it in the database.
10	Test the web application using open source testing tools like Selenium, Test runner and Junit

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Sketching the User experiences	2nd edition	Bill Buxton	Diane Cerra	2010
2	Rich Internet Application AJAX and Beyond	3rd edition	Dana Moore, Raymond Budd, Edward Benson	WROX Publisher	2017
3	Web Technology	2nd Edition	Srinivasan	Pearson	2014
4	API Recipes with Mulesoft(r) Anypoint Platform	1st Edition	WHISHWORKS Editorial Board	White falcon	2017

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	https://nodejs.org				
2	https://angularjs.org/				
3	https://reactjs.org/				
4	Internet Technology And Web Design	1st edition	R. K. JAIN	Khanna Book Publishing Company	2015
5	Understanding the Internet: A Clear Guide to Internet Technologies	1st edition	Keith Sutherland	A Butterworth-Heinemann Title	2016
6	RESTful Web APIs: Services for a Changing World	3rd edition	Leonard Richardson, Mike Amundsen, Sam Ruby	O'REILLY	2013

Semester VI

Sem VI (Cat 1- For Students who have NOT preferred semester long internship)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	OE	OEXXX	Open Elective-I	2	0	2	4	8	3
2	PC	AI306	Distributed Computing	3	0	2	5	10	4
3	PC	AI307	Machine Learning	3	0	2	5	10	4
4	PE	AI3X1	PE-I	2	0	2	4	8	3
5	PE	AI3X2	PE-II	2	0	2	4	8	3
6	SBC	AI308	Main Project-Stage-I	0	0	0	8	8	3
7	ABL	SVXX/STXX	SEVA II or III /SATVA II or III	0	0	0	3	3	1
8	S/M	SCX3/MNX3	SCOPE-III/Minor-III						3
TOTAL				**12**	**0**	**10**	**33**	**55**	**21**

Sem VI (Cat 2-For Students who have preferred semester long internship)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	PE*	AI3X1	PE-I	2	0	2	4	8	3
2	PE*	AI3X2	PE-II	2	0	2	4	8	3
4	SBC	AI309	Research Internship	0	0	0	40	40	15
5	S/M*	SCXX/MNXX	SCOPE-III/Minor-III						3
TOTAL				**4**	**0**	**4**	**48**	**56**	**21**
*To be completed online mode or allied courses from MOOCs									

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PC	Distributed Computing	3	0	2	5	10	3	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AI306		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	DS206 /AI202 : Operating Systems DS207/ AI203:Computer Networks and Communications
Course Objective: To familiarize students with the fundamental concepts, techniques and design of Distributed Systems and use of distributed computing applications domains.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
AI306.1	Understand the principles and desired properties of distributed systems.
	Apply the various communication techniques for distributed communication.
AI306.2	Apply the concepts of process, naming, consistency, replication and faults tolerance in a distributed environment.
AI306.3	Apply the algorithms such as clock synchronization, election, and mutual exclusion in distributed applications.
AI306.4	Identify the challenges in developing distributed applications.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO 2	PO3	PO 4	PO 5	PO6	PO 7	PO8	PO 9	PO10	PO11	PO12
AI306.1	2	1	-	-	-	-	-	-	-	-	-	2
AI306.2	2	2	2	1	-	-	-	2	2	1	-	2
AI306.3	2	2	2	1	-	-	-	2	2	1	-	2
AI306.4	2	2	2	1	-	-	-	1	2	1	-	2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PE04	PSO1	PSO2	PS03
AI306.1							
AI306.2							
AI306.3							
AI306.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create
			✓		

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Introduction to Distributed Systems**		
	1.1	Definition, Type, Goals, Distributed Computing Models, Issues in Distributed Systems.	**T1, T2**	**08**
	1.2	Hardware Concepts, Software Concepts, The Client-Server Model, Positioning Middleware, Models of Middleware, Services offered by Middleware, models of Distributed Algorithms and some fundamental problems.	**T1, T2**	
2	**Title**	**Communication In Distributed Systems**		**12**
	2.1	Introduction to Message Passing, Desirable Features of a Good Message-Passing System, Issues in IPC by Message Passing, Synchronization, Buffering, Multi-datagram Messages, Group Communication,persistence and synchronicity in communication, Message Oriented Transient and Persistent Communications	**T1, T2, R1**	
	2.2	Remote Procedure Call (RPC): Basic RPC Operations, Parameter Passing, Extended RPC Models. Remote Object Invocation: Distributed Objects, Binding a Client to an Object, Static Vs Dynamic RMI	**T1, T2**	
3	**Title**	**Process in Distributed Systems**		**6**
	3.1	Introduction to Threads, Threads in Distributed Systems, Clients, Server	**T1, T2**	
	3.2	Code Migration: Approaches to Code Migration, Models, Migration and Local Resources, Migration in Heterogeneous Systems	**T1, T2**	
4	**Title**	**Synchronization in Distributed Systems**		**10**
	4.1	Clock Synchronization: Physical Clocks, Global Positioning System, Clock Synchronization Algorithms; Logical Clocks: Lamport's Logical Clocks, Vector Clocks	**T1, T2**	
	4.2	Election Algorithms: Bully and Ring; Mutual Exclusion: Centralized Algorithm, Decentralized Algorithm, Distributed Algorithm, Token Ring Algorithm, Comparison of Algorithms; Load Balancing: Goals, Types, Strategies.	**T1, T2,**	
5	**Title**	**Consistency and Replication**		**6**
	5.1	Reasons for Replication, Object Replication, Replication as Scaling Technique Data Replication in Distributed Systems, Goals, Types, Schemes,	**T1**	
	5.2	Data-Centric Consistency Models, Client Centric Consistency Models Continuous Consistency, Consistent Ordering of Operations	**T1**	

6	**Self Study**	Naming Entities, Locating Mobile Entities, Distribution Protocols, Consistency Protocols, Faults Tolerance: Process Resilience, Distributed Commit, Recovery	**T1, T2, R1, R2**	**8**
Total				**42**

Laboratory Component, if any (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiments
1	Implementation of Client Server Communication using RPC.
2	Implementation of Client Server Communication using RMI.
3	Implementation of Clock Synchronization (logical/physical).
4	Implementation of Election algorithm.
5	Implementation of Mutual Exclusion algorithm.
6	Implementation of a Client Server based program to check data consistency.
7	Implement Load Balancing Algorithms.
8	Implement small application using data replication
9.	Implementation of Client Server based program to check data consistency.
10.	Implement Load Balancing Algorithms

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Distributed Systems– Principles and Paradigms.	Second Edition	Andrew S. Tanenbaum, Maarten Van Steen	PHI	2016
2	Distributed Operating Systems Concepts and Design	Second Edition	P. K. Sinha	PHI	2010

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Distributed Systems – Concept and Design	Fourth Edition	George Coulouris, Jean Dollimore, Tim Kindberg & Gordon Blair	Pearson	2010
2	Distributed VOD Systems	First Edition	Sudhir D. & Bandu B.M	Research India Publication	2011

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Machine Learning	3	0	2	4	8	2	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AI307		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective: To learn methodology and tools to apply machine learning algorithms to real data and evaluate their performance.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
AI307.1	Discuss the fundamentals of Machine Learning.
AI307.2	Solve regression and classification techniques suitable for a given problem
AI307.3	Apply the problems using clustering and dimensionality reduction techniques.
AI307.4	Design an application of different concepts and algorithms covered in the course.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AI307.1	2	2	--	--	--	--	--	--	2	2	2	2
AI307.2	2	2	2	--	2	--	--	--	2	2	2	2
AI307.3	2	2	2	--	2	--	--	--	2	2	2	2
AI307.4	2	2	2	2	2	--	--	--	2	2	2	2

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Introduction to Machine Learning**		**06**
	1.1	What is machine learning, Why Machine learning, Broad categories of machine learning algorithms- supervised and unsupervised learning.	**T1,T2**	
	1.2	Supervised learning- classification and regression, unsupervised learning-clustering. Real world applications of supervised and unsupervised algorithms.	**T1,T2**	
	1.3	Parametric Vs. non Parametric Models, Curse of dimensionality, model selection, No free lunch theorem, Bias-variance trade off	**T1,T2**	
2	**Title**	**Regression**		**06**
	2.1	Simple Linear Regression, Ordinary Least square, Multiple Regression,	**T1,T2**	
	2.2	Logistic Regression for binary classification	**T1**	
3	**Title**	**Learning with Trees and Classification**		**14**
	3.1	Decision Trees, Constructing Decision Trees using Gini Index (Regression), Classification and Regression Trees (CART)	**T1,T2**	
	3.2	k-Nearest Neighbors Algorithm, Naïve Bayesian Classifier, Support Vector Machine, Kernels in SVM	**T2**	
	3.3	Testing Machine Learning Algorithms, Overfitting, Training, Testing, and Validation Sets, The Confusion Matrix, Accuracy Metrics, Unbalanced Datasets, Measurement Precision	**T1**	
4	**Title**	**Ensemble Learning**		**06**
	4.1	Boosting, Stumping, AdaBoost,	**T1,T2**	
	4.2	Bagging, Subagging, Random Forest, Comparison with Boosting	**T1**	
5	**Title**	**Learning with Clustering and Dimensionality Reduction**		**10**
	5.1	Introduction Measuring (dis)similarity, Evaluating the output of clustering methods. K-means algorithm, Agglomerative Algorithms.	**T1,T2**	
	5.1	Dimensionality Reduction Techniques, Principal Component Analysis, Linear Discriminant Analysis, Singular Valued Decomposition.	**T1, T2, T3**	
		Reinforcement Learning	**T1, T2**	**5***

