Bharatiya Vidya Bhavan's
Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai)

Department of Computer Science and Engineering

Effective from Academic Year 2023-24

Board of Studies Approval: 02nd July 2024

Academic Council Approval: 20th August 20214

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

Bharatiya Vidya Bhavan's

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai)

[Knowledge is Nectar]

Liberal, Pi-Model of Engineering Education @ SPIT

(Department of Computer Science and Engineering)

CURRICULUM STRUCTURE FOR UNDERGRADUATE ACADEMIC PROGRAMS IN COMPUTER ENGINEERING AT SPIT
W.E.F. A.Y. 2023-24 [2023-2027 BATCH]

A common scheme for "Computer Science and Engineering" and "Computer Engineering" till Semester V.

Preamble: Government of Maharashtra has directed Autonomous Colleges to revise their curriculum and step into the implementation of National Education Policy (NEP) 2020. We commit ourselves to the effective and fruitful implementation of NEP 2020 in its spirit. The holistic development of learners has always been the priority and center of focus for "Bharatiya Vidya Bhavan". S.P.I.T. started implementing the philosophy of NEP in the year 2019 itself. We have in fact graduated the first batch of our holistic curriculum in 2023. Now based on our learnings from the implementation and recent recommendations of the Government, we are pleased to offer a 2nd iteration of our holistic curriculum for 2023-27, a Liberal Pi Model of Engineering Education.

This curriculum aims at the development of an **all-rounded** personality. It follows a **holistic** approach to education, ensures strong science, and mathematics foundation and program core, develops expertise in domain vertical through the sequel of electives, ensures significant exposure to additional discipline through a "Multidisciplinary Minor" courses, imparts state of the art practical knowledge through a semester-long industry / research internship, collaborates outside world for the imparting relevant skill 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, it offers a unique, liberal **"Pi-Model"** of Engineering Education.

***Table 1:** Nomenclature of the courses in the curriculum*

Groups	Abbreviation	Course Category
Basic Sciences and Engineering Sciences Courses (BSES)	BSESC	Basic Science & Engineering Science Courses
	BSESEC	Basic Science & Engineering Science Elective Courses
Skill Based Courses (SBC)	SEC	Skill Enhancement Course
	CC	Co-curricular Courses
Humanities, Social Science and Management (HSSM) Courses	HSSMC	Humanities, Social Science and Management Courses
	CP	Community Project
Ability Enhancement Courses (AEC)	IKS	Indian Knowledge System
	UHV	Universal Human Values
Program Related Courses (PRC)	PCC	Program Core Courses
	PEC	Program Elective Courses
	ELC	Experiential Leaning Courses
Multi-Cross-Trans disciplinary courses (MCTD)	OEC	Open Elective Courses
	MDM	Multidisciplinary Minor

Indicative List of BSESE Courses:

- Engineering Physics
- Engineering Chemistry
- Biology for Engineers
- Engineering Mechanics
- Engineering Graphics
- Material Science
- Environmental Science
- Thermal & Fluid Engineering

Table 2: Comparison of S.P.I.T. credit structure with the G.R. recommendations

SPIT											
Sem	**BSES**	**SEC**	**AEC**	**HSSM**	**CC (LLC)**	**PCC**	**PEC**	**OE**	**EXP LEARNING**	**MDM**	**Total**
I	11	5	2		1						**19**
II	11	5	2		1				2		**21**
III	6	2		2	1	12					**23**
IV	3	2		2	1	12				3	**23**
V						17			2	4	**23**
VI		2				7	6		2	3	**20**
VII							6	3	4	4	**17**
VIII								3	11		**14**
Total	31	16	4	4	4	48	12	6	21	14	**160**
%	**19.38**	**10**	**2.5**	**2.5**	**2.5**	**30**	**7.5**	**3.75**	**13.125**	**8.75**	**100**
G.R. (NEP-2020) Recommended											
Total	**30**	**10**	**8**	**4**	**4**	**44**	**20**	**8**	**22**	**14**	**164**
%	**18.3**	**6.1**	**4.88**	**2.44**	**2.44**	**27**	**12.2**	**4.88**	**13.42**	**8.54**	**100**

Figure 1: Comparison of S.P.I.T. credit structure with the G.R. recommendations

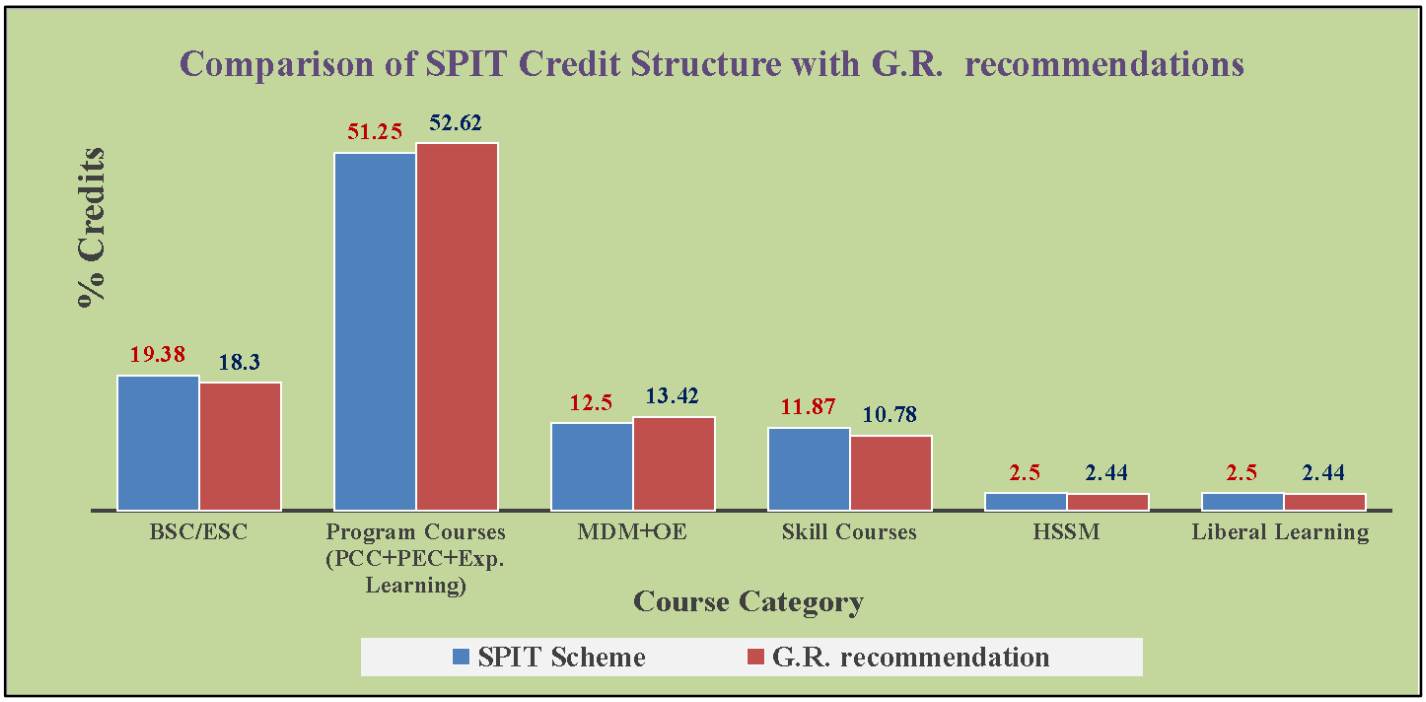

Figure 2: Pie-chart of vertical-wise allocation of credits

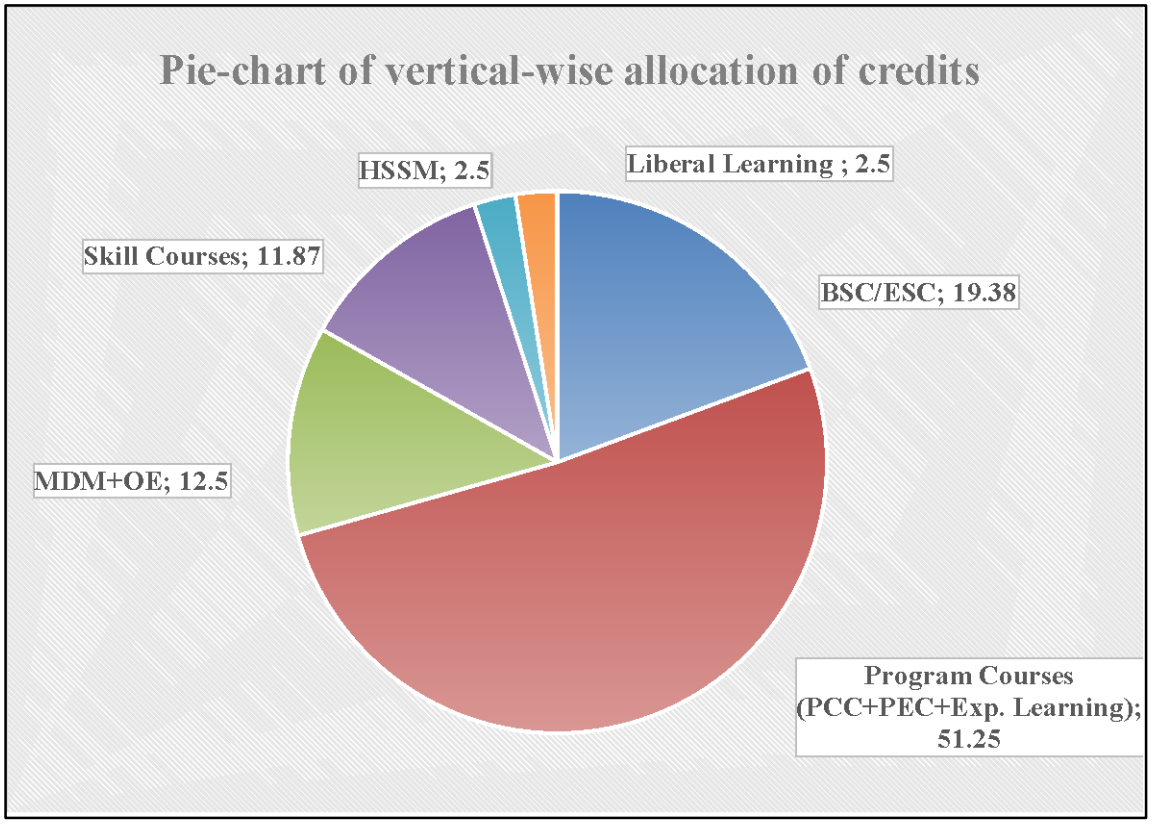

Table 3: Semester-wise allocation of credits to different verticals

SEM I										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Basic & Engg. Sciences	BSES	MA101	Mathematics I (ECL)	3	1	0	8	12	4
2	Skill Enhancement Course	SEC	CE101	Problem Solving using Imperative Programming Lab	0	1	2+2	4	9	3
3	Basic & Engg. Sciences Elective	BSESE		**Course I**						3
			AS101	Engineering Physics	2	0	2	4	8	
			AS102	Engineering Chemistry	2	0	2	3	7	
			AS103	Biology for Engineers	3	0	0	3	6	
			AS104	Engineering Mechanics	2	0	2	4	8	
			AS105	Engineering Graphics	1	0	2+2	2	7	
			AS108	Material Science	2	0	2	4	8	
			AS109	Environmental Science	3	0	0	3	6	
			AS110	Energy Science	2	0	2	3	7	
			AS111	Thermal & Fluid Engineering	3	0	0	3	6	
4	Skill Enhancement course	SEC	AS106	Tech Shop	1	0	2	2	5	2
			AS107	Soft Skill I						
5	Basic & Engg. Sciences	BSES	ET101	Digital Systems	3	0	2	5	10	4
			ET102	Basic Electrical Engineering	3	0	2	6	11	
6	Ability Enhancement -*Course	AEC	AS108	IKS	2	0	0	1	3	2
			AS109	UHV						
7	Cocurricular Courses	CC (LLC)	LLCXX	LLC--I	1	0	0	2	3	1
				Total	**12**	**2**	**10**	**25**	**49**	**19**

SEM-II										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Basic & Engg. Sciences	BSES	MA102	Mathematics II (DECA)	3	1	0	8	12	4
2	Skill Enhancement Course	SEC	CE102	Problem Solving using Object Oriented Programming Lab	0	1	2+2	4	9	3
3	Basic & Engg. Sciences Elective	BSESE		**Course I**						3
			AS101	Engineering Physics	2	0	2	4	8	
			AS102	Engineering Chemistry	2	0	2	3	7	
			AS103	Biology for Engineers	3	0	0	3	7	
			AS104	Engineering Mechanics	2	0	2	4	8	
			AS105	Engineering Graphics	1	0	2+2	2	7	
			AS108	Material Science	2	0	2	4	8	
			AS109	Environmental Science	3	0	0	3	6	
			AS110	Energy Science	2	0	2	3	7	
			AS111	Thermal & Fluid Engineering	3	0	0	3	6	
4	Skill Enhancement course	SEC	AS106	Tech Shop	1	0	2	2	5	2
			AS107	Soft Skill I						
5	Basic & Engg. Sciences	BSES	ET101	Digital Systems	3	0	2	5	10	4
			ET102	Basic Electrical Engineering	3	0	2	6	11	
6	Ability Enhancement -*Course	AEC	AS108	IKS	2	0	0	1	3	2
			AS109	UHV						
7	Cocurricular Courses	CC (LLC)	LLCXX	LLC--I	1	0	0	2	3	1
				Total	**12**	**2**	**10**	**25**	**49**	**19**

Summer Term										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Experiential Learning	CP (in Summer)	PR101	Community Project	0	0	4	4	8	2
2	HSSE	COI	AS112	Constitution of India (2Hrs/Week)	1	**0**	**0**	**1**	**2**	**NC**

SEM III										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Basic & Engg. Sciences	BSES	CS201	Discrete Structures and Graph Theory	3	0	0	5	8	3
2	Basic & Engg. Sciences *	FOM-I	MA202	Foundation of Mathematics-I*	2	1	0	0	3	3
3	Skill Enhancement Course	SEC	AS201	Soft Skill II-Professional Communication Skills	0	1	2	4	7	2
4	Basic & Engg. Sciences Elective	BSESE		**Course I**						3
			AS101	Engineering Physics	2	0	2	4	8	
			AS102	Engineering Chemistry	2	0	2	3	7	
			AS103	Biology for Engineers	3	0	0	3	7	
			AS104	Engineering Mechanics	2	0	2	4	8	
			AS105	Engineering Graphics	1	0	2+2	2	7	
			AS108	Material Science	2	0	2	4	8	
			AS109	Environmental Science	3	0	0	3	6	
			AS110	Energy Science	2	0	2	3	7	
			AS111	Thermal & Fluid Engineering	3	0	0	3	6	
5	Humanities	HSSM-I	HS2XX	**Course I**	2	0	0	3	5	2
7	Program Core Courses (12 Credits)	PCC	CS202	Data Structures	3	0	2	4	9	4
8		PCC	CS203	Computer Organization and Architecture	3	0	2	4	9	4
9		PCC	CS204	Database Management Systems	3	0	2	4	9	4
10	Cocurricular Courses	CC (LLC)	LLCXX	LLC--III	1	0	0	1	2	1
				Total	**17**	**1**	**10**	**28**	**56**	**23**

SEM IV										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Basic & Engg. Sciences	BSES	CS205	Statical Methods in Computer Science	3	0	0	6	9	3
2	Basic & Engg. Sciences *	FOM-II	MA204	Foundation of Mathematics-II*	2	1	0	0	3	3
3	Skill enhancement course	SEC	AS202	Python Programming for Data science	0	1	2	4	7	2
4	Humanities	HSSM-II	HS2XX	**Course II**	2	0	0	3	5	2
5	Program Core Courses (12 credits)	PCC	CS206	Operating Systems	3	0	2	4	9	4
6		PCC	CS207	Design and Analysis of Algorithms	3	0	2	4	9	4
7		PCC	CS208	Computer Communications and Networks	3	0	2	4	9	4
8	Cocurricular Courses	CC (LLC)	LLCXX	LLC--IV	1	0	0	1	2	1
9	Multidisciplinary Minor	MDM	MDEC1X	MDM-I	To be defined by others					3
				Total	**15**	**1**	**8**	**26**	**50**	**23**

**Only for Lateral Entry Students*

Summer term (For Lateral Entry Students)										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Basic & Engg. Sciences	BSES	CS201	Discrete Structures and Graph Theory	3	0	0	5	8	3
2			CS205	Statical methods in Computer Science	3	0	0	6	9	3

- Students are expected to start working for the Mini Project I during the summer.
- Research internship of minimum 2 months for the "Honors by Research" for 6 credits- HR21 (Not for DSY)
- For Enrollment to Honors by research, Minimum CGPA must be 8.25

SEM V										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Experiential Learning	ELC	PR1	Mini Project I	0	0	4	4	8	2
2	Program Core Courses (17 Credits)	PCC	CS301	Distributed Computing	2	0	2	6	10	3
3		PCC	CS302	Software Engineering	2	0	2	6	10	3
4		PCC	CS303	Artificial Intelligence and Soft Computing	3	0	2	6	11	4
5		PCC	CS304	Theory of Computation	3	0	0	5	8	3
6		PCC	CS305	Cryptography and Network Security	3	0	2	5	10	4
7	Multidisciplinary Minor	MDM	MDEC2X	MDM-II	To be defined by others					4
		Total			**13**	**0**	**12**	**32**	**57**	**23**

- Research internship of minimum 1 month for the "Honors by Research" for 3 credits HR31 (Not for DSY)
- For Enrollment to Honors by research, Minimum CGPA must be 8.25

SEM VI										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Program Core Courses (7credits)	PCC	CS306	Human Machine Interaction	3	0	2	4	9	4
2		PCC	CS307	Machine Learning	2	0	2	5	9	3
3	Multidisciplinary Minor	MDM	MDEC3X	MDM-III	To be defined by others					3
4	Experiential Learning	ELC	PR3-I	Main Project Stage I	0	0	4	4	8	2
5	Program Elective Courses	PEC	CS3X1	PE-I	2	0	1	4	7	3
6	Program Elective Courses	PEC	CS3X2	PE-II	2	0	1	4	7	3
7	Skill Enhancement Course	SEC	CS308	DevOps Lab	0	1	2	2	5	2
				Total	**9**	**1**	**12**	**23**	**45**	**20**

- Research internship of minimum 2 month for the "Honors by Research" for 6 credits HR32 (Not for DSY)
- For Enrollment to Honors by research, Minimum CGPA must be 8.25

SEM VII									
Course Category	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
Multidisciplinary Minor	MDM	MDEC4X	MDM-IV	To be defined others					4
Program Elective Courses	PEC	CS4X3	PE-III	2	0	1	4	7	3
Program Elective Courses	PEC	CS4X4	PE-IV	2	0	1	4	7	3
Open Elective	OE	OE1	OE-I	2	0	1	4	7	3
Experiential Learning	ELC	PR3-II	Main Project Stage II	0	0	8	4	12	4
			Total	**6**	**0**	**11**	**16**	**33**	**17**

- Research internship of minimum 1 month for the "Honors by Research" for 3 credits HR41 (Not for DSY)
- For Enrollment to Honors by research, Minimum CGPA must be 8.25

SEM VIII										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Open Elective	OE	OE2	OE-II**	2	0	1	4	7	3
2	Experiential Learning	ELC	INTR INTI PR4-III	Research/ Industry Internship/Main Project Stage III***	0	0	24	12	36	11
				Total	**2**	**0**	**25**	**16**	**43**	**14**

*** To be completed from MOOCs*

****Students neither taking research or industry internship nor willing to extend their project work can earn additional 11 credits from Swayam Platform or NPTEL or registering courses from any peer institution of higher learning., besides open elective program elective courses offered by the institute.*

Indicative List of Humanities courses (HSSM-I):

Course Code	Course Title	Course Code	Course Title
HS211	Law for Engineers-I	HS212	Law for Engineers-II
HS221	Psychology -I	HS222	Psychology -II
HS231	Finance for Engineers-I	HS232	Finance for Engineers-II
HS241	Economics-I	HS242	Economics-II
HS251	French-I	HS252	French-II
HS261	German-I	HS262	German-II
HS271	Japanese-I	HS272	Japanese-II
HSNP	NPTEL (HSS/Management)	HSNP	NPTEL (HSS/Management)

Indicative List of Cocurricular courses (LLC)

Course Code	Course Title
LLC01	Dance (Kathak)
LLC02	Dance (Bharatnatyam)
LLC02	Fundamentals of Photography
LLC03	Art of Short Film Making / Cinematography
LLC04	Film Appreciation
LLC05	Basics of Music Composition
LLC06	Basics of Keyboard playing
LLC07	Physical Fitness
LLC08	Self Defense for Women
LLC09	Pran-Vidya (Combo of Yoga and Pranayam)
LLC10	Jeevan Vidya (Work Life Balance)
LLC11	Integrated Personality Development-I
LLC12	Indian Knowledge System-I
LLC13	Design Thinking
LLC14	Innovation and Creativity
LLC15	Principle Centered Leadership
LLC16	Social Psychology
LLC17	Mentoring of School Children at SPIT (Abhudaya)
LLC18	Basics of Fire Safety
LLC19	Study of one of the Identified Books
LLC20	Teaching Assistantship
LLC21	Trekking
LLC22	Kannada Language
LLC23	Telugu Language
LLC24	Tamil Language
LLCXX	Any other Course approved by Dean Academics and Research

PROGRAM ELECTIVE COURSES

4 Electives are sufficient to specialize in a particular domain.

Track	PE-I CS3X1	PE-II CS3X2	PE-III CS4X3	PE-IV CS4X4
Emerging Networking Technologies	CS311: Digital Forensic	CS312: Cloud Computing	CS413: Block chain Technology	CS414: IT Infrastructure Monitoring and Management
Emerging AI	CS321: Natural Language Processing	CS322: Deep Learning	CS423: Generative AI	CS424: Explainable AI
Data Analytics	CS331: Business analytics with Python	CS332: Big data Analytics	CS433: Data Warehouse and Mining	CS434: AI for Healthcare Analytics
Digital Visualization	CS341: Fundamentals of Signal & Image Processing	CS332: Augmented Reality &Virtual Reality [AR-VR]	CS433: Computer Vision	CS434: Visual Intelligence

Indicative list of Multidisciplinary Minors

MDM Sequels for EXTC

- Computer Engineering
- AIML
- Data Science
- Interface and Experience Design
- IT Infrastructure

Course Category of Multidisciplinary Minor	MDM-I (Semester IV)	MDM-II (Semester V)	MDM-III (Semester VI)	MDM-IV (Semester VII)
Computer Engineering	**MDCE11:** Database Management Systems	**MDCE12:** Data Structures and Algorithms	**MDCE13:** Cloud Computing	**MDCE14:** Internet and Web Technology
Artificial Intelligence and Machine Learning	**MDCE21:** Fundamentals of NNFL	**MDCE22:** Artificial Intelligence Machine Learning	**MDCE23:** Natural Language Processing	**MDCE24:** Image Processing and Pattern Recognition
Data Science	**MDCS31:** Fundamentals of Data Science	**MDCS32:** Data Analytics and Visualization	**MDCS33:** Decision Making and Business Intelligence	**MDCS34:** Social Media Analytics
Interface and Experience Design	**MDCS41:** UI/UX Fundamentals	**MDCS42:** Design Thinking and Innovations	**MDCS43:** Human Computer Interaction	**MDCS44:** Total Experience Design
IT Infrastructure	**MDCE51:** IT Infrastructure and DevOps Lab	**MDCE52:** Virtualization and Computing	**MDCE53:** SDN and NFV	**MDCE54:** Network Management