6	**Self Study**	Elements of Reinforcement Learning, Q Learning, Non deterministic rewards and actions, Temporal Difference Learning, Generalization		
			Total	**42**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	**Title of the Experiment**
1	Implement Simple Linear Regression
2	Implement Multiple Linear Regression
3	Implement Logistic Regression
4	Implement Decision Tree algorithm
5	Implement K-Nearest Neighbors / Naive Bayes algorithm
6	Implement Random forest algorithm
7	Implement Clustering algorithm
8	Implement Principle Component Analysis/ Singular Valued Decomposition for Dimensionality Reduction
9	Implement Research paper 1
10	Implement Research paper 2

Text Books

S.N.	**Title**	**Edition**	**Authors**	**Publisher**	**Year**
1	Machine Learning: A probabilistic perspective	2nd edition	Kevin Murphy	MIT Press	2012
2	Machine Learning An Algorithmic Perspective	2nd Edition	Stephen Marsland	CRC Press	2014
3	Machine Learning In Action	1st	Peter Harrington	Dream Tech Press	2001

Reference Books

S.N.	Title	Edition	Authors	Publisher	Year
1	Data Mining - Concepts and Techniques	3rd Edition	Jiawei Han, Micheline Kamber, Jian Pei	Morgan Kaufmann Publishers	2012
2	Pattern Recognition and Machine Learning,	1st Edition	C. M. Bishop	Springer	2013
3	Machine Learning	1st Edition	Tom Mitchell	Mc-Grawhill	1997
4	Introduction to Machine Learning	3rd	Ethem Alpaydın	MIT , PRESS	2012
5	Elements of Statistical Learning	2nd Edition	Trevor Hastie Robert Tibshirani Jerome Friedman	Springer	2001

Useful Digital Links	
1	Data sets for Machine Learning algorithms: https://www.kaggle.com/datasets
2	Machine Learning repository- https://archive.ics.uci.edu/ml/index.php
3	Machine Learning from Coursera
4	https://towardsdatascience.com/machine-learning/home
5	https://onlinecourses.nptel.ac.in/noc21_cs85/preview

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE)	Computer Vision	2	0	2	5	9	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
1T11		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective:	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1T11.1	Understand the basics of 2D and 3D Computer Vision
1T11.2	Describe various geometric techniques in computer vision
1T11.3	Perform shape analysis and extract features from Images and do analysis of Images.
1T11.4	Explore the diverse applications of computer vision.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T11.1	2	2	2		3							1
1T11.2	3	2	3		3							1
1T11.3	3	2	3	**1**	3							1
1T11.4	3	3	3	**1**	3				3	**2**	2	2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T11.1							
1T11.2							
1T11.3							
1T11.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	Introduction to Computer Vision and Camera Geometry		**4**
	1.1	Image Processing, Computer Vision and Computer Graphics , What is Computer Vision - Low-level, Mid-level, High-level ,		
	1.2	**Camera Models and 3D Computer Vision,** Camera Calibration, Stereo Vision, Depth from Stereo, Generating 3D images from 2D views, Camera Projections, Camera Calibration		
	..			
2	**Title**	Digital Image Processing		**5**
	2.1	Image Formation, Image Filtering, Edge Detection, Principal Component Analysis,		
	2.2	Corner Detection, SIFT, Feature Extraction from images : Histogram of Gradient (LoG), Local Binary Patterns, Interest points . Harris detector, Hessian detector,		
	..			
3	**Title**	Binary Machine Vision		**6**
	3.1	Thresholding, Connected Components Labeling : An iterative Algorithm, The Classical Algorithm, A Space Efficient Two Pass Algorithm, Digital Signature,		
	3.2	Feature point tracking: Kanade-Lucas-Kanade tracker, Applications of feature point tracking: mosaicing, video stabilization		
4	**Title**	Shape Representation and Segmentation:		**7**
	4.1	Shape Representation and Segmentation: Contour based representation, Region based representation, De-formable curves and surfaces,		
	4.2	Snakes and active contours, Level set representations, Fourier, and wavelet descriptors, Medial representations, Multi-resolution analysis.		
5	**Title**	Computer Vision Applications		**6**
	5.1	Object Detection, Object Recognition, Object Classification, Real Time Monitoring, Human Motion Recognition and Tracking.		
	5.2	3D shape models of faces Application: Surveillance – foreground-background separation –human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians		
6	**Self-Study**	Machine learning in computer Vision: Introduction to Machine Learning, Image Classification, Semantic Segmentation		**4**
			Total	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are

1	Perform basic Image Handling and Processing operations on the image.
2	Geometric Transformation
3	Compute Homographic Matrix
4	Perspective Transformation
5	Edge Detection, Line Detection and Corner detection
6	Camera Calibration
7	IFT Feature descriptor ,SURF HOG descriptor SIFT Feature discriptor
8	SURF and HOG feature descriptor
9	Object detection and Recognition
10	Project based on Computer Vision Applications

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1.	Computer Vision A modern approach	**-**	D. Forsyth and J. Ponce	Prentice Hall	**-**
2.	Computer Vision: Algorithms and Applications	**-**	Richard Szeliski	Springer,	**2010**

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1.	Introductory Techniques for 3-D Computer Vision	-	Emanuele Trucco , Ales sandro Verri	Prentice Hal	Jan 1998

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE)	Explainable Artificial Intelligence	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
1T21		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	AI303, AI304
Course Objective: This course is designed to provide fundamental concepts of explainable AI.The students should be able to grasp the basic concepts of explainable AI, including its definition, importance, and the challenges involved in developing an AI system that is explainable. The students will be able to understand interpretability , explainability and attribution methods for AI models.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1T21.1	Understand the concept and importance of XAI and its applications in various domains.
1T21.2	To explore the various XAI techniques and tools used for tabular, image and text dataset.
1T21.3	To gain practical experience with XAI frameworks..
1T21.4	To evaluate the trade-offs between explainability and accuracy.
1T21.5	To Understand ethical and legal aspects of XAI

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T21.1												
1T21.2												
1T21.3												
1T21.4												
1T21.5												

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T21.1							
1T21.2							
1T21.3							
1T21.4							
1T21.5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	Introduction to Explainable Artificial Intelligence		**4**
	1.1	Why Explainable AI?, What Is Explainable AI?, Who Needs Explainability?, Challenges in Explainability, Types of explanation,	T1-T3, R1,R2	
2	**Title**	Explainability for Tabular Data		**8**
	2.1	Permutation Feature Importance: Permutation Feature Importance from Scratch, Permutation Feature Importance in scikit-learn	T1-T3 R1-R5	
	2.2	Shapley Values: SHAP (Shapley Additive exPlanations), Visualizing Local Feature Attributions, Visualizing Global Feature Attributions, Interpreting Feature Attributions from Shapley Values, Managed Shapley Values		
	2.3	Explaining Tree-Based Models: From Decision Trees to Tree Ensembles, SHAP's TreeExplainer		
	2.4	Partial Dependence Plots and Related Plots: Partial Dependence Plots (PDPs), Individual Conditional Expectation Plots (ICEs)		
3	**Title**	Explainability for Image Data		**8**
	3.1	Integrated Gradients (IG), Choosing a Baseline, Accumulating Gradients, Improvements on Integrated Gradients, (Extremal regions with attributions importance) XRAI, How XRAI Works, Implementing XRAI, Grad-CAM, How Grad-CAM Works, Implementing Grad-CAM	T1-T3 R1,R2	
	3.2	LIME: How LIME Works, Implementing LIME, Guided Backpropagation and Guided Grad-CAM, Guided Backprop and DeConvNets, Guided Grad-CAM		
4	**Title**	Explainability for Text Data		**8**
	4.1	Overview of Building Models with Text: Tokenization, Word Embeddings and Pretrained Embeddings, LIME, How LIME Works with Text, Gradient x Input, Intuition from Linear Models From Linear to Nonlinear and Text Models	T1-T3, R1,R5	
	4.2	Layer Integrated Gradients: A Variation on Integrated Gradients, Layer-Wise Relevance Propagation (LRP), How LRP Works, Deriving Explanations from Attention, Which Method to Use?, Language Interpretability Tool		
6	**Self Study**	Building with Explainability in Mind, The ML Life Cycle AI Regulations and Explainability, What to Look Forward To in Explainable AI, Natural and Semantic Explanations, Interrogative Explanations, Targeted Explanations		**4**
			Total	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

No	Title of the Experiment
1	To implement a simple decision tree model. Note : students could implement decision trees using a dataset, visualize the decision tree, and explain the results
2	Feature Importance: To implement SHAP algorithm to calculate the feature importance on a given data set. Note:students could analyze a dataset and calculate the feature importance using an algorithm such as permutation importance or SHAP (SHapley Additive exPlanations), and explain the results.
3	Non linear relationship between features and predicted model: Interpretation and explanation of ML models [marginal effect of a single feature on the predicted outcome while holding all other features constant] To implement PDP(partial dependance plot) to calculate the feature importance on a given data set. Note: students could perform sensitivity analysis on a trained model to understand how the output varies with changes in the input features.
4	Non linear relationship between features and predicted model: Interpretation and explanation of ML models To implement ICE (Individual Conditional Expectation Plots) to calculate the feature importance on a given data set.[conditional effect of a single feature on the predicted outcome for each individual sample in a dataset] Note: students could perform sensitivity analysis on a trained model to understand how the output varies with changes in the input features.
5	To implement an IG algorithm for attributions analysis for a given problem statement.
6	To implement the XRAI algorithm for attributions analysis for a given problem statement.
7	To implement a grad-CAM method to generate class activation maps for a given problem statement.
8	Local Interpretable Model-agnostic methods: To implement LIME to explain the predictions of a given problem statement. Note: students could use model-agnostic methods such as LIME (Local Interpretable Model-Agnostic Explanations) or Anchors to explain the predictions of a machine learning model
9	To implement LIME to analyze text data, such as social media posts or customer reviews, and classify them into different categories.
10	To study LRP and demonstrate LIT by Google for interactive visualization, interpretation and understanding NLP models.

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1.	Explainable AI for Practitioners: Designing and Implementing Explainable ML Solutions	1st Edition	Michael Munn, David Pitman	OReilly Media, Inc	2022
2.	Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning	1st Edition	Uday Kamath , JohnLiu	Springer Link	2021
3.	Explainable AI: Interpreting, Explaining and Visualizing Deep Learning	1st Edition	Wojciech Samek,, Grégoire Montavon, , Andrea Vedaldi, , Lars Kai Hansen, Klaus-Robert Müller	Springer Link	2019

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1.	Interpretable Machine Learning: A Guide for Making Black Box Models Explainable	1st Edition	Christoph Molnar, published	Springer	2019
2.	Explainable AI: Interpreting, Explaining and Visualizing Deep Learning	1st Edition	Konstantinos G. Margaritis and Evangelos N. Daskalakis, published	Wiley	2020
3.	Explainable AI in Healthcare: An Interdisciplinary Approach	1st Edition	Kristin H. Jarman and Julia A. Lane	Springer	2021
4.	XAI - Explainable Artificial Intelligence: Foundations, Methods, and Applications	1st Edition	Fatma Bouali and Sihem Mesnager	Springer	2020
5.	Explainable AI: Interpreting, Explaining and Visualizing Deep Learning	1st Edition	Kalyan Veeramachaneni, published by	O'Reilly Media	2021

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE)	Big Data Analytics	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
IT12		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	Data Base Management System(CS204)
Course Objective:	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1T12.1	Understand the building blocks of Big Data Analytics.
1T12.2	Choose appropriate storage structures to make sense out of big data.
1T12.3	Apply scalable algorithms based on Hadoop and Map Reduce to perform Big Data Analytics.
1T12.4	Achieve adequate perspectives of big data analytics in various applications like, recommender systems, social media applications etc.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T12.1												
1T12.2												
1T12.3												
1T12.4												

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T12.1							
1T12.2							
1T12.3							
1T12.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	**Understand**	**Apply**	**Analyze** ✔	**Evaluate**	**Create**

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introduction to Big data**		**2**
	1.1	Big Data characteristics, types of Big Data, Traditional vs. Big Data, Big data challenges	1	
2	**Title**	**Memory-efficient data structures**		**6**
	2.1	Introduction to data streams, problems related to handling data stream, Mining Data Streams using DGIM algorithm, Need of dimensionality reduction - PCA, SVD - Singular Value Decomposition	3	
	2.2	Hash functions, universal / perfect hash families, Bloom filters, Sketches for distinct count, Flajolet Martin Sketch, Majority Algorithm, Misra-Gries sketch, Count-Min Sketch, Count Sketch, LSH, MinHash, SimHash	2	
3	**Title**	**Scaling with Big Data using Hadoop**		**8**
	3.1	HDFS - Data in Hadoop, MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures	1	
	3.2	Hadoop Ecosystem architecture **Hive** - Architecture, various data operations using Hive **HBase** - Architecture, General Commands **Pig** - What is Pig, advantages	1	
4	**Title**	**Frequent Itemsets And Clustering**		**5**
	4.1	Handling Larger Data sets in Main Memory Algorithm - Park, Chen and Yu Algorithm, The Multi stage Algorithm, The Multihash Algorithm. The SON Algorithm, BFR clustering algorithm, CURE algorithm	1	
5	**Title**	**Big Data Analytics Applications**		**7**
	5.1	Clustering of Social-Network Graphs - Clique Percolation Method, counting triangles, PageRank, Efficient Computation of PageRank, Topic-Sensitive PageRank, Link Spam, Hubs and Authorities	1	
	5.2	Recommendation Systems: Introduction, A Model for Recommendation Systems, Content based Recommendation System, Collaborative-Filtering System: Nearest Neighbour Technique		
7	**Self Study**	Scaling with Big Data using Apache SPARK SPARK Ecosystem, SPARK streaming, Distributed Batch Processing with Spark	4	**5***
		Total		28

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	Title of the Experiment
1	Installation of Hadoop and execution of HDFS commands
2	Study of any latest research paper on memory efficient data structure for big data.
3	Demonstrate use of modern tools like Matlab for Exploratory Data Analysis.
4	Implement algorithms in Map-Reduce on Strings and integers
5	Implement algorithms in Map-reduce on Relational Algebra
6	Download a real world dataset and find insights using map reduce. For e.g for a movie dataset list all the movies and the number of ratings, list all the Movie IDs which have been rated (Movie Id with at least one user rating it), list all the Users who have rated the movies (Users who have rated at least one movie), list of all the User with the max, min, average ratings they have given against any movie
7	To use Apache Hbase and implement CRUD operations on database inside HDFS.
8	Extract facts in real world dataset using Hive
9	Extract sessions in real world dataset using Pig
10	Implement wordcount using Apache Spark.

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Mining of Massive Datasets	3rd	Anand Raja Raman an Jeff Ullman	Cambridge University	2019
2	Algorithms and models of computation	1st	Jeff Erickson	University of Illinois	2015
3	Introducing Data Science	3rd	Davy Cielen, Meysma Mohamed Ali	Dreamtech Press	2014
4	Learning Apache Spark 2	2nd	Muhammad Asif Abba	Packt Publishing	2017

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Data streams :Algorithms and applications.	2nd	Muthukrishnan. S	now publishers In	2005
2	Introducing Data Science	3rd	Davy Cielen, Meysman, Mohamed Ali	Dreamtech Press	2015
3	Hadoop, the Definitive Guide	3rd	Tom White	O'Reilly	2013

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE)	Blockchain Technology and Applications	2	0	2	5	10	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
1T22		Theory	50		50		100			200
		Laboratory	50		-		50			100

Pre-requisite Course Codes, if any.	CSS
Course Objective: To apply and analyze different cryptography and system security protocols/techniques	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1T22.1	Describe the basic concepts of blockchain technology, Bitcoin, and Ethereum.
1T22.2	Apply and implement a smart contract on the Ethereum test network
1T22.3	Build a Decentralized Application running on a decentralized peer-to-peer network.
1T22.4	Evaluate and propose use cases for a new blockchain and/or cryptocurrency.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T22.1	2											
1T22.2			2									
1T22.3					2							
1T22.4		2	2		3	2						

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T22.1	**2**	-	-	-	-	**2**	-
1T22.2	**2**	-	-	-	-	**2**	-
1T22.3	**2**	-	-	-	-	**2**	-
1T22.4	**2**	-	-	-	-	**2**	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**1.1**	**Introduction to Blockchain Technology**		**08**
		Blockchain Basic, Four Core building blocks of blockchain, the Life cycle of Blockchain, Blockchain working, Difference between blockchain and databases, Centralized, Decentralized and Distributed system, Distributed Ledger Technology, Blockchain ecosystem and structure, Features of Blockchain, Advantages of Blockchain. Blockchain Primitives-Cryptography, PKI, Hash functions, properties of Hash Functions, Merkle Tree, Zero Knowledge Proof (ZKP), ZK-SNARK	1,2	
	1.2	**Distributed Consensus:** The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on the permissionless, Proof of Work (PoW) as a random oracle - formal treatment of consistency, liveness, and fairness - Proof of Stake (PoS) based Chains – Hybrid models (PoW + PoS).	2	
2	**2.1**	**Cryptocurrencies- Bitcoin and Ethereum**		**08**
		History of Cryptocurrency, Bitcoin,Monetary Policy, The Halving, Block Frequency,Bitcoin Ecosystem, Bitcoin Network, Bitcoin Mining, Mining Pool, Mining Systems-CPU,GPU,FPGA and ASIC, Nonce range,Timestamp, Wallet, UTXOs,SegWit, Wallet Address, Bitcoin Network Payment and API, Bitcoin-core, bitcoind, bitcoin-cli, bitcoin-qt, Bitcoin Improvement Proposal (BIP)	1,2,3,4	
	2.2	**Introduction to Ethereum:** Ethereum Technology Stack, Ethereum Characteristics, Types of Ethereum, Ethereum Virtual Machine (EVM) Ethereum Network, Nodes, Smart contract, Solidity, Consensus, Gas, Gas Price,Gas Limit, Out of Gas, Mining, DApps, EVM, ICOs, DAOs, DAO Attack, Forking, Hard and Soft Fork, Sharding, Ethereum 2.0, Enterprise use cases Alternative coins- Ethereum and Smart contracts Alternative coins- Ethereum continued, IOTA, Solana vs Ethereum Advantages and Drawbacks of ethereum, Smart Contract, Wallets for Ethereum, Solidity Smart Contracts - some attacks on smart contracts.	1,2,3,4	

	2.3	**Non-Fungible Tokens (NFTs) and Decentralized Finance (DeFi):** Tokenization of Assets, Types of Tokens, Non-fungible Tokens(NFTs), Properties of NFTs, ERC20 and ERC721 Ethereum Standards, NFT Market Place Decentralized Finance Ecosystem, Traditional Finance vs DeFi, Building DeFi system, Concerns of DeFi, NFTs vs DeFi	1,2	
3	**3.1**	**Digital Ledger Technologies (DLT) and Hyperledger**		**06**
		Digital Ledger Technology(DLT), Hyperledger Project, IBM, Linux Foundation, HF Framework, Libraries, Tools, Business Critical Applications, Consortium, HF Architecture, HF Components, HFC Client, Fabric-CA, Membership Services, Endorser, Orderer, Commiter, Ledger, Chaincode, Notifications, Secure Channel, transaction flow-Life cycle, SOLO, Apache Kafka Hyperledger Fabric Network Setup, Hyperledger Composer – Application Development. Hyperledger Composer - Network Administration	2	
4	**4.1**	**Applications Blockchain Technology**		**06**
		Uses of Blockchain in E-Governance, Land Registration, Medical Information Systems, and smart cities, innovative industries, Cybersecurity, FinTech, Security Standards, and Compliances, European Union (EU) Data Privacy- Fundamental Right, Emergence Blockchain and Personal Data Privacy Act- GDPR	1,2,3,4	
5	**Self Study**	Smart-contract vulnerabilities Scaling the blockchain: payment channels and state channels Scaling the blockchain using optimism and using SNARK Privacy in the public blockchain	online resources	**04***
				28