MDM Sequels for CE/CSE

- Industrial IoT
- Digital Signal Processing
- Electronics Communication
- VLSI
- Mathematics and Statistics
- Finance
- Economics

Course Category of Multidisciplinary Minor	**MDM-I (Semester IV)**	**MDM-II (Semester V)**	**MDM-III (Semester VI)**	**MDM-IV (Semester VII)**
Industrial IoT	**MDEC11:** Fundamental of Internet of Things	**MDEC12:** Embedded "C" and Micro Python for IoT	**MDEC13:** IOT Communication and Network Layer Protocols	**MDEC14:** IoT Applications and Security
Digital Signal Processing	**MDEC21:** Digital Signal Processing	**MDEC22**: Digital Image Processing	**MDEC23:** Multimedia Signal Processing	**MDEC24:** Digital Signal Processor System Design
Electronics Communication	**MDEC31:** Linear Electronics Circuit	**MDEC32:** Principles of Communication & Systems	**MDEC33:** Data Compression and Encryption	**MDEC34:** Wireless Communication and Networks
VLSI	**MDEC41:** Hardware Description Language programming	**MDEC42:** Digital CMOS VLSI Design	**MDEC43:** VLSI Physical Design	**MDEC44:** ASIC Verification

Notes:

1. Learners who earn a minimum of total 160 credits will be awarded **"B. Tech in Engg. /Tech. with Multidisciplinary Minor"** degree.
2. Learners will have the following options to earn **B. Tech. in Engg. /Tech. degree with MDM and Honors Certification.** If learners earn top grades in any 8 Program core courses. They will be awarded a Honors Certification.
3. Learners who earn 18 additional credits through 6-month (2+1+2+1) Research Internships during summer and winter breaks, as mentioned in the scheme, are eligible for the degree: **"B. Tech. in Engg. /Tech. with Multidisciplinary Minor and Honors by Research",** subject to earning CGPA of 8.25 throughout all semesters.
4. Learner can earn the certificates based on his/her exit from the program as follows:
   a) After a one-year (40 credits to be earned) and 8-week summer workshop: **Certificate in Engineering.**
   b) After two-years (80 credits to be earned) and 8-week summer workshop: **Diploma in Engineering**.
   c) After three-years (120 credits to be earned) and 8-week summer workshop: **B. Sc. Engineering.**

Dr. D. R. Kalbande	**Dr. Y. S. Rao**	**Dr. B. N. Chaudhari**
HoD Computer Science and Engg.	**Dean Academics & Research**	**Principal**

SYLLABUS
SEMESTER I

SEM I										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Basic & Engg. Sciences	BSES	MA101	Mathematics I (ECL)	3	1	0	8	12	4
2	Skill Enhancement Course	SEC	CE101	Problem Solving using Imperative Programming Lab	0	1	2+2	4	9	3
3	Basic & Engg. Sciences Elective	BSESE		**Course I**						3
			AS101	Engineering Physics	2	0	2	4	8	
			AS102	Engineering Chemistry	2	0	2	3	7	
			AS103	Biology for Engineers	3	0	0	3	6	
			AS104	Engineering Mechanics	2	0	2	4	8	
			AS105	Engineering Graphics	1	0	2+2	2	7	
			AS108	Material Science	2	0	2	4	8	
			AS109	Environmental Science	3	0	0	3	6	
			AS110	Energy Science	2	0	2	3	7	
			AS111	Thermal & Fluid Engineering	3	0	0	3	6	
4	Skill Enhancement course	SEC	AS106	Tech Shop	1	0	2	2	5	2
			AS107	Soft Skill I						
5	Basic & Engg. Sciences	BSES	ET101	Digital Systems	3	0	2	5	10	4
			ET102	Basic Electrical Engineering	3	0	2	6	11	
6	Ability Enhancement -*Course	AEC	AS108	IKS	2	0	0	1	3	2
			AS109	UHV						
7	Cocurricular Courses	CC (LLC)	LLCXX	LLC--I	1	0	0	2	3	1
				Total	**12**	**2**	**10**	**25**	**49**	**19**

SEMESTER II

SEM-II										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Basic & Engg. Sciences	BSES	MA102	Mathematics II (DECA)	3	1	0	8	12	4
2	Skill Enhancement Course	SEC	CE102	Problem Solving using Object Oriented Programming Lab	0	1	2+2	4	9	3
3	Basic & Engg. Sciences Elective	BSESE		**Course I**						3
			AS101	Engineering Physics	2	0	2	4	8	
			AS102	Engineering Chemistry	2	0	2	3	7	
			AS103	Biology for Engineers	3	0	0	3	7	
			AS104	Engineering Mechanics	2	0	2	4	8	
			AS105	Engineering Graphics	1	0	2+2	2	7	
			AS108	Material Science	2	0	2	4	8	
			AS109	Environmental Science	3	0	0	3	6	
			AS110	Energy Science	2	0	2	3	7	
			AS111	Thermal & Fluid Engineering	3	0	0	3	6	
4	Skill Enhancement course	SEC	AS106	Tech Shop	1	0	2	2	5	2
			AS107	Soft Skill I						
5	Basic & Engg. Sciences	BSES	ET101	Digital Systems	3	0	2	5	10	4
			ET102	Basic Electrical Engineering	3	0	2	6	11	
6	Ability Enhancement -*Course	AEC	AS108	IKS	2	0	0	1	3	2
			AS109	UHV						
7	Cocurricular Courses	CC (LLC)	LLCXX	LLC--I	1	0	0	2	3	1
				Total	**12**	**2**	**10**	**25**	**49**	**19**

First Year Evaluation Scheme (Percentage)

Sr. No.	Course Code	Course Name	Credits	ISE (%)	MSE (%)	ESE (%)	Sub-total (%)	Total
1	MA101	Engineering Calculus-Theory	4	20	20	60	100	100
2	EC101	Digital Systems-Theory	3	15	15	45	75	100
		Digital Systems-Lab	1	15	0	10	25	
3	EC102	Basic Electrical Engineering-Theory	3	15	15	45	75	100
		Basic Electrical Engineering - Lab	1	15	0	10	25	
4	AS101	Engineering Physics-Theory	2	13.5	13.5	40	67	100
		Engineering Physics-Lab	1	26	0	07	33	
5	AS102	Engineering Chemistry-Theory	2	13.5	13.5	40	67	100
		Engineering Chemistry-Lab	1	26	0	07	33	
6	AS103	Biology for Engineers-Theory	3	20	20	60	100	100
7	AS104	Engineering Graphics - Theory	1	13	0	20	33	100
		Engineering Graphics-Lab	2	40	0	27	67	
8	AS105	Engineering Mechanics-Theory	2	13.5	13.5	40	67	100
		Engineering Mechanics-Lab	1	26	0	07	33	
9	AS108	Material Science and Engineering-Theory	3	20	20	60	100	100
10	AS109	Environmental Science -Theory	3	20	20	60	100	100

11	AS110	Energy Science -Theory	3	20	20	60	100	100
12	AS111	Thermal & Fluid Engineering - Theory	3	20	20	60	100	100
13	AS106	Tech Shop- Lab	2	80	0	20	100	100
14	AS107	Soft Skill I	2	80	20	0	100	100
15	CE101	Programming I - Lab	3	80	0	2	100	100
16	CE102	Programming II -Lab	3	80	0	20	100	100
17	AEC01	IKS	2	80	0	20	100	100
18	AEC02	UHV	2	80	0	20	100	100
19	LLC01	LLCXX	1	100	0	0	0	100
20	LLC02	LLCXX	1	100	0	0	0	100
21	PRJ01	Project-01	2	80	0	20	100	100

Note: Course coordinators desirous of changing the percentage allocation to ISE: MSE: ESE for Theory / Lab of any course, must seek approval of Dean Academics and the Principal,

Engineering Calculus: Sem-I

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSES)	Mathematics I (Engineering Calculus)	3	1	0	8	12	3	1	0	4
		Examination Scheme								
MA101		Component	ISE		MSE		ESE		Total	
		Theory	20%		20%		60%		100%	
		Laboratory	--		--		--		--	

Pre-requisite Course Codes, if any.	Basics of derivatives and integration done earlier.
Course Objective: To develop mathematical skills for solving engineering problems.	
Learning Outcomes (LO): ***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.
MA101.6	Solve multiple integral in various coordinate systems and use to calculate Area.

LO-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											
MA101.3	3											
MA101.4	3											
MA101.5	3											
MA101.6	3											

LO-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) McLaurin'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. 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.**

Textbooks

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
4	Higher Engineering Mathematics	Eleventh	B.V. Ramana	Tata McGraw-Hill	2010
5	Advanced Engineering Mathematics	Sixth	Dennis G. Zill	Jones and Bartlett	2016

Differential Equations and Complex Analysis: Sem-II

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSES)	Mathematics II (Differential Equations and Complex Analysis)	3	1	0	8	12	3	1	0	4
		Examination Scheme								
		Component	ISE		MSE		ESE		Total	
MA102		Theory	20%		20%		60%		100%	
		Laboratory	--		--		--		--	

Pre-requisite Course Codes, if any.	Topics from Engineering Calculus- Semester I
Course Objective: To develop mathematical skills for solving engineering problems.	
Learning Outcomes (LO): ***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.

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

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

LO-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, and 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	**8**
	3.1	De Moivre's Theorem and its application to determine powers of complex numbers. Roots of complex numbers by De Moivre's Theorem.		3
	3.2	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.		1
	3.3	Hyperbolic Functions: relation between circular and hyperbolic functions, Inverse hyperbolic functions. Separation into real and imaginary parts of complex functions.		3
	3.4	Logarithm of a complex number.		1
4	**Title**	**Analytic functions and Complex Integrals**	1,2,3	**12**
	4.1	Analytic functions, Cauchy Riemann equations in Cartesian and polar form, construction of analytic functions using Milne-Thompson's method, Harmonic functions, poles of f(z).		6
	4.2	Line Integral of complex valued function, Cauchy's Integral theorem for simply connected regions, Cauchy's Integral formula (for poles lying inside or outside the curve).		6
5	**Self Study**	1.3 To form D.E. for given L-C-E-R circuit. 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.		**08**
			Total	**42***

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

Textbooks

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 Mathematic	Fourth	Jain and Iyengar	Narosa Publications	2014
4.	A First Course in Differential Equations with Modelling Applications	Ninth	Dennis G. Zill	Cengage India	2009

Engineering Physics

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
BSESE	Engineering Physics	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component			ISE %		MSE %		ESE %	Total %
AS101		Theory			13.5		13.5		40	67
		Laboratory			26		–		7	33

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	
Learning Outcomes (LO): At *the End of the course students will be able to*	
AS101.1	Demonstrate the conceptual knowledge of quantum mechanics, semiconductors, lasers and wave optics.
AS101.2	Solve the problems by applying the basics concepts of physics.
AS101.3	Explain the working principle of various LASERs and its practical applications.
AS101.4	Develop experimental skills and practical abilities.
AS101.5	Use scientific apparatus and comprehend the importance of precision, accuracy of the experimental data.

LO-PEO/PSO 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								

	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

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; 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 (Tunneling)	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; concept of carrier current densities in p-n junction in equilibrium, forward bias and reverse bias	5,6	
	2.4	P-N junction devices: LED, Zener diode, photoconductors, solar cells	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 lasers 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 using four probe method
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. Bhattacharya & 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
7	Engineering Physics	First	B. K. Pandey and S. Chaturvedi	CENGAGE	2023

Bharatiya Vidya Bhavan'

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

Engineering Chemistry

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
BSESE	Engineering Chemistry	L	T	P	O	E	L	T	P	Total
		2	0	2	3	7	2	0	1	3
AS102		Examination Scheme								
		Component	ISE %	MSE %	ESE %	Total %				
		Theory	13.5	13.5	40	67				
		Laboratory	26		7	33				

Course Education Objective:

To provide necessary background of applied chemistry suited for relevant areas of engineering.

Pre-requisite Course Codes		HSC Level Chemistry
After successful completion of the course, learner will be able to		
Learning Outcomes	**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, (Understanding)
	AS102.3	Compare different sources of energy like conventional fossil fuels, alternative fuels, batteries, fuel cells with respect to availability, working principles, constitution, efficiency of performance and environmental impact (Understanding)
	AS102.4	Apply knowledge of electrochemistry and green chemistry in the interest of public health and environment (Application)
	AS102.5	Make use of analytical techniques (potentiometric and iodometric titrations) and instruments (pHmeter, conductometer and Orsats's Apparatus) for various purposes like redox reactions, neutralization reactions etc.
	AS102.6	Estimate key properties of lubricants like flash point, Viscosity and acid value

LO-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							2					
AS102.6				1								

LO-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

Module No	Module Name	Unit No.	Topics	Ref.	Hrs
1	Thermodynamics	1.1	Introduction, Terminology, Concepts of Internal Energy and Thermodynamic equilibrium, Zeroth and First Law of Thermodynamics, Implications and Limitations of First law	1, 2,	1
		1.2	Joule Thomson Effect and significance of inversion temperature, Carnot's Cycle, Carnot's theorem and related numericals, Second Law of thermodynamics	1, 2	1
		1.3	Overview of applications of thermodynamics	1,2	1
2		2.1	Introduction to polymers, Effect of heat on polymers : Glass transition temperature and melting with	2, 3,4	2

	Polymers		significance;		
		2.2	Latest Applications: Conducting polymers, Liquid crystal polymers, Engineering Polymers,	2, 3,4,5	2
3	**Fuels and combustion**	**3.1**	Definition and classification of fuels, Calorific value : Definition, Gross or Higher calorific value & Net or lower calorific value, Dulong‟s formula & numericals for calculations of Gross and Net calorific values.	2,3	2
		3.2	Knocking, Octane number, Antiknock agents, unleaded petrol, Cetane number	2,3	1
		3.3	Calculations for requirement of only oxygen and air (by weight and by volume only) for given solid & gaseous fuels.	2,3	2
		3.4	Disadvantages of fossil fuels, Alternative (Green) Fuels : Power alcohol , Biomass, Biogas, Biodiesel, Natural Gas and CNG (Description, Utility, advantages and disadvantages)	2,3	1
4	**Electro-chemistry**	**4.1**	Introduction, concept of electrode potential, electrochemical cells, Nernst Equation with applications and numericals,	2,3,4	2
		4.2	Reference Electrodes (Hydrogen electrode, calomel electrode), Glass Electrode for pH measurements, Electrochemical sensors : Working principle, construction and applications	2,3,4	2
		4.3	Faraday's Laws of electrolysis and numericals,	2,3,4	1
5	**Batteries and Battery Technology**	**5.1**	Introduction, Important terms, Lead Acid storage Cell, Nickel-Hydrogen(metal hydride), Rechargeable Lithium ion batteries, Sodium ion batteries	2,3, 6	2
		5.2	Reserve Batteries, Fuel cells, characteristics, description, construction and working of Hydrogen-oxygen fuel cells	2,3, 6	2
6	**Green Chemistry**	**6.1**	12 principles of green chemistry with examples, Numericals on Atom Economy, Green Solvents (Water, Supercritical Fluids),	2,3	3
	Engineering materials	**7.1**	Eutectic mixtures and soft solders Advanced Ceramic materials and cermets and applications Carbon nanomaterials : Fullerenes and Carbon nanotubes, Structure, Properties and applications	2,3,4	1

7		**7.2**	Semiconductors, Stoichiometric and defect semiconductors.	2,3,4	1
		7.3	Superconductors, perovskite structure and 1:2:3 compound $YBa_2Cu_3O_{7-y,}$ properties and applications	2,3,4	1
			Total		**28**
	Self Learning		Challenges pertaining to use of Li ion batteries, Different types of fuel cells, Calculation of hardness of water and COD of wastewater		

Laboratory Component

Sr. NO	Title Of the Experiment
1	Determination of total hardness of water sample
2	Removal of hardness using ion exchange column
3	Determination of Viscosity of oil by Redwood Viscometer
4	To determine flash point of a lubricating oil
5	Analysis of flue gas for its composition (by Orsat's Apparatus)
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	Potentiometric titration (acid-base, redox)
11	Estimation of Iron in plain Carbon steel
12	Determination of COD of wastewater sample

References:

[1] Peter Atkins, Physical Chemistry, XIth ed, Oxford, United Kingdom, Oxford University Press, 2017
[2] P. C. Jain & M. Jain, *Engineering Chemistry*, XVIth ed , New Delhi, India:Dhanpat Rai Publishing Co. (P) Ltd., 2014
[3] S. S. Dara & S. S. Umare,*A Textbook of Engineering Chemistry*, XIIth ed., New Delhi, India: S. Chand & Co. Ltd., 2013
[4] S. Chawla, *A Textbook of Engineering Chemistry*, IIIrd ed.,Delhi, India:Dhanpat Rai & Co. (Pvt.) Ltd., 2015
[5] S. Agarwal, *Engineering Chemistry Fundamentals and Applications*, Ist ed, Delhi, India: Cambridge Univ. Press., 2015

[6] Dell, Ronald M Rand, David A J, 'Understanding Batteries', Royal Society of Chemistry, (2001).

Biology for Engineers

Course (Category) Code	Course Name	Teaching Scheme (Hrs./week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSESE)	Biology for Engineers	3	0	0	4	7	3	0	0	3
		Examination Scheme (%)								
		Component		ISE		MSE		ESE		Total
AS103		Theory		20		20		60		100
		Laboratory		0		--		0		0

Pre-requisite Course Codes, if any.	**12th**
Course Objective: To motivate the students to develop a system with a multidisciplinary approach using basic biological concepts and Artificial Intelligence. Learners will gain a comprehensive understanding of how AI is revolutionizing healthcare and biomedical research.	
Learning Outcomes (LO): ***At the End of the course students will be able to***	
AS103.1	Understand the basic biomolecules and their engineering applications.
AS103.2	Grasp how biological systems can be re-designed as substitute products for natural systems.
AS103.3	Acquire the interdisciplinary vision of biological engineering
AS103.4	Explore the use of AI in medical imaging for diagnosis and treatment planning
AS103.5	Understand AI-driven approaches for disease diagnosis, prediction, and personalized medicine with ethical, legal and social implications.

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

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

AS103.5	**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**	**Biomolecules and their applications**	1,2	8
	1.1	Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting),		
	1.2	Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, alginolytic enzyme in bio-bleaching).		
2	**2**	**Cardiovascular and Nervous System**	1,2	10
	2.1	Anatomy of the heart; Heart valves, systemic and pulmonary circulation; Conduction system of the heart; Cardiac action potential, electrocardiogram (ECG); Cardiac cycle; Cardiac output; Blood pressure.		
	2.2	Divisions of the nervous system (central and peripheral nervous system); Structure and functions of the brain and spinal cord; Reflex actions and reflex arc; Functions of sympathetic and parasympathetic nervous system; Nerve action potential and nerve conduction.		
3	**3**	**Human Organ Systems and Bio-Designs**	1,2	10
	3.1	Brain as a CPU system, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease).		
	3.2	Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye).		
	3.3	Heart as a pump system (architecture, electrical signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pacemakers, defibrillators).		
4	**4**	**AI for Biomedical Applications**	1	14

	4.1	Introduction to AI in Biomedical Applications: Overview of artificial intelligence and machine learning, Challenges and opportunities in applying AI to biomedicine, Ethical considerations in AI-driven healthcare		
	4.2	Medical Imaging and AI: Basics of medical imaging modalities, Image preprocessing and feature extraction, AI applications in medical image analysis and interpretation		
	4.3	Personalized Medicine and Precision Health: Concept of personalized medicine, AI-driven approaches to patient stratification, Precision health initiatives and challenges	2	
	4.4	Genomics and Bioinformatics: Basics of genomics and next-generation sequencing, AI-driven analysis of genomic data, Precision genomics and its applications in healthcare		
	4.5	Regulatory and Ethical Considerations: Regulatory landscape for AI in healthcare, Ethical and privacy considerations in AI-driven healthcare, Bias and fairness in AI algorithms		
5	**Self Study**	Trends in Bioengineering: Bioprinting techniques and materials, 3D printing of ear, bone, and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Self-healing Bio concrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).	1,2,3	6*
			Total (6*Not included)	42

ISE Component: Presentations on the following topics

Sr. No	Biology for Engineers
1	Signal Conditioning for ECG
2	Signal Conditioning for EEG
3	Study of Robotic arm for prosthetics
4	Study of Parkinson's disease
5	Utilize Python libraries such as OpenCV and TensorFlow to preprocess medical images and develop a deep learning model for automated diagnosis or classification of medical images (e.g., X-rays, MRI scans).
6	Collect and preprocess relevant clinical data (e.g., patient demographics, lab results, symptoms and implement predictive analytics algorithms to forecast disease progression or patient outcomes.
7	Design personalized treatment plans based on genetic profiles using decision support systems

8	Apply machine learning techniques (e.g., random forests, deep learning) to predict gene function or classify genomic variants [Access genomic datasets from repositories such as the Genomic Data Commons (GDC) or The Cancer Genome Atlas (TCGA).]
9	Develop predictive models for hospital readmission or patient risk stratification using clinical data.
10	A case studies involving ethical dilemmas in AI-driven healthcare (e.g., patient privacy, algorithmic bias). To study and analyze regulatory frameworks (e.g., HIPAA, GDPR) governing the use of AI in healthcare and Propose strategies for addressing ethical concerns and ensuring fairness and transparency in AI algorithms.

Text Books:

Sr. No	Title	Edition	Authors	Publisher	Year
1	Human Physiology	16th	Stuart Fox, Krista Rompolski	McGraw-Hill	2022
2	Biology for Engineers	3rd	Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K.	Tata McGraw Hill	2012
3	Artificial Intelligence in Medicine		Adam Bohr and Gopalakrishnan Venkitaraman	Academic Press; 1st edition (21 June 2020)	2020

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Biology for Engineers	--	Arthur T. Johnson	CRC Press, Taylor and Francis	2011
2	Biology for Engineers		Danial Schodek	MIT Press	

Bharatiya Vidya Bhavan'
Sardar Patel Institute of Technology
(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

Engineering Graphics

Course (Category) Code	Course Name	Teaching Scheme (Hrs./week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
BSESEC	Engineering Graphics	1	0	4	2	7	0	1	2	3
		Examination Scheme								
		Component	ISE %		MSE %		ESE %		Total %	
AS105		Theory	13		0		20		33	
		Laboratory	40		–		27		67	

Pre-requisite Course Codes, if any.	10+2 Basics
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.	
Learning Outcomes (LO): ***At the End of the course students will be able to***	
AS105.1	Construct basic engineering curves.
AS105.2	Draw projection of points and lines.
AS105.3	Draw projection of regular solids inclined to both the reference planes.
AS105.4	Read the 3-dimensional view and draw the orthographic and sectional orthographic projections.
AS105.5	Read the orthographic projection and draw an isometric view.
AS105.6	Draw the development of lateral surfaces of solids.