Text Books:

Sr. No	**Title**	**Edition**	**Authors**	**Publisher**	**Year**
1	Blockchain in Action	First Edition	Bina Ramamurthy	Manning Publications	2020
2	Mastering Blockchain	Third Edition	Imran Bashir	Packt Publications	2021
3	Building Ethereum Dapps	First Edition	Roberto Infante	Manning Publications	2019
4	Blockchain by Example	First Edition	Bellaj Badr Richard Horrocks	Packt Publications	2018

Reference Books:

Sr. No	Title	Edition	Authors	Publisher	Year
1	Bitcoin and Cryptocurrency Technologies- A Comprehensive Introduction	First Edition	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller,	Princeton University	2019
2.	Beginning Ethereum Smart Contracts Programming: With Examples in Python, Solidity, and JavaScript	First Edition	Wei-Meng Lee	Apress	2019

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	Title of the Experiment
1	Cryptosystems - I
2	Cryptosystems - II
3	Merkle Tree and Genesis block
4	Ethereum Blockchain Setup
5	Smart contract-Solidity Programming Language (Remix IDE, Metamask Wallet, Truffle Suite)
6	Develop Blockchain applications for Cybersecurity (Two-Factor Authentication)
7	Building DApp for Auction- full stack development (Front-end, Back-end, Business Logic-Web3.0 and Blockchain)
8	Hypeledger fabric for Supply Chain Management (SCM)
9	Development of NFTs
10	Bitcoin
11	Development of the DeFi application
12	Multichain

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
Program Elective	Software Engineering	3	0	2	5	10	3	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
1X		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	CS102: Object-oriented programming language IT204: Database Management Systems
Course Objective: To understand the best practices in software engineering and gain knowledge to analyze, design, implement and test software project.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1X.1	Analyze software requirements.
1X.2	Apply UML models for a project.
1X.3	Evaluate system architecture and develop detailed task schedule from the overall estimates and planning.
1X.4	Illustrate different coding principles with unit test process.
1X.5	Understand the need for DevOps.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1X.1	-	3	-	-	-	-	-	-	2	2	-	-
1X.2	-	2	-	-	2	-	-	-	2	2	-	-
1X.3	-	3	2	1	2	-	-	-	2	2	2	-
1X.4	-	-	3	-	2	-	-	-	2	-	-	-
1X.5	-	1	1	-	-	-	-	-	-	-	-	1

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1X.1	3	-	-	-	-	-	-
1X.2	3	2	-	-	-	-	-
1X.3	3	2	-	-	2	-	-
1X.4	3	-	-	-	2	-	-
1X.5	1	2	1	-	-		1

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create
				✓	

Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Introduction**		**07**
	1.1	Software Development Challenges, Software Scope, The Human Side of Software Development	**T1,T2**	
	1.2	Software Methodologies and Related Process Models with applications, Traditional Life Cycle Models, Waterfall, Incremental, Iterative models, Agile Software Engineering Process Models, SCRUM, Extreme Programming, Test Driven Development (TDD)	**T1,T2**	
2	**Title**	**Requirements Management and Project Planning**		**10**
	2.1	Requirements Development Methodology, Specifying Requirements, Eliciting Accurate Requirements, Documenting Business Requirements, SRS, Defining User Requirements, Validating Requirements, Achieving Requirements Traceability, Managing Changing Requirements, Agile Requirements Engineering	**T1,T2**	
	2.2	Scheduling, Work Breakdown Structure, Gantt Chart, Pert Chart, Critical Path, Earned Value Analysis, Schedule and Cost slippage, Estimation, Decomposition techniques, Empirical estimation models, Software Risk Management**:** Risk Identification, Risk Projection, Risk Refinement, RMMM Plan	**T1,T2**	
3	**Title**	**Software Analysis**		**08**
	3.1	Difference between Structured and Object-Oriented analysis, Data Flow Diagrams	**R2,R3**	
	3.2	Object Oriented Analysis, Uses Case, Class diagram, Interaction diagrams, Activity diagram, State Chart diagram, Component and Deployment diagram	**R2,R3**	
4	**Title**	**Software Design & Development**		**07**
	4.1	Software Architecture, Architectural and Pattern-Based Design, Model Driven Architectures	**T1,T2**	
	4.2	DevOps, Continuous Integration, Continuous Deployment, System Provisioning and Configuration Management	**R1**	
	4.4	Software Change Management, Change Control, Version Control	**T1,T2**	
5	**Title**	**Software Quality & Testing**		**10**
	5.1	Software Quality Concepts, Quality Assurance, Quality Control, Formal Technical Reviews	**T1,T2**	
	5.2	Software Metrics, Product Metrics – McCall's Quality Factor, Metrics for Analysis Model and Design Model	**T1,T2**	

	5.3	Software Testing, Unit Testing, Integration Testing, System Testing	**T1,T2**	
6	**Title**	Advance Topic in software Engineering		**5***
	Self Study	• Design Pattern		
Total				**42**

Laboratory Component, if any (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Gather requirements and write a project proposal for case study. Prepare SRS document. (Use IEEE template)
2	Design UML diagram -Use Case, Class diagram
3	Design UML diagram -Interaction diagrams
4	Design Data flow diagram (level 0 and1) for the case study.
5	Create work breakdown structure and schedule the activities
6	Develop Risk Mitigation, Monitoring and Management Plan for the case study.
7	Create versions of software using version control tool.
8	Implement any one Module from chosen case study.
9	Prepare test cases and perform Unit Testing (test scenario, test cases, test data)
10	Study on continuous Integration using DevOp

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Software Engineering: A Practitioner's Approach	Ninth Edition	Roger S. Pressman and Bruce Maxim	McGraw-Hill	2019
2	Fundamentals of Software Engineering	Fifth Edition	Rajib Mall	PHI Learning	2018

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations	--	Gene Kin, Patrick Debois, John Willis, Jez Humble and John Allspaw	IT Revolution Press	2016
2	UML for Java Programmers	--	Robert C. Martin	Pearson	2006
3	UML Distilled: A Brief Guide to the Standard Object Modeling Language	Third Edition	Martin Fowler	Addition Wesley	2003

Course(Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
Program Elective	Information System and Security	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
1P		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective:	
Course Outcomes (CO):*At the End of the course students will be able to*	
1P.1	Provide the basic results of computer security and its limitations.
1P.2	Contrast the different types of security policies, standards and practices.
1P.3	Contrast the different cryptographic algorithms and typical applications.
1P.4	Enforce security policies, standards and practices to a system.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1P.1	2											
1P.2	2	2			3			2				2
1P.3	2	2		1	3							2
1P.4	2	2	1		3	2	1	2	1			2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1P.1							
1P.2							
1P.3							
1P.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Overview of Information Security**		**5**
	1.1	**Introduction** - Basic Components, Threats, Policy and Mechanism, Assumptions and Trust, Assurance, Operational and Human Issues	1	
	1.2	**Foundation Results** - Protection State, Access Control Matrix Model, General Security Question, Take-Grant Protection Model	1	
2	**Title**	**Security Policies**		**6**
	2.1	**Security Policy Basics** - Types, Role of Trust, Types of Access Control, Policy Languages. **Confidentiality Policies** - Goals, Bell-LaPadula Model	1	
	2.2	**Integrity Policies** – Goals, Biba Integrity Model, Lipner's Integrity Matrix Model, **Availability Policies** – Goals, Deadlock, Denial of Service Models. **Hybrid Policies** - Chinese Wall Model, Role-Based Access Control.	1	
3	**Title**	**Cryptosystems**		**6**
	3.1	**Symmetric Cryptosystems**-Substitution cipher-Monoalphabetic , polyalphabetic, Playfair, hill cipher, transportation cipher-keyless and keyed transposition cipher, Stream and Block Cipher.	2	
	3.2	**Asymmetric Cryptosystems** -RSA and diffie hellman, Cryptographic hash functions-SHA, checksum -HMAC.	2	
4	**Title**	**Secure Protocols**		**5**
	4.1	Digital Signatures-DSS and RSA, Digital Certificates, X.509 Directory Services.	1,2	
	4.2	Symmetric key distribution, public key distribution, PKI, Needham Schroeder, Kerberos.		
5	**Title**	**Network Security**		**6**
	5.1	**Network security basics,** TCP/IP vulnerabilities. Internet Security Protocols: SSL, TLS, IPSEC, Secure Email and S/MIME.	1,2	
	5.2	Firewalls, Intrusion Detection Systems: Host-Based and Network-Based IDS.		
6	**Self Study**	a) Study the assurance in requirement definition and analysis. b) Study the assurance during system and software design. c) Study the assurance in implementation and integration. d) Mathematics of cryptography e) Study of a cryptographic function - Md5 f) Study of steganography techniques		***5**
			Total(* Not Included)	**28**

List of Experiment

Sr. No	Title of the Experiment
1	Experiment on Access Control Matrix Model
2	Experiment on Take-Grant Protection Model
3	Experiment on Policy Language
4	Experiment on Role-Based Access Control
5	Demonstration of Symmetric Key Cryptography
6	Demonstration of public key cryptography
7	Implementation of cryptographic hash function
8	Implementing the firewall using iptables
9	Implementing HIDS and NIDS
10	Implementation of PKI using OpenSSL