LO-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										3
AS105.2	3	3										3
AS105.3	3	3										3
AS105.4	3	3										3
AS105.5	3	3										3
AS105.6	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 and Construction of engineering curves**	1,2	**4**
	1.1	Types of Lines, Dimensioning Systems as per IS conventions. First angle method of projection only		
	1.2	Basic construction of Cycloid and Involutes.		
2	**Unit2**	**Projection of Points and Lines: -**	1,2	**5**
	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**	**Projection of solid** (Regular solids like Prism, Pyramid, Cylinder, Tetrahedron, Hexahedron and Cone only)	1,2	**5**
	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 Projection**	1	**Lab session (4)**
	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 visualization**	2	**Lab session (2)**
	5.1	Isometric view (Natural scale only)		
6	**Unit6**	**Development of lateral surface of solids**		**Lab session (2)**
	6.1	Development of lateral surface of solids (Exclude DLS of a solid with a hole in it and Reverse Development)		

7	**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 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.) 2.2 Half sectional orthographic views. 3.1 Projection of lines with traces, application-based problems on Projection of lines 4.1 Projection of section of solid with cutting planes. 5.1 Development of lateral surface of solids with openings, reverse development of solid.	1,2,3	**6***
			Total (*Not included)	**14**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No	Engineering AutoCAD Laboratory
1	Introduction to Auto-CAD: -Basic Drawing and Editing Commands. Knowledge of setting up layers, Dimensioning, Hatching, plotting and Printing. **Auto-Cad Practice sheet-1** (Two Examples)
2	**Auto-Cad Practice sheet-2** (Two Examples)
3	**Introduction to Orthographic projections sheet-1** (Two Problems)
4	**Orthographic projections sheet-2** (Two Problems)
5	**Introduction to Sectional Orthographic projections sheet-1** (Two Problems)
6	**Sectional Orthographic projections sheet-2** (Two Problems)
7	**Introduction to Isometric Projection/View: -** Isometric View/Drawing of blocks of plain and cylindrical surfaces using plain/natural scale only. (Exclude Spherical surfaces). **Isometric Projection/View sheet-1** (Two Problems)
8	**Isometric Projection/View sheet-2** (Two Problems)
9	**Draw development of lateral surface of solids with simple sections** **DLS sheet-1** (Prism and Cylinder)
10	**DLS sheet-2** (Pyramid and Cone)

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

Engineering Mechanics

Course (Category) Code	Course Name	Teaching Scheme (Hrs./week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
BSESE	Engineering Mechanics	2	0	2	4	8	2	0	1	3
AS104		Examination Scheme								
		Component			ISE %		MSE %		ESE %	Total %
		Theory			13.5		13.5		40	67
		Laboratory			26		--		7	33

Pre-requisite Course Codes, if any.	10+2 Basics
Course Objective: To provide knowledge of force analysis methods required in engineering applications and solutions. Also, to develop analytical and computational ability.	
Learning Outcomes (LO):*At the End of the course students will be able to*	
AS104.1	Draw free body diagram and determine reactive forces using conditions of equilibrium and Lami's theorem
AS104.2	Determine coefficient of friction for various contact surfaces
AS104.3	Analyze the three-dimensional system of space forces.
AS104.4	Analyze the kinematics of particles and obtain the various parameters of motion.
AS104.5	Determine Instantaneous center of rotation (ICR).
AS104.6	Design and conduct an experiment to demonstrate principles of statics and dynamics

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

	PO 1	PO2	PO3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO1 0	PO11	PO12
AS104.1	3	3							3			
AS104.2	3	3							3			
AS104.3	3	3							3			
AS104.4	3	3							3			
AS104.5	3	3							3			
AS104.6	3	3							3			

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2
AS104.1						
AS104.2						
AS104.3						
AS104.4						
AS104.5						
AS104.6						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	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 a concurrent coplanar force system.
2	Use the conditions of equilibrium for the 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 a 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 the projectile using an air-cushion table apparatus.) A small project based on the 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

Material Science and Engineering

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
BSESE	Material Science and Engineering	2	0	2	4	08	3	0	0	3
		Examination Scheme								
		Component	ISE (%)		MSE (%)		ESE (%)			Total
AS108		Theory	20		20		60			100
		Laboratory	-		--		-			-

Pre-requisite Course Codes, if any.	12th Physics and Chemistry
Course Objective: To make learners understand the fundamental physical origins of material behavior to optimize the properties for various engineering materials.	
Learning Outcomes (LO): ***At the end of the course students will be able to***	
AS108.1	Demonstrate the knowledge of the basics of crystallography.
AS108.2	Visualize Planes and directions using Miller Indices.
AS108.3	Classify the various magnetic materials and identify the magnetic materials for various engineering applications.
AS108.4	Comprehend the basics of physics and chemistry on the nanometer scale and applications of nano materials.
AS108.5	Comprehend the basic physical properties of smart materials with various engineering applications.
AS108.6	Comprehend the use of various analytical techniques to characterize various materials.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS108.1	1											
AS108.2	1											
AS108.3	1											
AS108.4	1											
AS108.5	1											
AS108.6	1											

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

	PEO1	PEO2	PEO3	PSO1	PSO2	PSO3
AS108.1						
AS108.2						
AS108.3						
AS108.4						
AS108.5						
AS108.6						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember✓	Understand✓	Apply✓	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Crystallography**	1& 2	10
	1.1	Introduction, types of solids, space lattice, basis, unit cell and its characterization, lattice parameters, Bravais space lattices, seven crystal systems		
	1.2	Miller Indices of planes and directions, Interplanar spacing in cubic system		
	1.3	X-rays, Bragg's law, Bragg's X-ray spectrometer and determination of crystal structure		
	1.4	Crystal imperfections: Point and Line defects		
2	Title	**Magnetic properties of materials**	2,3 &4	8
	2.1	Introduction, magnetic moment of an atom, useful magnetic parameters		
	2.2	Classification of magnetic materials		
	2.3	Hysteresis, soft and hard magnetic materials and their applications		
3	Title	**Nanomaterials and their applications**	4	6
	3.1	Introduction, types of nanoparticles (carbon, metals, organic, and composites)		
	3.2	Molecular self assemblies, and Applications		
4	Title	**Modern, Smart and Intelligent Engineering Materials**	2,4	10
	4.1	Introduction, distinguish features of smart materials, Types of smart materials and their various engineering applications		
	4.2	Dielectric materials: polarization, temperature and frequency effects, electric breakdown, ferroelectric materials and its various applications		

	4.3	Metallic glasses and their various engineering applications		
	4.4	Wide-bandgap (WBG) semiconductors: Silicon Carbide, Gallium nitride. Applications of WBG materials		
5	**Title**	**Materials' Characterization Techniques**	4	**8**
	5.1	UV and visible spectroscopy Fluorescence spectroscopy		
	5.2	X-ray photo luminescence spectroscopy, Transmission Electron Microscopy, Scanning Electron Microscopy		
	5.3	Raman effect and Raman spectroscopy		
6	**Self Study**	Superconductivity, Type I and Type II superconductors, Meissener effect, High temperature superconductors, various applications of superconductors.	1,2 & 4	**06**
			Total	**42**

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Electrical Engineering Materials	tenth	A.J. Dekker	Prentice- Hall India	2008
2	Nanotechnology: Principles and practices	third	Sulbha K. Kulkarni	Springer	2015

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1.	Solid State Physics	tenth	S.O.Pillai	New Age International	2022
2.	Materials Science and Engineering	sixth	V. Raghavan	PHI	2004
3..	Fundamentals of Materials science and engineering; an integrated approach	sixth	William Callister and Jr. David Rethwisch	John Wiley & Sons.	2021
4..	Engineering Physics	second	B.K. Pandey and S. Chatur	Cengage	2022

Problem Solving using Imperative Programming SEM-I

Course (CategoryCode)	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(ESC)	Problem Solving using Imperative Programming Laboratory	0	1	4	4	8	0	1	2	3
		Examination Scheme								
		Component		ISE		MSE		ESE		Total
CE101		Theory		-		-		-		-
		Laboratory		100		--		100		200

Pre-requisite Course Codes, if any. -	
Course Objective: To develop problem solving skills using imperative programming.	
Learning Outcomes : At *the End of the course students will be able to*	
CE101.1	Understand and conceptualize the problem-solving aspects using various programming paradigms.
CE101.2	Solve real world problems using imperative programming approaches.
CE101.3	Apply control structures for solving real world problems.
CE101.4	Solve problems using Arrays and Text processing.
CE101.5	Develop modular code for a given problem.
CE101.6	Develop a solution to 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
CE101.1	1											
CE101.2	2	2										
CE101.3	2	2										
CE101.4	2	2										
CE101.5	2	2										
CE101.6	2	2										

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CE101.1							
CE101.2							
CE101.3							
CE101.4							

CE101.5							
CE101.6							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

Module No.	Unit No.	Topics	Ref.
1	**Title**	**Introduction to Problem Solving and Programming Paradigms**	
	1.1	What is a Problem, Characteristics of good Program, Overview of Programming Paradigms – Declarative and Imperative, Problem-solving using Algorithm and Flowcharts	3,4
2	**Title**	**Basic Elements of Computer Programming and Control flow**	
	2.1	Variables, keywords, Data types, Operators**:** Arithmetic, Relational and Logical, Assignment, Unary, Conditional, Ternary, Bitwise, Expression, Statements.	1,2
	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	**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, Solving using Arrays like Array Order Reversal, Array Counting or Histogramming.	1,2
	3.2	Strings and Operations on Strings.	1,2,4
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, Arrays and pointers.	1,2
	4.2	Recursion	1,2,4
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, Pointer to a structure.	1,2
6	**Self-Study**	File handling**:** Types of Files, File operation-opening, Closing, Creating, Reading, Processing File, Command line arguments, Dynamic Memory Allocation	1,2,4

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 basics of C language (formatted input/output statements, operators and expressions)
2	Apply various selection control structures to solve given problems.
3	Apply various iterative control structures to solve given problems.
4	Apply the concept of functions to incorporate modularity.
5	Demonstrate the use of arrays to solve a given problem. (one-dimensional/two-dimensional)
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.

Textbooks

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

Problem Solving using Object Oriented Programming SEM-II

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
SEC	Problem Solving using Object Oriented Programming	0	1	4	4	8	0	1	2	3
CE102		Examination Scheme								
		Component		ISE		MSE	ESE		Total	
		Theory		--		--	--		--	
		Laboratory		80		--	20		100	

Pre-requisite Course Codes, if any.	Problem Solving using Imperative Programming
Course Objective: To learn problem solving using Object-Oriented programming paradigm	
Learning Outcomes (LO): ***At the End of the course students will be able to***	
CE102.1	Apply concepts of object-oriented programming using classes and objects
CE102.2	Apply Inheritance for a given scenario
CE102.3	Solve the given problems using concept of polymorphism
CE102.4	Develop efficient programs abstraction and exception handling to.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE102.1	3	2			3							2
CE102.2	3	2			3							2
CE102.3	3	2			3							2
CE102.4	3	2			3							2

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CE102.1							

CE102.2							
CE102.3							
CE102.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

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

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction and Encapsulation**		**4**
	1.1	Introduction to Object Oriented Programming, Procedural versus 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 members and methods, constructors and their types. Strings, Arrays		
2		**Inheritance**		**3**
	2.1	Concept of Inheritance, parent class, derived class, this and super keyword	1,2	
	2.2	Types of inheritance: single, multiple, multilevel, hierarchical, hybrid		
3		**Polymorphism**		**3**
	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, interface	1,2	
5		**Exception Handling**		**2**
	5.1	try, throw, and catch exceptions	1,2	
	5.2	Function exception declaration		
6	**Self Study**	File Handling, Multithreading, Packages, Collection Framework, Swings, Aggregation and Composition	1,2	**5***
			Total	**14+ 5***

Laboratory

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 level Inheritance
7	Program on Inheritance: Implement a Program to demonstrate multilevel Inheritance
8	Program on Abstraction: Implement a Program to demonstrate multiple Inheritance/ interface
9	Program on Abstraction: Implement a Program to demonstrate Abstraction using abstract class
10	Program on abstraction: Implement a Program to demonstrate multithreading

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1.	Java -The Complete Reference	10th	Herbert Schildt	Tata McGraw-Hill	2017
2.	Java Programming From the Ground Up	1st	Ralph Bravaco,Shai Simoson	Tata McGraw-Hill	2009

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1.	An introduction to Programming and Object Oriented Design using Java	3rd	Jaime Nino, Frederick A. Hosch	Wiley Student Edition	2010
2.	**Head First Java**	3rd	Kathy Sierra & Bert Bates	O'Reilly	2022

Digital Systems

Course(Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSES)	Digital Systems	3	0	2	5	10	3	0	1	4
		Examination Scheme								
		Component		ISE %		MSE %		ESE %		Total %
EC101		Theory		15		15		45		75
		Laboratory		15		--		10		25

Pre-requisite Course Codes, if any.	
Course Objective:	
Learning Outcomes (LO):*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

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

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

LO-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, Up Down 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 Metastability 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		
			Total	**42**

Laboratory Component, if any. (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 Edition	R. P. Jain	Tata McGraw Hill	**2009**
2	Digital Design Principles And Practices	Third Edition	John F. Wakerly	Pearson Education	**2001**
3	Microprocessor Architecture, Programming, and Applications with the 8085	Sixth Edition	Ramesh S. Gaonkar	Penram International	**2013**

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
4	Digital Design	Fourth Edition	Morris Mano	Pearson Education	**2008**
5	Fundamentals of digital logic design with VHDL	Second Edition	Stephen Brown and Zvonko Vranesic	McGraw Hill	**2006**

Basic Electrical Engineering

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSES)	Basic Electrical Engineering	3	0	2	6	11	3	0	1	4
		Examination Scheme								
		Component		ISE %			MSE %		ESE %	Total %
EC102		Theory		15			15		45	75
		Laboratory		15			--		10	25

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.	
Learning Outcomes (LO): ***At the End of the course students will be able to***	
EC101.1	Compute various electrical quantities of given dc circuit using circuit simplification techniques and various network theorems.
EC101.2	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
EC101.3	To study the working principles of electrical machines and their applications
EC101.4	To expose the students the fundamental concepts in Controllable Switch and Modulation based Power Conversion
EC101.5	To study Electrical Parameters of the Batteries and their selection and design criteria for a specific application

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

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

LO-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 (Theory +Tut)
1	**Title**	**DC Circuits**	1,2	**12**
	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	**9**
	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		
4	**Title**	**Electric Power Converters**	1,2	**6**
	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**		**3**

	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**	Fundamental Principles of Rotating Machines, Working Principle,Characteristics and applications of Induction motor, BLDC motor and Stepper Motor		
			Total	**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

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

Soft Skills-I

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
SEC	Soft Skills (Communication Skills)	1	0	2	2	5	0	1	1	2
		Examination Scheme								
		Component		ISE %			MSE %		ESE	Total
AS107		Theory		--			20		--	20
		Laboratory		80			--		-	80

** MSE will be evaluated on the basis of a 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 a personal and professional environment.	
Learning Outcomes (LO): 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 advanced 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.

LO-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	2		2
AS107.2									2	2		2
AS107.3									2	2		2
AS107.4									2	2		2

LO-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: 1. Common everyday situation: Conversation and dialogues (group activity, ice-breaking session) 2. 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 Knowledge ware, 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

Bharatiya Vidya Bhavan'
Sardar Patel Institute of Technology
(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

Technical Shop

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
SEC	Technical Shop	1	0	2	2	5	0	1	1	2
		Examination Scheme								
		Component		ISE %		MSE %		ESE %		Total %
AS106		Theory				--		–		–
		Laboratory		80		--		20		100

Pre-requisite Course Codes, if any.	
Course Objective: To provide essential modern skills that enable today's engineers to create our tomorrow.	
Learning Outcomes (LO):*At the End of the course students will be able to*	
AS106.1	Assemble and disassemble computer hardware for PCs and laptops.
AS106.2	Create and troubleshoot basic computer networks.
AS106.3	Create and troubleshoot basic electrical networks.
AS106.4	Identify and troubleshoot electrical gadgets.
AS106.5	Model any object in 3d software and prepare it for 3d printing.
AS106.6	Design and fabricate PCBs.
AS106.7	Construct physical structures using acrylic and PVC materials.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS106.1					3				3			3
AS106.2					3				3			3
AS106.3					3				3			3
AS106.4					3				3			3
AS106.5			3		3				3			3
AS106.6			3		3				3			3
AS106.7			3		3				3			3

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2

AS106.1	**2**					
AS106.2	**2**					
AS106.3	**2**					
AS106.4	**2**					
AS106.5	**2**					
AS106.6	**2**					
AS106.7	**2**					

BLOOM'S Levels Targeted (Pl. Tick appropriate)

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

Lecture Component

Module No.	**Unit No.**	**Topics**	**Ref.**	**Hrs.**
1	**Unit1**	**Introduction to skill shop.**		
	1.1	The need for skill shop. The utility of the contents covered. Special significance to Computer and EXTC students.		**1**
2	**Unit2**	**3D modeling - ideation and creation.**		
	2.1	Introduction to the various 3d software and their specialization. AutoCAD: brief 2d toolset, establishing 3d workspaces, 2d to 3d tools, primitive based design, sections, lofting and extrusion, revolving and other solid operations, dimensionally accurate design. Blender (open source): differences in approach compared to AutoCAD, solid and surface based modeling, modifiers and symmetric modeling, advanced mesh-based and sculpting techniques.		**6**
3	**Unit3**	**3d printing - prototyping and fabrication.**		**4**
	3.1	Processing 3d models for slicing, slicing models for 3d printing, slicing software (open source). File formats and conventions, watertighting. The file pipeline from .dwg/.blend to .stl to .gcode. File optimization. 3d printing - the process and the mechanisms. FDM (fused deposition modeling) based printing, printing materials and variations, best practices, troubleshooting, alternative, non-machine based 3d printing techniques using pens.		
4	**Unit4**	**Specialized tool sets for manufacturing**		**1**
	4.1	Autodesk Inventor/Fusion 360/ANSYS		
			Total	**12**

Laboratory Component: comprises building and assembling various trade jobs such as:

Trade job 1: Computer Assembly (4 hours)

- Assemble all components of a computer from an OFF and disassembled state, installing CPU, RAM, hard drive, connecting data and power pins, turn it on, install an operating system.

- Additional training imparted during/for this trade:
  - Identification of components such as power supply, motherboard, processor, hard disk drive, RAM etc.
  - Assembly, disassembly, and component identification of a laptop.
  - Basic troubleshooting.

Trade job 2: Network Switch Installation (2 hours)

- Identify various components of a network assembly.

- Crimp LAN cables using crimping tools and patching them into a 10 port LAN switch and testing operation of the network.

- Adopt best practices in LAN network assembly.

Trade job 3: Electrical Networks (2 hours)

- Assemble different types of networks such as:
  - House wiring
  - Staircase wiring
  - Godown wiring
  - 3-phase wiring
  - Study wiring diagram

- Test, trace and troubleshoot these networks with tools such as multimeters

Trade job 4: Electrical Gadgets (2 hours)

- Repairing electrical household appliances: ceiling fan, electric iron.

Trade job 5: 3D Modeling and Printing (2 hours)

- Using the skills learned in the 3d sessions to develop a CAD file (.iges/.step/.dwg) of a 3D model and exporting it as an .stl file for the purpose of 3D printing.

- Importing the 3D .stl file in slicers to generate a .gcode file for 3D printing through slicing, using open source software

Trade job 6: Make a House (8 hours)

- Design a PCB using software such as Eagle for a simple miniature house with various points for patching LED lights.

- Fabricate the PCB using various tools.
  - Additional skills learned: soldering and desoldering, layout drawing, positive and negative film making, PCB etching and drilling, tinning.

- Fabricate an acrylic house using tools such as cutters, hacksaws, files, glue guns, sand paper, etc.

○ Additional skills learned: drilling holes at precise locations for installing LED lights using drill machines.

- Install a PVC fence around the house using PVC formed in L shaped joints at the corners.
- Create various additional models around the house - street light, chimneys and lights, etc.
- Connect the PCB to the electrical network and test proper operation of the network.
- Additional skills learned: integration of multiple design and fabrication techniques to create a finished product.

Trade job 7: Make a Product
Students may select one of the following jobs to create into a finished product. They are then required to either successfully sell the product or purchase it themselves to recover the cost of materials, resulting in a reduction in generated waste. The choices are:

- Keychain
- Simple extension board
- Liquid Level Sensor
- Water Level Controller
- Voice Recorded Message (Jan-Gan-Man)
- Audio Amplifier using IC386
- Lead Acid Battery Charger (6v/12v)
- LM723 IC power supply AI, 0-30v
- LED chaser

Trade job 8: Modern Plumbing
To better understand modern plumbing materials and tools, fabricate a simple stool made of PVC material, including cutting pipes into half pipes, L-shaped joints, and test it for sturdiness.

The above trades will be carried out in two labs in parallel per batch as follows:

Lab 1 (Room 202)	**Lab 2 (Prayas Idealab)**
Trade job 1: Computer Assembly **Trade job 2: Network Switch Installation** **Trade job 3: Electrical Networks** **Trade job 4: Electrical Gadgets**	**Trade job 5: 3D Modeling and Printing** **Trade job 6: Make a House** **Trade job 7: Make a Product** **Trade job 8: Modern Plumbing**

IDEALab Demonstrations: (4 hours)
Demonstrations on various IDEALab equipment, such as:

- CO2 Laser Cutter and Engraver
- Mini Lathe with Drilling
- Sewing Machine
- Vinyl Cutter and Printer (for making banners, posters, stickers, t-shirt printing)
- 3D scanner
- All-in-one PCB maker (Voltera v1) - PCB printing, heating, drilling and soldering
- PCB fabrication - reflow oven
- Computer desktop based drilling, milling and engraving machine - Roland SRM20

- Welding machines (Spot, ARC etc)
- Test and measuring equipments
- Mechanical fabrication (Wood cutter etc)

Course Evaluation:
The course is evaluated via:
- End-of-semester quiz exam. (20 marks)
- Fabrication and submission of finished jobs in all 6 included trades. (80 marks)

Indian Knowledge System (IKS)

Indian Knowledge System (IKS) holds a significant place in your curriculum, as recommended by NEP 2020. The Government of India has mandated a compulsory credit generic IKS course to spread the rich heritage and traditional knowledge of our country in various fields such as Arts and Literature, Agriculture, Basic Sciences, Engineering & Technology, Architecture, Management, Economics, and more. In line with this, the Government of Maharashtra has recommended a generic IKS course for UG students in the first year of your graduation.

Introduction:
The Indian knowledge system is a rich and diverse heritage of intellectual, philosophical, and scientific traditions that have evolved over thousands of years in the Indian subcontinent. It encompasses a wide range of disciplines, including philosophy, spirituality, medicine, mathematics, astronomy, and more. The Indian knowledge system reflects a deep reverence for wisdom, a holistic approach to life and well-being, and a profound understanding of the interconnectedness of various aspects of human existence. It remains a vibrant and influential part of India's cultural and intellectual heritage.
The Indian knowledge system has had a profound and lasting influence not only on the subcontinent but also on the broader world. Its teachings and practices continue to be studied, adapted, and appreciated globally, making it an integral part of human heritage.

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
AEC	Indian Knowledge System (IKS)	2	0	0	1	3	1	1	-	2
		Examination Scheme								
		Component		ISE (%)		MSE	ESE (%)			Total (%)
AEC01		Theory		--		--	20			20
		Laboratory		80		--	--			80

** ISE will be evaluated on the basis of individual and group activities.
** ESE will be evaluated on overall modules of the course.

Pre-requisite Course Codes, if any.

Course Objectives:

- To create awareness amongst the students about the true history and rich culture of the country.
- To understand the scientific value of the traditional knowledge of India.
- To explain the key features of the Indian Numeral System and appreciate the key role it has played in the advancement of Science & Technology.
- To develop familiarity with the science, engineering & technology heritage of ancient and medieval India

Learning Outcomes (LO): At *the end of the course students will be able to*	
AEC01.1	Develop a deep understanding of the major philosophical traditions in India.
AEC01.2	Appreciate Indian mathematics and mathematicians along with number systems.
AEC01.3	Understand the interdisciplinary nature of Indian knowledge systems and their connections to science, technology, and other fields.
AEC01.4	Establish familiarity with the classical languages and linguistics of India and exposure to key texts.