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Computer Security: Art and Science	SECOND	Matt Bishop, Elisabeth Sullivan & Michelle Ruppel	Addison-Wesley Professional	2018
2	Cryptography and Network Security	SECOND	Behrouz A. Forouzan, Debdeep Mukhopadhyay	McGraw-Hill Education	2010

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Computer Security: Principles and Practice	FOURTH	William Stallings & Lawrie Brown	Pearson Education	2018
2	Cryptography and Network Security Principles and Practices	FOURTH	William Stallings	Addison-Wesley Professional	2005
3	Introduction to Computer Security	FIRST	Matt Bishop	Addison-Wesley Professional	2005

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
Program Elective	User Experience Design	2	0	2	4	8	2	0	1	3
1Y		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes		Software Engineering
Course Objectives	This course provides an opportunity to learn and apply User experience design principles in day-to-day life. Learners will understand and identify the steps in the life cycle template of UX Design. Learners will be able to design a UI prototype of an application with UX design guidelines. This course covers the discussion of various UX design concepts. The laboratory experiments are designed to practice the concepts and to adopt the systematic approach for gaining user experience via interface design using various UX tools.	
At the End of the course students will be able to		
Course Outcomes	PE1Y.1	Analyze the UX design life cycle and its process for users.
	PE1Y.2	Apply the UX design process for the given scenario
	PE1Y.3	Create real-life applications with an end-to-end understanding of User experience practices.
	PE1Y.4	Evaluate the UX design process for the best experience.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1Y.1												
1Y.2												
1Y.3												
1Y.4												

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1Y.1							
1Y.2							
1Y.3							
1Y.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**UX Design and Life Cycle**	1,2	4
	1.1	What is UX (User Experience), Ubiquitous interaction, A UX process lifecycle template, The system complexity space, Meet the user interface team		
2		**The UX Design Process – Understand Users**	1	8
	2.1	**Contextual Inquiry:** Introduction, the system concept statement, User work activity gathering, Abridged contextual inquiry process		
	2.2	**Contextual analysis:** Introduction, Creating and managing work activity notes, Constructing your WAAD (Work Activity Affinity Diagram)		
	2.3	**Extracting Design Interaction requirements:** Formal Requirements Extraction, Abridged method for requirement extraction		
	2.4	**Design Informing Model:** User Model (Social Model), Usage Model (Flow Model, Task Interaction Model), Work Environment Model.		
3		**The UX Design Process-Design Thinking, Ideation and Sketching**	1,3	8
	3.1	Design Paradigm, Design thinking, Design perspective, User personas, Ideation, Sketching		
	3.2	Mental Models and Conceptual Design		
	3.3	Storyboards, Wireframes		
4		**The UX Design Process- Prototyping, Evaluation and Agile development**	1,3,5	8
	4.1	Fidelity of Prototype, To make effective paper prototype,		
	4.2	UX Evaluation and Improve UX Goals, Metrics and Targets		
	4.3	UX Evaluation Techniques- Formative vs Summative		
	4.4	UX Method for Agile Development: Introduction, Basics of agile SE methods, drawbacks of agile SE methods from UX perceptive.		
5		**Self-Learning**		4
	5.1	Affordance, Integration of UX into agile SE methods		
			Total	28

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	To Study of open source UX tools (Justinmind Prototype, Pidoco, Marvel Prototype) and create UX design for a given problem definition.
2	Design Mobile/Web UI for your own Travelling agent considering adding map and localization features along with descriptions if required. (e.g, Make my Trip,Tripadvisor,thrillophilia etc.)
3	Design a Map-based UI(Web User) for Mumbai Dabbawalas with localization feature.
4	Pick a website/app that you use on a daily basis (eg. facebook, gmail, whatsapp, zomato, etc). Evaluate the product based on user experience principles and give suggestions for improvement. Explain the usability testing process for the same.
5	Analyze and redesign the (IRCTC/IndianRail) website for a better User Experience and create the heuristic report using Nielsen's Heuristic
6	Design UI for students to teach mathematics in rural areas/ to sell the products of farmers directly to consumers.
7	Design UI for students to sell the products of farmers directly to consumers.
8	Design UI/UX Mobile App along with making a logo for the same for your own newly opened restaurant. (Consider all the UX Parameters while designing).
9	Design UI for any differently-abled users.
10	Design UI for analysis of the number of children suffering from juvenile diabetic children in India. The design aims at providing solutions for improving quality treatment and making the treatment affordable.

Note: All the experiments need to be tested for usability. The problem statement for any experiment can be changed by the instructor during the laboratory with different examples.

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	The UX Book	1st	Rex Hartson and Pardha Pyla	MK Publication	2012
2	A Project Guide to UX Design: For user experience designers in the field or in the making.	2nd	Russ Unger and Carolyn Chandler	O'reilly, Series Editor	2012
3	UI Design:Key to captivate user understanding	1st	Jain, Kalbande,	SybGen Publications	2021

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
4	Smashing UX Design	1st	Jesmond Allen and James Chudley	John Wiley & Sons	2012
5	Agile Experience Design	1st	Brian Fling	, O'Reilly Media Inc.,	2009.

Online Web Resources for conceptualizing and practicing the UX tools as:
[w1] https://www.sketch.com/
[w2] https://www.figma.com/
[w3] https://www.adobe.com/in/products/illustrator.html
[w4] https://pencil.evolus.vn/
[w5] https://www.lucidchart.com/pages/
[w6] https://www.invisionapp.com/
[w7] https://xtensio.com/
[w8] https://miro.com/
[w9] https://uxpressia.com/

Semester VII

Sem VII									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	PC	AI401	Natural Language Processing	2	0	2	4	8	3
1	OE	OEXXX	OE-II	2	0	2	4	8	3
2	OE	OEXXX	OE-III*	2	0	2	4	8	3
3	PE	AI4X3	PE-III	2	0	2	4	8	3
4	PE	AI4X4	PE-IV	2	0	2	4	8	3
5	SBC	AI402	Main Project Stage-I/ Main Project Stage- II	0	0	0	6	6	3
6	ABL	SVXX/STXX	SEVA-IV/SATVA-IV	0	0	0	4	4	1
7	S/M/H	SCX4/MNX4 /HOXX	SCOPE-IV/Minor-IV/Honors-I						3
TOTAL									**19**
*OE-III must be from Basic Science Elective or Engineering Science Elective									

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Natural Language Processing	2	0	2	2	6	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AI401		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	Artificial Intelligence and Machine Learning, Basic knowledge of Python

Course Objective: To provide the students the techniques and tools to devise and develop Natural Language Processing (NLP) components and applications. The course will cover the foundations, building blocks and applications of NLP, with an emphasis on the necessary linguistic intuitions as well as a broad coverage of statistical and deep learning models that can be used for language tasks. NLP is an important topic in Artificial Intelligence with a wide range of applications, from sentiment analysis to machine translation. Modern NLP is primarily based on statistical methods and machine learning algorithms, where linguistic information is provided by instances of uses of language. For most NLP tasks, state of the art approaches are based on neural models, which will be at the core of this module. However, significant attention will be given to the linguistic principles that underpin the field.

Course Outcomes (CO): ***At the End of the course students will be able to***

AI401.1	Identify the language processing tasks.
AI401.2	Devise and evaluate solutions for a range of natural language components using existing algorithms, techniques and frameworks, including part-of-speech tagging, language modeling, parsing and semantic role labeling.
AI401.3	Devise, implement and evaluate algorithms for single and multi-class classification problems.
AI401.4	Apply existing statistical and deep learning techniques to language applications such as machine translation.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AI401.1	**3**		**2**									
AI401.2			**2**									
AI401.3	**3**		**2**									
AI401.4	**3**				**2**				**2**			**3**

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
AI401.1	**2**						
AI401.2	**2**	**2**					
AI401.3	**2**						
AI401.4	**2**	**2**	**2**		**2**	**2**	

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate ✓	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Introducing to NLP**	1,2	**7**
	1.1	A brief history of natural language processing, language challenges, applications, classical vs statistical vs deep learning-based, Basic concepts in linguistic data Structure: Morphology, syntax, semantics, pragmatics, Tokenized text and pattern matching-Recognizing names, Stemming, Tagging Parts of speech-identify parts of speech, Constituent structure, NLP pipeline		
	1.2	Regular Expression, Words, Corpora, Text Normalization, Minimum Edit Distance, Words and Vectors, Cosine Similarity, TF-IDF, Word2Vec, Bag of words, CBOW, Word Sense Disambiguation		
2	**Title**	**Computational tools for text analysis**	1,2	**5**
	2.1	Natural Language Toolkit (NLTK): Corpora and other data resources, Uses of corpora: Lexicography, Grammar and syntax, Stylistics, Training and evaluation, Basic corpus analysis: Frequency distribution building and analyzing a corpus.		
	2.2	Data structures: strings and sequences, Tokenization in the NLTK, Tokenizing text, Stemming: Comparing stemmers, Tagging: RE tagging, Trained taggers and backoff, Transformation-based tagging.		
3	**Title**	**Statistically based techniques for text analysis**	1,2	**10**
	3.1	Fundamentals of machine learning: Naive Bayes classifiers, Hidden Markov models; Viterbi decoding, Information and entropy; Decision trees and maximum entropy classifiers, Unigram, Bigram, Trigram, N-gram language models, Advance smoothing for language model, Neural language models (RNNs, LSTMs, GRUs, Bert Model)		
	3.2	Machine learning in action: document classification, Information extraction: Types of information extraction, Regular expressions for personal names, Information extraction as sequential classification: chunking and Named Entity Recognition (NER)		
4	**Title**	**Analyzing sentences: Syntax and Parsing**	1,2	**6**
	4.1	Grammars and parsing, Context Free Grammar (CFG), parsing with CFG, Building feature based grammar: Grammatical features; Processing feature structures and extracting feature-based grammar. Rules-based and probabilistic parsing: Neural models for parsing; Semantic role labeling; Sequence to sequence modelling - machine translation (SMT, NMT, Attention).		
	4.2	Application of NLP:Auto Correct, Summarizing, Text extraction		
6	**Self Study**	Chunking and chinking with NLTK, Text generation,Translation Large language models: GPT-3, ChatGPT		**2***
			Total	**28**

*Not included in Total Hours

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	Title of the Experiment
1	Install NLTK and perform basic Corpus analysis using NLTK such as (i) frequency distribution (ii) learn about morphological features of a word by analysing it.
2	(i) Generate word forms from root and suffix information. (ii) Understanding the morphology of a word by the use of Add-Delete table
3	(i) Calculate bigrams from a given corpus and calculate probability of a sentence. (ii) to apply add-one smoothing on sparse bigram table
4	Classification using suitable classification model (NB)
5	Calculate emission and transition matrix which will be helpful for tagging Parts of Speech using Hidden Markov Model.
6	Find POS tags of words in a sentence using Viterbi decoding
7	Implement an application of NLP: Auto Correct/ Summarizing/ Text extraction/ Intent detection/Question answering
8	Capture linguistic patterns and grammatical constructions with feature-based grammars
9	Without using any library Perform Text summarization
10	Perform Text summarization using library.

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Natural Language Processing with Python	1st	Steven Bird, Ewan Klein & Edward Loper	O'Reilly Media, Inc. ISBN: 9780596516499	**2009**
2	Natural Language Processing with PyTorch	1st	Delip Rao & Brian McMahan	O'Reilly Media, Inc. ISBN: 9781491978238	**2019**
3	Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition	2nd	Jurafsky / Martin	Pearson	**2013**

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Neural Network Methods for Natural Language Processing	1st	Yoav Goldberg	Morgan and Claypool	2017
2	Linguistic Fundamentals for Natural Language Processing	1st	Emily M. Bender	Morgan and Claypool	2013

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE-III)	Deep Learning	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
1T13		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	AI304/DS302
Course Objective: To introduce the fundamental concepts of Deep learning with primary focus on the architectures and applications as appropriate to real world problems	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1T13.1	Interpret the mathematical foundations of Deep Learning architectures.
1T13.2	Construct deep neural networks for a given problem.
1T13.3	Analyze deep learning models for a given scenario.
1T13.4	Develop real-world applications using various deep learning techniques.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T13.1	2	2	2		3							1
1T13.2	3	2	3		3							1
1T13.3	3	2	3	2	3							1
1T13.4	3	3	3	2	3				3	3	2	2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T13.1							
1T13.2							
1T13.3							
1T13.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create✓

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introduction to Deep Learning**	T1,T2	**6**
	1.1	Linear Algebra Primer, Vector Calculus Review		
	1.2	Revision of Learning Algorithms Concepts: Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Stochastic Gradient Descent, Challenges Motivating Deep Learning,		
	1.3	Deep Feedforward Networks		
2	**Title**	**Convolutional Neural Networks**	T1,T2,R1,R3	**6**
	2.1	The Convolution Operation, Motivation,		
	2.2	Pooling, Convolution and Pooling as an Infinitely Strong Prior		
	2.3	Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, Fully Connected CNN		
3	**Title**	**Autoencoders**	T1, T2,R1,R3	**6**
	3.1	Architecture of Autoencoder,		
	3.2	Undercomplete v/s Overcomplete Autoencoder, Regularized Autoencoders,		
	3.3	Representational Power, Layer Size and Depth, Applications of Autoencoders		
4	**Title**	**Sequence Modeling**	T1,T2,T3, R1, R2, R3	**6**
	4.1	Recurrent Neural Networks (RNNs), Bidirectional RNNs, Gated Recurrent Units (GRUs)		
	4.2	Long short term memory (LSTM)		
	4.3	Encoder-Decoder sequence to sequence architecture		
	4.4	Deep Recurrent Network		
5	**Self Study**	Generative Adversarial Networks, Large-Scale Deep Learning (LLMs: BERT/GPT etc.) and their applications in Computer Vision, Speech Recognition, Natural Language Processing		**4***
			Total	**28**

Laboratory Component:
** Lab experiments may be performed using any open-source, freely available deep learning frameworks.

Sr. No	Title of the Experiment
1	To implement a deep feed-forward network for a given problem
2	To implement a CNN for a given problem.
3	To use pre-trained CNN models like ResNet/VGG16 for a given problem
4	To implement basic autoencoders for a given problem.
5	To implement and compare autoencoder variants of undercomplete/overcomplete/regularized for a given problem.
6	To implement RNN for a given problem.
7	To implement LSTM networks for a given problem
8	To implement encoder-decoder architectures for a given problem.
9	To implement deep recurrent networks for a given problem
10	To use pre-trained recurrent architectures like BERT/GPT/T5 for a given problem.

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Deep Learning	1st edition	Ian Goodfellow, Yoshua Bengio, Aaron Courvile	An MIT Press book	2016
2	Fundamentals of Deep Learning	1st edition	Nikhil Buduma	O'Reilly	2017
3	Deep Learning using Python	1st edition	Dr. S Lovelyn Rose, Dr. L Ashok Kumar, Dr. D Karthika Renuka	Wiley	2019

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Deep Learning: Methods and Applications	1st edition	Deng & Yu	Now Publishers	2013
2	Generative Deep Learning	1st edition	David Foster	O'Reilly	2019
3	Deep Learning CookBook	1st edition	Douwe Osinga	O'Reilly	2017

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE-III)	Data Driven Internet of Things	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
1T23		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective:	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1T23.1	Analyze various protocols for IoT.
1T23.2	Apply data driven approaches in IoT.
1T23.3	Analyze and visualize the data from IoT devices.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T23.1	**2**											
1T23.2	**2**				**2**							
1T23.3	**2**				**2**							
1T23.1	**1**											
1T23.2	**1**											
1T23.3	**1**											

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Introduction to IoT**		**5**
	1.1	The Internet Of Things (IoT), IoT Application Domains IoT Reference Model, Performance Evaluation And Modeling Of IoT Systems Machine Learning And Statistical Techniques For IoT	1	
	1.2	The situation, Defining IoT analytics, Defining analytics, Defining the Internet of Things, The concept of constrained, IoT analytics challenges, The data volume, Problems with time, Problems with space, Data quality, Analytics challenge	2	
2	**Title**	**IoT Devices and Networking Protocols**		**7**
	2.1	IoT devices, The wild world of IoT devices: Healthcare,5 Manufacturing, Transportation and logistics, Retail, Oil and gas, Home automation or monitoring, Wearables, Sensor types	2	
	2.2	IoT networking data messaging protocols: Message Queue Telemetry Transport (MQTT), Hyper-Text Transport Protocol (HTTP), Constrained Application Protocol (CoAP), Data Distribution Service (DDS)	2	
3	**Title**	**IoT Analytics for the Cloud**		**9**
	3.1	Exploring the Data Analysis (EDA), and Visualizing data, attributes study for predictive modeling, industry-specific problem analysis	2	
	3.2	Building elastic analytic, Elastic analytics concepts, Designing for Scale, Cloud security and analytics, Apache Hadoop, Apache Spark	2	
	3.3	The AWS overview, Designing data processing for analytics, Applying big data technology to storage, Apache Spark for data processing		
4	**Title**	**Security in IoT**		**6**
	4.1	Vulnerabilities of IOT, Security requirements, Challenges for a secure Internet of Things, Threat modeling, Threat analysis, Use cases and misuse cases, Activity modeling of threats, Security Architecture, Security Model, Attacks Modeling, Security attacks, Key Elements of IOT Security	2	
	4.2	Security Engineering for IOT Development : Building Security into design and Development, Secure Design, safety and security design, process and agreement, Technology Selection IOT Security Life Cycle: Implementation and integration, IOT security CONOPS document, Network and security integration, Operations and Maintenance, Managing identities, roles and attributes, security monitoring	4	

6	**Self Study**	i. Solving industry-specific analysis problems: Manufacturing, Healthcare, Retail. Autonomous vehicles, Supply chain management, Smart Agriculture,Smart City,, tracking and monitoring livestock ii. Power saving and Unique identification & authenticity.	2	**4**
			Total	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	Title of the Experiment
1	Programming the Arduino/Raspberry Pi, Basic electronic components such as LED, resistors, battery.
2	Interfacing IoT device with Cloud using mobile phone demonstrating MQTT protocol
3	Detecting Human Stress by Sleep cycle tracked by sensors. Human Stress Detection in and through Sleep | Kaggle
4	Analyze Maternal Health from IoT Sensors data at hospitals. Classification Maternal Health 5 Algorithms ML | Kaggle
5	Analyze and visualize weather information for Smart Home. Smart Home Dataset with weather Information | Kaggle
6	Analyze and visualize data from Temperature Sensors for a given scenario. Temperature Readings : IOT Devices | Kaggle
7	Analyze Room Occupancy using IoT Sensor dataset Room Occupency IOT Data | Kaggle
8	Detecting IoT botnet. N-BaIoT Dataset to Detect IoT Botnet Attacks | Kaggle
9	Detecting the smoke from IoT Sensors data. Smoke Detection Dataset | Kaggle
10	Analyze and visualize data from Smart City IoT Sensors. Smart Cities Index Datasets | Kaggle

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	An Introduction to IoT Analytics	First	Harry G. Perros	CRC Press	2021
2	Analytics for the Internet of Things (IoT)	-	Andrew Minteer	Packt Publishing	July 2017

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Internet of Things-A Hands-On Approach	First	Arshdeep Bahga, Vijay Madisetti	University Press	2015
2	Practical Internet of Things Security	First	Brian Russel and Drew Van Duren	Packt Publication	2016