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
AEC01.1									**2**	**2**		**2**
AEC01.2									**2**	**2**		**2**
AEC01.3									**2**	**2**		**2**
AEC01.4									**2**	**2**		**2**

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

	PEO1	**PEO2**	**PEO3**	**PEO4**	**PSO1**	**PSO2**	**PSO3**
AEC01.1							
AEC01.2							
AEC01.3							
AEC01.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

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

Theory Component

Module No.	Unit No.	Topics	Ref.	LHrs.	PHrs
1	Title	**Indian Knowledge System – An Introduction**		1	
	1.1	What is IKS? Why do we need IKS?			
	1.2	Organization of IKS Historicity of IKS Some salient aspects of IKS			
2	Title	**The Vedic Corpus:**		2	3
	2.1	Introduction to Vedas A synopsis of the four Vedas Sub-classification of Vedas Messages in Vedas			
	2.2	Introduction to Vedāṅgas Prologue on Śikṣā and Vyākaraṇa Basics of Nirukta and Chandas			
	2.3	Introduction to Kalpa and Jyotiṣa Vedic Life: A Distinctive Features			
3	Title	**Number Systems and Units of Measurement**		3	2
	3.1	Number systems in India - Historical evidence Salient aspects of Indian Mathematics Bhūta-Saṃkhyā system			
	3.2	Kaṭapayādi system Measurements for time, distance, and weight 1. Piṅgala and the Binary system			
4	Title	**Mathematics**		3	2
	4.1	Introduction to Indian Mathematics Unique aspects of Indian Mathematics Indian Mathematicians and their Contributions			
	4.2	Algebra Geometry Trigonometry			
	4.3	Binary mathematics and combinatorial problems in Chandaḥ Śāstra Magic squares in India			

5	**Title**	**Linguistics**		**3**	**3**
	5.1	Introduction to Linguistics Role of Sanskrit in natural language processing Aṣṭādhyāyī Phonetics			
	5.2	Word generation Computational aspects Mnemonics			
	5.3	Recursive operations Rule based operations Sentence formation Verbs and prefixes			
			Total (*Not included)	**12 hrs**	

List of activities (Graded, Non-graded)

Sr. No.	Title of the assignments	Marks
1	ISE 1 – Group Discussion	30
2	ISE 2 – Presentation	30
3	ISE 3 – Assignment (Group or Individual)	20
5	ESE	20
	Total	**100**

Text Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	IKS: The Knowledge System of Bhārata	2023	Bhag Chand Chauhan	Garuda Prakashan	2023
2	Introduction to Indian Knowledge System: Concepts and Applications	2022	B.Mahadevan (Author), Nagendra Pavana (Author), Vinayak Rajat Bhat (Author)	PHI Learning	2022

Reference Books:

1. Raha, Sibaji, et al. Histrory of Science in India Volume-1, Part-I, Part-II, Volume VIII. National Academy of Sciences, India and The Ramkrishan Mission Institute of Culture, Kolkata (2014).

2. Kohle, Pradeep et al (edited by). Pride of India- A Glimpse of India's Scientific Heritage. Samskrit Bharati (2006).

3. Verma, Keshav Dev. Vedic Physics, Motilal Banarsidass Publishers (2012).

4. Soni, Suresh. India's Glorious Scientific Tradition, Ocean Books Pvt. Ltd. (2010).

5. Kapur K and Singh A.K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of Advanced Study, Shimla. Tatvabodh of sankaracharya, Central chinmay mission trust, Bombay, 1995.

6. Nair, Shantha N. Echoes of Ancient Indian Wisdom. New Delhi: Hindology Books, 2008.

7. Kulkarni, R P, Glimpese of Indian Engineering and Technology (Ancient & Medieval period, Munshiram Manoharlal Publishers Pvt. Ltd. 2018

8. Pathak, AK, Science and Technology in India, Anshika prakashan pratapgarh, 2016

9. NVP, Unithiri, Indian Scientific Traditions (Professor K.N. Neelakantan Elayath Felicitation Volume), publication division univeristy of Calicut, 2006

10. Biswal, S, B L ray, Vedic Science and technology, DK Print world, 2009

11. Yadav, BS, Ancient Indian Leaps into Mathematics, Brikausher publication, 2010

Universal Human Values

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
AEC	Universal Human Values (UHV)	2	0	0	1	3	1	1	-	2
		Examination Scheme								
		Component		ISE %		MSE %		ESE %		Total %
AEC02		Theory		--		--		20		20
		Laboratory		80		--		--		80

** ISE will be evaluated on the basis of individual and group activities.
** ESE will be evaluated on overall modules of the course.

Pre-requisite Course Codes, if any.	
Course Objectives: ● To develop a holistic perspective based on self-exploration, family, society and nature/existence. ● To understand (or developing clarity) of the harmony in the human being, family, society and nature/existence. ● To strengthen self-reflection. ● To develop commitment and courage to act.	
Learning Outcomes (LO): At *the end of the course students will be able to*	
AEC02.1	Demonstrate a comprehensive understanding of what human values are and their significance in individual and societal contexts.
AEC02.2	Develop ethical awareness and the ability to critically evaluate moral and ethical dilemmas in various aspects of life.
AEC02.3	Foster a sense of social responsibility and awareness of the global community, including environmental and social justice issues.
AEC02.4	Promote interdisciplinary learning by exploring how values and ethics intersect with various academic disciplines and real-world challenges.

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2
AEC02.1								2	2	2		2
AEC02.2								2	2	2		2
AEC02.3								2	2	2		2
AEC02.4								2	2	2		2

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
AEC02.1							
AEC02.2							
AEC02.3							
AEC02.4							

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	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**		2	2
	1.1	1. Purpose and motivation for the course, recapitulation from Universal Human Values-I 2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations			
	1.2	4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority 5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario 6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.			
2	Title	**Understanding Harmony in the Human Being - Harmony in Myself!**		2	2
	2.1	7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body' 8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility 9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)			
	2.2	10. Understanding the characteristics and activities of 'I' and harmony in 'I' 11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail 12. Programs to ensure Sanyam and Health.			
3	Title	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**		3	2
	3.1	13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship 14. Understanding the meaning of Trust; Difference between intention and competence 15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship			

	3.2	16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals 17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives			
4	**Title**	**Understanding Harmony in the Nature and Existence - Whole existence as Coexistence**		**2**	**2**
	4.1	18. Understanding the harmony in the Nature 19. Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self regulation in nature			
	4.2	20. Understanding Existence as Co-existence of mutually interacting units in all pervasive space 21. Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.			
5	**Title**	**Implications of the above Holistic Understanding of Harmony on Professional Ethics**		**3**	**2**
	5.1	22. Natural acceptance of human values 23. Definitiveness of Ethical Human Conduct 24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order			
	5.2	25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. 26. Case studies of typical holistic technologies, management models and production systems			
	5.3	27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations 28. Sum up. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.			
Total				**12 hrs**	

List of activities (Graded, Non-graded)

Sr. No.	Title of the assignments	Marks
1	ISE 1 – Group Discussion	30
2	ISE 2 – Presentation	30
3	ISE 3 – Assignment (Group or Individual)	20
5	ESE	20
	Total	**100**

Text Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Human Values and Professional Ethics	2010	R R Gaur, R Sangal, G P Bagaria	Excel Books	2010

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

3. The Story of Stuff (Book).

4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

5. Small is Beautiful - E. F Schumacher.

6. Slow is Beautiful - Cecile Andrews

7. Economy of Permanence - J C Kumarappa

8. Bharat Mein Angreji Raj - PanditSunderlal

9. Rediscovering India - by Dharampal

10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

11. India Wins Freedom - Maulana Abdul Kalam Azad

12. Vivekananda - Romain Rolland (English)

13. Gandhi - Romain Rolland (English)

SEMESTER III

SEM III										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Basic & Engg. Sciences	BSES	CS201	Discrete Structures and Graph Theory	3	0	0	5	8	3
2	Basic & Engg. Sciences *	FOM-I	MA202	Foundation of Mathematics-I*	2	1	0	0	3	3
3	Skill Enhancement Course	SEC	AS201	Soft Skill II-Professional Communication Skills	0	1	2	4	7	2
4	Basic & Engg. Sciences Elective	BSESE		**Course I**						3
			AS101	Engineering Physics	2	0	2	4	8	
			AS102	Engineering Chemistry	2	0	2	3	7	
			AS103	Biology for Engineers	3	0	0	3	7	
			AS104	Engineering Mechanics	2	0	2	4	8	
			AS105	Engineering Graphics	1	0	2+2	2	7	
			AS108	Material Science	2	0	2	4	8	
			AS109	Environmental Science	3	0	0	3	6	
			AS110	Energy Science	2	0	2	3	7	
			AS111	Thermal & Fluid Engineering	3	0	0	3	6	
5	Humanities	HSSM-I	HS2XX	**Course I**	2	0	0	3	5	2
7	Program Core Courses (12 Credits)	PCC	CS202	Data Structures	3	0	2	4	9	4
8		PCC	CS203	Computer Organization and Architecture	3	0	2	4	9	4
9		PCC	CS204	Database Management Systems	3	0	2	4	9	4
10	Cocurricular Courses	CC (LLC)	LLCXX	LLC--III	1	0	0	1	2	1
				Total	**17**	**1**	**10**	**28**	**56**	**23**

**Only for Lateral Entry Students*

Bharatiya Vidya Bhavan'

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

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	5	8	3	0	0	3
CS201		Examination Scheme								
		Component			ISE		MSE		ESE	Total
		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*	
CS201.1	Use set theory, logic and its various proof techniques to solve given problem.
CS201.2	Analyze the problems based on the concepts of relations, functions, lattices and recurrence relations to solve problems
CS201.3	Apply the concepts of graph, trees and their various types with their traversing techniques to solve problems.
CS201.4	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
CS201.1	3	2										2
CS201.2	3	2										2
CS201.3	3	2										2
CS201.4	3	2										2

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS201.1							
CS201.2							
CS201.3							
CS201.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply✓	Analyze✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**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	Eight	Kenneth H. Rosen	Tata McGraw- Hill	2021
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

Bharatiya Vidya Bhavan'

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

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	4	09	3	0	1	4
CE202		Examination Scheme								
		Component			ISE		MSE		ESE	Total
		Theory			20		30		100	150
		Laboratory			50		--		50	100

Pre-requisite Course Codes, if any.	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***	
CE202.1	Apply various operations of linear and non-linear data structures to given problems.
CE202.2	Apply the concepts of Trees and Graphs to a given problem.
CE202.3	Understand various operations of heap data structures.
CE202.4	Implement 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
CE202.1	3		3						3	3	3	
CE202.2	3		3						3	3	3	
CE202.3	3		3						3	3	3	
CE202.4	3		3						3	3	3	

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CE202.1			1			1	
CE202.2			1			1	
CE202.3			1			1	
CE202.4			1			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 Data Structures**		
	1.1	Concept of Linear and Nonlinear Data Structures	1,2	1
	1.2	Stack: Stack as ADT, operations on stack, Applications of Stacks	1,2	3
	1.3	Queue: Queue as ADT, Operations on Queue, Applications of Queue, Types of Queue-Circular and Priority Queue	1,2	3
	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, Applications of linked List	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	4
	2.2	Self-balancing trees: AVL trees Properties, Rotations, Insertion, Deletion	1,2	4
	2.3	Introduction to B tree- Insertion, Deletion, Introduction to Tries (Prefix Tree) - Operations and Applications	1,2	5
3	Title	**Graphs**		
	3.1	Graph as ADT, Introduction to Graph, Representation of GraphAdjacency 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	4
	4.2	Binomial Heaps, 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 Techniques	1,2	4
6	Self-Study	Optimal Binary Search Tree, Probabilistic Data Structures, B+ trees, multi-dimensional trees (k-d trees, quadtrees)	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 or Tries
6	Implementation of Expression Tree
7	Implement insertion of node in AVL tree