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE-IV)	Data Warehousing and Business Intelligence	2	0	2	5	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
1T14		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	DS204: Database Management Systems
Course Objective:	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1T14.1	Demonstrate data warehouse principles and its working.
1T14.2	Analyze data warehouse characteristics to perform OLAP and ROLAP operations
1T14.3	Apply data models on a given scenario
1T14.4	Design Business Intelligence strategy for an enterprise

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T14.1	2											2
1T14.2		2										2
1T14.3					2							2
1T14.4				2			2			2	2	2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T14.1							
1T14.2							
1T14.3							
1T14.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Data Warehousing Concepts**		**5**
	1.1	History of Data Warehousing, What is OLAP & Decision Support Systems	1	
	1.2	Business Vs Data Requirements, Reasons to Build a Data Warehouse, The Technology Solution	1	
	1.3	Characteristics of a Data Warehouse, Identifying Business Data Flow & Processes, Data sources	1	
	1.4	The Data Extraction process, Transformation process, Assuring Data Quality, Transportation process, Maintaining Warehouse Data, Metadata	1	
2	**Title**	**Data Warehouse Architecture and Models**		**6**
	2.1	Warehouse architecture, Identifying Warehouse Data: Fact data, Dimension data, Hierarchies, Summaries (roll-ups)	1	
	2.2	OLAP versus OLTP systems. Data analysis, extraction, transformation, and data loading methods. Data quality. Data warehouse: building, maintenance, and accessing techniques.	1	
	2.3	Data Warehouse models: star, snowflake, fact constellation schema, Modelling the Data Warehouse	1	
3	**Title**	**Accessing a Data Warehouse**		**6**
	3.1	User query requirements and User query progression, OLAP Access, OLAP Cube, Relational OLAP (ROLAP) Access, Multidimensional OLAP (MOLAP), HOLAP, OLAP Query Techniques	1	
	3.2	DBMS Schemas for Decision Support, reporting using Excel, Query tools and Applications	1	
4	**Title**	**Business Intelligence**		**5**
	4.1	Use of Business Intelligence, Effective and timely decisions; Data, information, and knowledge; The role of mathematical models.	2	
	4.2	Business intelligence architectures; Enabling factors in business intelligence project; Development of a business intelligence system; Ethics and business intelligence	2	
	4.3	Business intelligence Technologies: Data Mining, Big Data Analytics, Augmented Analytics, Web Analytics	2	
5	**Title**	Decision Making and Decision Support Systems		**6**
	5.1	Representation of the decision-making process; Evolution of information systems, Definition of decision support system; Development of a decision support system.	2	
	5.2	Data Visualization and Dashboard Design, Business Performance Management cycle, key performance indicators (KPIs), role of visual and business analytics (BA), Handling Unstructured Data, The Business Intelligence Project Plan: Planning the Plan, Resources and Roles, Risk Management, Data Migration Issues	2	

	5.3	Business Intelligence Applications in marketing, sales, finance, operations. How to improve Business Intelligence to make company a leader, BI strategies used in companies like Sabre Airline Solutions, New York Shipping Exchange, Netflix, Grow, Stitch Fix, Target, Payless Shoes, TikTok, Uber etc.	2	
6	**Self Study**	Use Cases: Prominent Companies Business Intelligence Strategies, Data Mart	1, 2	
			Total	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	**Title of the Experiment**
1	To identify, install and experiment Data Warehousing tools.
2	To perform data cube operations on a multidimensional model i.e implement OLAP operation (Rollup, slice, dice, and pivot).
3	Implement OLAP for multidimensional data
4	Design star schema and implement it for a scenario.
5	Design snowflake schema and implement it for a scenario.
6	Design fact constellation schema and implement it for a scenario.
7	Implement various Data Visualization techniques on a given data.
8	Design a Dashboard for an enterprise.
9	Phase-I: Implementation of a Project on Business Intelligence.
10	Phase II: Implementation of a Project on Business Intelligence.

Text Books

Sr. No	**Title**	**Edition**	**Authors**	**Publisher**	**Year**
1.	Data Mining- Concepts and Techniques	2 Edition	Jiawei Han, Micheline Kamber, Morgan Kaufmann	Elsevier	2006
2.	Successful Business Intelligence	2 Edition	Cindi Howson	McGraw-Hill	2013

Reference Books

Sr. No	**Title**	**Edition**	**Authors**	**Publisher**	**Year**
1.	Business Transformation: A Roadmap for Maximizing Organizational Insights	1st Edition.	Aiman Zeid, Jim Davis	Wiley	2014
2.	Business Intelligence A Comprehensive Approach to Information Needs, Technologies and Culture	1 Edition	Rimvydas Skyrius	Springer	2021

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE-IV	AI for Healthcare Analytics	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
IT24		Theory	50		50		100			200
		Laboratory	50		--		50			100

sPre-requisite Course Codes, if any.	–

Course Objective: This course provides an introduction to the principles, techniques, and applications of Artificial Intelligence (AI) in healthcare. Understand how Artificial Intelligence (AI) and Machine learning (ML) can be used for implementing applications in healthcare and to analyze the healthcare data and process it using data analysis and statistical tools.

Course Outcomes (CO): ***At the End of the course students will be able to***

IT24.1	To study the fundamental tools within modern artificial intelligence (AI) with a focus on intelligent agents and systems for healthcare analytics
IT24.2	To analyze the healthcare data for prediction and future use
IT24.3	To explore the applications of AI and ML with respect to the healthcare domain

CO-PO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IT24.1												
IT24.2												
IT24.3												

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
IT24.1							
IT24.2							
IT24.3							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Mo**	**AI for Healthcare**		**2**
	1.1	Introduction to Artificial Intelligence (AI) and Machine learning (ML) Importance and Applications of AI and ML in Healthcare	1,2	
2	**Title**	**Statistics for AI in Healthcare Analytics in Excel**		**4**
	2.1	Linear Algebra and Multivariable Calculus and statistics (Hypothesis testing, ANOVA,ChiSqaure etc.)	4	
3	**Title**	**Types of Machine Learning for Healthcare Analytics**		**8**
	3.1	Introduction to supervised, unsupervised, and reinforcement learning for Data Analytics in Healthcare	1,3, 6	
	3.2	Decision Tree, Bayesian Classifier, K-NN and Regression for Data Analytics in Healthcare	4, 5	
4	**Title**	**Data Representation and Analytics**		**5**
	4.1	Introduction to data, data frames, Data standardization, Dealing with noise and missing values and Transforming and normalizing data	1, 7, 8	
	4.2	Overview of tools like R, Python and Statistical and Visualization tools like Power BI and Tableau		
5	**Title**	**Healthcare Data Analysis:**		**9**
	5.1	Sources of the healthcare data, Pre-processing of the healthcare data, Handling of the healthcare data and Creation of analysis-ready datasets	3, 5,8	
	5.2	Case studies - Future trends in AI Healthcare		
6	**Self Study**	Reinforcement Learning, conversational AI methods, Various Chatbot, statistical software tools for various healthcare domain like TB analysis from X-ray images, identifying tumors, root canal of tooth by dentist, cardiologist for heart risk analysis etc		**4**
			Total	**28**

Laboratory Component:

Sr. No	Title of the Experiment
1	To implement the regression for healthcare datasets
2	To implement the decision Tree for healthcare datasets
3	To implement the K-NN for healthcare datasets
4	Hypothesis Testing in Excel for healthcare datasets - ANOVA and Chi Square
5	Data Transformation and preparation for analysis of healthcare data
6	Healthcare data analysis using Python/ R Programming
7	Healthcare data analysis using Power BI
8	Healthcare data analysis using Tableau
9	To implement KERAS or tensorflow model for automatic detection of abnormalities
10	To implement NLTK, spaCY (NLP libraries in Python) to extract important information like patient diagnosis,medications and lab results.

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Artificial Intelligence: A Modern Approach	4th	Russell, S. and Norvig,	Pearson	2022
2	Healthcare Data Analytics	1st	Chanda Reddy, Charu Aggarwal	CRC Press	2020
3	Artificial Intelligence in Healthcare	1st	Parag Mahajan	Parag Mahajan	2022
4	The Elements of Statistical Learning	2nd	Hastie, T., Tibshirani, R. and Friedman, J.	Springer	2017
5	Machine Learning for Healthcare Analytics - Projects	1st	Eduonix Academic Solutions	PackT	2018
6	Artificial Intelligence Fundamentals and Applications	1st	Cherry Bhargava, Pradeep Kumar	CRC Press	2021
7	Hands on Healthcare Data	1st	Andrew Neugen	Shroff Publications	2015
8	Artificial Intelligence in Healthcare: Review and Prediction Case Studies	NA	Guoguang Rong, Arnaldo Mendez, Elie Bou Assi, Bo Zhao, Mohamad Sawan	www.science direct.com	2020

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE)	**Advanced Algorithm and Complexity**	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
1Q		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	Data Structures, Design and Analysis of Algorithms

Course Objective: This course provides the theoretical backbone of computer science and is required in the daily work of the successful developer/programmer. The goal of this course is to provide a solid background in the design, analysis and performance of the major classes of advanced algorithms.

Course Outcomes (CO): ***At the End of the course students will be able to***

1Q.1	Analyze the asymptotic performance of algorithms.
1Q.2	Apply Graph Algorithms for a real-life problem
1Q.3	Apply Geometrical algorithms to solve the engineering problems.
1Q.4	Apply Randomized algorithms to solve the engineering problems.
1Q.5	Classify P, NP, and NP-Completeness

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

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

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1Q.1							
1Q.2							
1Q.3							
1Q.4							
1Q.5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create

Theory Component				
Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Title**	**Formal introduction to algorithmic paradigms:**		4
	1.1	Divide and conquer, recursion, dynamic programming, greedy, branch and bound, etc.	1	
	1.2	**Advanced data structures:** Fibonacci heap, union-find, splay trees.	1	
2	**Title**	**Graph Algorithms**		5
	2.1	**Network flow:** Definition, applications, Ford–Fulkerson, Edmonds–Karp, and push-relabel algorithms.	1	
	2.2	Weighted Bipartite Matching (Hungarian Algorithm) Stable Matching: Gale–Shaply algorithm	1	
3	**Title**	**Geometric Algorithms**		6
	3.1	Representation of points, lines, segments, and polygons. Basic calculations.	1,2	
	3.2	Convex hulls: Definition, lower bound, naive algorithms, Jarvis' march, Graham's scan, Preparata–Hong algorithm.	1,2	
	3.3	Sweep paradigm: Line-segment intersection, visibility polygon.	1,2	
	3.4	Voronoi diagrams: Definition, applications, size, naive algorithm, Fortune's line-sweep algorithm.	1,2	
4	**Title**	**NP-completeness**		6
	4.1	Complexity classes P and NP, nondeterministic algorithms	1	
	4.2	polynomial-time verifiabiity, polynomial-time reduction.	1	
	4.3	NP-hard and NP-complete problems, SAT, CNFSAT.	1	
	4.4	Examples: 3CNFSAT, DHamPath, Vertex-Cover, Clique, TSP, Longest-Path, Independent-Set	1	
	4.5	The class NP-Hard	1	
5	**Title**	**Randomized Algorithms**		7
	5.1	Monte Carlo algorithms: Fermat and Miller–Rabin primality tests, Karger and Karger–Stein algorithms for minimum cut.	1	
	5.2	Las Vegas algorithms: Randomized quicksort, graph coloring, bit-vector search	1	

	5.3	Relation between Monte Carlo and Las Vegas algorithms Randomized data structures: Bloom filters	1	
	Self Study	**Approximation Algorithms:** Basic concepts, approximation ratio, minimum vertex cover. Minimum set cover. Euclidean TSP. Inapproximability. Use of linear programming. Polynomial-time approximation schemes.		*5
			Total (* Not included)	28

Laboratory Component:

Sr. No	Title of the Experiment
1	Implement Advanced Data structures
2	Implementation of Graph Algorithm .
3	Implementation of Convex hulls: naive algorithms
4	Implementation of Graham's scan Algorithm
5	Implementation of Preparata–Hong algorithm
6	Implementation of Jarvis' march
7	Implementation of Voronoi diagram : naive algorithm.
8	Implementation of Fortune's line-sweep algorithm.
9	Implementation of Karger and Karger–Stein algorithms
10	Implementation of Las Vegas algorithms: Randomized quicksort

Text Books:

Sr. No	Title	Edition	Authors	Publisher	Year
1	Introduction to Algorithms	Third Edition	Thomas H. Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein	MIT Press	2009
2	Algorithmics for Hard Problems Introduction to Combinatorial Optimization, Randomization, Approximation, and Heuristics	Second Edition	Juraj Hromkovič	Springer-Verlag	2004

Reference Books:

Sr. No	Title	Edition	Authors	Publisher	Year
3	Fundamentals of Computer Algorithms	Second Edition	Horowitz E, Sahni S and S.Rajasekaran	Galgotia Publications	2010
4	Operations Research	7^{th} Edition	P K Gupta, D S Hira	Sultan Chand & Sons	2018

Semester VIII

Sem VIII (Option A: Cat1/Cat2)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	PC	AI403	Human Machine Interaction	2	0	2	4	8	3
2	OE *	OEHXX	OE-IV	2	0	2	4	8	3
3	PE	AI4X5	PE-V	2	0	2	4	8	3
4	PE	AI4X6	PE-VI	2	0	2	4	8	3
5	SBC	AI404	Main Project Stage-II	0	0	0	6	6	3
6	H	HOXX	Honors-II						3
	*May be taken from MOOCs, Essentially Humanities, Management related								
TOTAL									**15**

Sem VIII (Option B: Only for Cat1 students)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	SBC	AI405	Industry Internship/ Major Project	0	0	0	36	36	15
3	H	HOXX	Honors-II						3
	*May be taken from MOOCs, Essentially Humanities, Management related								
TOTAL								**40**	**15**

The 'Major Project' in the "Option B" must be completed from an institute of national interest. If a student wishes to complete a Major Project under the mentorship of SPIT faculty, approval from the Dean Academics and Research is required.

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PC	HMI (Human Machine Interaction)	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AI403		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	AI305
Course Objective: This course provides an opportunity to learn and apply the design principles of Human Machine Interaction. Learners will learn the basic human psychology of everyday actions and will be able to design an UI prototype of an application. This course covers the discussion on various interaction design concepts. The laboratory experiments are designed to practice the concepts and to adopt the systematic approach for interface design using various UX tools.	
Course Outcomes (CO):*At the End of the course students will be able to*	
AI403.1	Identify the various design principles used for interacting between human and machine.
AI403.2	Apply human psychology of everyday actions and UI design processes for real world applications.
AI403.3	Implement mobile, windows, and web-based application
AI403.4	Evaluate and justify UI design
AI403.5	Create an application for a social and technical task.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO5
AI403.1	2	-	2	-
AI403.2	2	-	2	-
AI403.3	2	3	-	**2**
AI403.4	2	-	2	-
AI403.5	2	3	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	**PEO2**	**PEO3**	**PSO1**	**PSO2**
AI403.1					
AI403.2					
AI403.3					
AI403.4					
AI403.5					

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	**Understand**	**Apply ✓**	**Analyze**	**Evaluate**	**Create**

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introduction**	T1-T4	**06**
	1.1	Introduction to Human Machine Interface, Hardware, software and operating environment to use HMI in various fields.		
	1.2	The psychopathology of everyday things – complexity of modern devices; human-centered design; fundamental principles of interaction;		
	1.3	Psychology of everyday actions- how people do things; the seven stages of action and three levels of processing; human error;		
2	**Title**	**Graphical User Interface and Web Interface**	T2,T4	**04**
	2.1	The Graphical User Interface: Popularity of graphics, the concept of direct manipulation, characteristics of GUI,		
	2.2	Web user Interface: Interface popularity, characteristics. Principles of user interface design.		
3	**Title**	**Understanding Goal-Directed Design**	T1-T4	**06**
	3.1	Goal-directed design; Implementation models and mental models; Beginners, experts, and intermediates – designing for different experience levels		
	3.2	Understanding users; Modeling users – personas and goals.		
4	**Title**	**Design Guidelines**	T1-T4	**06**
	4.1	perception, Gestalt principles, visual structure, reading is unnatural, color, vision, memory, six behavioral patterns, recognition and recall, learning, factors affecting learning, and time.		
5	**Title**	**Interaction Styles and Communication:**	T2,T4	**06**
	5.1	**Interaction Styles:** Menus, Windows, Device-based and Screen-based Controls.		
	5.2	**Communication:** Text messages, Feedback, and Guidance, Icons, Multimedia, and colors.		
	Self Study	UX tools: Figma, Just In Mind, and any open-source tool for prototype designing Mobile Ecosystem: Platforms, Application frameworks: Types of Mobile Applications: Widgets, Applications.		**04**
			Total	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	Title of the Experiment
1	To Study of open-source UX tools (Just in mind Prototype, Pidoco, Marvel ,Figma Prototype) and create a simple design for a given problem definition.
2	**Know your client.** a. Design an app that can teach mathematics to children of 4-5 years age in schools in Rural Sector. b. Design an app that can teach mathematics to children of 4-5 years age in schools in Urban Sector. c. Design a site that can help people to sell their handmade products in metro cities. d. Design a site that can connect housewives and keep them engaged. **Note : Students should be able to do the following for any given problem statement** i. Analysis of user's/client's behavior eg their preferences, interests etc ii. What kind of interfaces will they like and why? iii. Existing apps - analyze and rate them. iv. What will be your choice of screen elements? v. How will your app/web design be better than the existing one?
3	**Goal-oriented design** - Design an experience for passengers whose flight /train is delayed.
4	**Design Principles** - Understand principles of good UI design by heuristic evaluation. Design UI for a given problem statement.
5	**Menus & Navigation** – Redesign of a user interface (Suggest and implement changes in Existing User Interface) for a given problem statement.
6	**Windows & Screen controls** – Design UI for a given problem statement. **a.** Design a navigator for a student new in your Institute. **b.** Design a navigator for a person new in tourist city/ village. **c.** Motor paralysis for differently able people. **d.** Vaccination App design with localization
7	**Icons** - Design appropriate icons pertaining to a given domain. (Eg. Greeting cards, Travelling, restaurants, Education, Medical, security at Airport, Malls etc)
8	**Colors** – Design a personal website for any socio-technical problem. Use color guidelines with statistical graphics for better visualization.
9	Design a Map-based UI(Web User) for the given problem statement. Example: Mumbai Dabbawallas with localization feature. Pet Care New Visitors to Hospital
10	To calculate the screen complexity of the existing Graphical User Interface and redesign the interface to minimize the screen complexity.

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Human Computer Interaction	3rd	Alan Dix, J. E. Finlay, G. D. Abowd, R. Beale	Peason,Prentice Hall	2003
2	The Essential Guide to User Interface Design	3rd	Wilbert O. Galitz,	Wiley publication	2007
3	Design of everyday things	2nd	Donald A. Normann	Basic Books; Reprint edition	2013
4	Galitz's Human Machine Interaction	1st	Kalbande,Kanade,Iyer	Wiley Publications	2015

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Interaction Design: Beyond Human Computer Interaction	5th	Rogers Sharp Preece	Wiley publications	2019
2	Mobile Design and Development	1st	Brian Fling	, O'Reilly Media Inc.,	2009.