8	Apply Graph Traversal Technique on a given problem statement to solve the problem
9	Implement Operations of Heap Structures
10	Implement hash functions with different collision resolution techniques

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
3	Data Structures and Algorithm Analysis in C++	Fourth	Mark Allen Weiss	Pearson	2014
4	Probabilistic Data Structures and Algorithms for Big Data Applications	First	Andrii Gakhov	BoD GmbH, Germany	2022

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
3	Data Structures and Algorithms in Python	First	Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser	Wiley	2013
4	The Algorithm Design Manual	Second	Steven S. Skiena	Springer	2008

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Computer Architecture Organization	3	0	2	4	9	3	0	1	4
		Examination Scheme								
		Component		ISE		MSE		ESE		Total
CS203		Theory		20		20		60		100
		Laboratory		80		--		20		100

Pre-requisite Course Codes, if any.	Digital Systems
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*	
CO.1	Conceptualize basic computer structure with its models and compute performance metrics.
CO.2	Design algorithms to solve ALU operations
CO.3	Comprehend processor organization with various design methods of CPU with comparative analysis
CO.4	Design memory systems with analysis of mapping techniques for cache and virtual memory
CO.5	Comprehend different types of I/O buses, compare and contrast different types of data transfer methods and arbitration techniques
CO.6	Analyze different parallel organizations that includes pipelined and parallel processors

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

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

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2
CO.1	**2**	**2**	-	-	-	-
CO.2	**2**	**2**	-	-	-	-
CO.3	**2**	**2**	-	-	-	-
CO.4	**2**	**2**	-	-	-	-
CO.5	**2**	**2**	-	-	-	-
CO.6	**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**	**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	1,2	
	1.2	Performance Issues: Designing for performance, Amdahl's Law, Multi-core, GPGPU	1,2	
2	**Title**	**ALU, Processor Organization and Control Unit Design**		**10**
	2.1	ALU: Integer and Floating Point Operation CPU Architecture, Register Organization , Instruction formats, basic instruction cycle. Instruction interpretation and sequencing, Case Study of 80386 architecture and Register Organization	2,3	
	2.2	Control Unit: Soft wired (Micro-programmed) and hardwired control unit design methods. Microinstruction sequencing and execution. Micro operations	2,3	

	2.3	RISC and CISC: Introduction to RISC and CISC architectures and design issues.	2,3	
3	**Title**	**Memory Systems Organization**		**12**
	3.1	Introduction to Memory and Memory parameters. Classifications of primary and secondary memories. Types of RAM and ROM, Allocation policies, Memory hierarchy and characteristics.	2	
	3.2	Cache memory: Concept, architecture (L1, L2, L3), mapping techniques. Cache Coherency, Interleaved and Associative memory. Case study of Pentium Processor Cache Memory Model (MESI Protocol)	2,4	
	3.3	Virtual Memory: Concept, Segmentation and Paging, Page replacement policies. Case study of 80386 Virtual Memory Concepts	2,3	
4	**Title**	**I/O Organization**		**5**
	4.1	Buses: Types of Buses, Bus Arbitration, BUS standards	1,2	
	4.2	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	**Title**	**Parallel Processing**		**11**
	5.1	Advanced Processor Models: Real Model, Protected Model, Virtual Model (x86 Processors)	3	
	5.2	Superscalar Architecture: Case study of Pentium processor	4	
	5.3	Pipelined Architecture: Pipleine Stages, Pipeline Hazards, Mitigation of Hazards with branch prediction and data forwarding techniques	1,2,4	
	5.4	Introduction to parallel processing concepts, Flynn's classifications,	2	
6	**Self-Study**	Comparative Study of microprocessors and micro architectures with respect to their important features. Detailed analysis of Multicore and GPGPU Architectures. Vector and Array Processors with VLIW architecture. 8086 instructions set with assembler directives		
			Total	**42**

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

[Only for CE/CSE]

Sr. No	Title of the Experiment
1	Installation and configure: DOS, MASM, Debug and X86 Mode
2	Implementation of various arithmetic operations through assembly language programming for 8086 using MASM and Debug.
3	Implement various String Operations in 8086 through the utilities provided by DOS and BIOS interrupts (MASM)
4	Block Transfer and Block Exchange using Index Registers
5	Drawing basic shapes like triangle, etc. using BIOS services [Use C/MASM]
6	Design Password Detection Application using BIOS and DOS interrupts along with 8086 instructions.
7	Implement file operations [DOS Interrupts in C/MASM]
8	Implement I/O interfacing using inbuilt speakers of IBM PC
9	Implement Booth's Multiplication Algorithm
10	Implement Division Algorithm (Non-Restoring and Restoring)
11	Implementation of Mapping techniques of Cache memory
12	Implementation of Page Replacement Policies

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Computer Organization	**Fifth**	Carl Hamacher, Zvonko Vranesic and Safwat Zaky	**Tata McGraw-Hill**	**2002**
2	Computer Organization and Architecture: Designing for Performance	**Eighth**	William Stallings	**Pearson**	**2010**
3	The 80386, 80486, and Pentium Microprocessor: Hardware, Software, and Interfacing	**Third**	Walter Triebel	**Pearson**	**1997**
4	Pentium Pro Processor System Architecture	**Third**	Tom Shanely	**Addison Wesley**	**1996**

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**	**Paperback-2017**
4	Advance Computer Architecture: Parallelism, Scalability, Programmability	**Third**	Kai Hwang	**Tata-McGraw Hill**	**2017**
5	Programmer's reference Manual for IBM Personal Computers	**First**	Steven Armburst	**Tata-McGraw Hill**	**1986**

Bharatiya Vidya Bhavan'

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

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	4	9	3	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
CS204		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.	
Learning Outcomes (LO):*At the End of the course students will be able to*	
CS204.1	Demonstrate understanding of given system to construct a database model.
CS204.2	Apply various Relational and SQL commands on the populated database.
CS204.3	Examine the functional dependencies to make a normalized database system.
CS204.4	Examine transaction processing techniques on a database.
CS204.5	Illustrate indexing, 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
CS204.1	1	2	2	2	2	1		1	2			2
CS204.2	2	2	2		2							
CS204.3	1	2	2		2							
CS204.4	1	2			2							
CS204.5	2	2										

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS204.1					3	3	
CS204.2							
CS204.3							
CS204.4							
CS204.5						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**	**Introduction: Database Concepts and ER Modeling**	1,2	**08**
	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	**15**
	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**	**Indexing and Query Optimization:**	1,2	**06**
	5.1	Indexing techniques: B-trees, Hashing.		
	5.2	Query processing and optimization, Query execution plans.		
6	**Self Study**	1. NO SQL-Data type, Database creation, Basic command for creation, updating and querying the database, Mongo dB, 2. Real-world database applications and case studies	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 Create a application using above concept using front end and back end.

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	McGra w Hill.	2018
3	SQL, PL/SQL programming language of ORACLE	Forth	Ivan Bayross	BPB	2010

Bharatiya Vidya Bhavan'
Sardar Patel Institute of Technology
(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

SEMESTER IV

SEM IV										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Basic & Engg. Sciences	BSES	CS205	Statical Methods in Computer Science	3	0	0	6	9	3
2	Basic & Engg. Sciences *	FOM-II	MA204	Foundation of Mathematics-II*	2	1	0	0	3	3
3	Skill enhancement course	SEC	AS202	Python Programming for Data science	0	1	2	4	7	2
4	Humanities	HSSM-II	HS2XX	**Course II**	2	0	0	3	5	2
5	Program Core Courses (12 credits)	PCC	CS206	Operating Systems	3	0	2	4	9	4
6		PCC	CS207	Design and Analysis of Algorithms	3	0	2	4	9	4
7		PCC	CS208	Computer Communications and Networks	3	0	2	4	9	4
8	Cocurricular Courses	CC (LLC)	LLCXX	LLC--IV	1	0	0	1	2	1
9	Multidisciplinary Minor	MDM	MDEC1X	MDM-I	To be defined by others					3
				Total	**15**	**1**	**8**	**26**	**50**	**23**

Summer term (For Lateral Entry Students)										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Basic & Engg. Sciences	BSES	CS201	Discrete Structures and Graph Theory	3	0	0	5	8	3
2			CS205	Statical methods in Computer Science	3	0	0	6	9	3

- Students are expected to start working for the Mini Project I during the summer.
- Research internship of minimum 2 months for the "Honors by Research" for 6 credits- HR21 (Not for DSY)
- For Enrollment to Honors by research, Minimum CGPA must be 8.25

Bharatiya Vidya Bhavan'

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSCS)	Statistical methods in Computer Science (Linear Algebra, Probability and Statistics)	3	0	0	6	9	3	0	0	3
CS205		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory			--					

Pre-requisite Course Codes, if any.	Engineering Calculus/Foundations of Mathematics-I and Differential Equations and Complex Analysis/Foundations of Mathematics-II
Course Objective: To develop mathematical skills for solving engineering problems.	
Learning Outcomes (LO): ***At the End of the course students will be able to***	
CS205.1	Solve a homogeneous and non-homogeneous system of linear equations using rank of a matrix
CS205.2	Apply concepts of eigenvalues and eigenvectors to calculate functions of a square matrix, google rank vector and solve systems of differential equations using diagonalisation of matrices
CS205.3	Familiarize with basic probability axioms, rules and their applicability
CS205.4	Identify the characteristics of various discrete and continuous distributions.
CS205.5	Test the hypothesis for means and variances using t and F; chi-square distribution tests
CS205.6	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
CS205.1	3											
CS205.2	3											
CS205.3	3	1										
CS205.4	2											
CS205.5		2										
CS205.6		2										

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS205.1							
CS205.2							
CS205.3							
CS205.4	2						
CS205.5	2						
CS205.6	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 Linear Algebra**	**3,4, 6,7**	**08**
	1.1	Review of basic matrices, row echelon form, reduced row echelon form, rank of a matrix		
	1.2	Consistency and solution of simultaneous linear homogeneous and non-homogeneous equations, Applications of solving systems of equations in traffic control.		
2	**Title**	**Eigenvalues and Eigenvectors**	**3,4, 6,7**	**07**
	2.1	Eigenvalues, Eigenvectors and its properties, Cayley Hamilton Theorem and its applications, Diagonalisation of matrices.		
	2.2	Application to find Google Page Rank, Function of a square matrix, Solving system of differential equations using diagonalization		
3	**Title**	**Probability and Random Variables**	**1,2**	**14**
	3.1	Classical, relative frequency and axiomatic definitions of probability, addition rule and multiplication rule, Conditional Probability, Bayes' Theorem and Independence		
	3.2	Discrete, continuous and mixed random variables, Probability Mass Function , Probability Density Function		
	3.3	Mathematical expectation, moments, moment generating function		
	3.4	Standard discrete distributions: Binomial, Poisson and Normal		
4	**Title**	**Hypothesis Testing**	**1,2**	**9**
	4.1	Statistical hypothesis, Null and Alternate Hypothesis, test of hypothesis and significance, Type I and Type II errors, Level of significance.		
	4.2	Special tests of significance for large samples and small samples- F, chi-square,z,t-test.		
5	**Title**	**Correlation and Regression**	**1,2**	**4**
	5.1	Spearman and Karl-Pearson Rank Correlation, Regression Analysis, Curve Fitting by method of least squares.		
6	**Self Study**	1. Applicability of Bayes Theorem 2. Examples to test goodness of fit using Chi-square 3. Normal form 4. Singular Value Decomposition 5. Derogatory and non-derogatory matrices		**5**
			Total	**42***

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

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, K.Ye	Pearson Education	2007
3	Linear Algebra and its Applications	Fourth	Gilbert Strang	Cengage	2014
4	Higher Engineering Mathematics	Forty Fourth	Dr. B.S.Grewal	Khanna Publications	2020

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
5	Elementary Linear Algebra with Applications	Sixth	H Anton and C Rorres	John Wiley and Sons	2010
6	Advanced Engineering Mathematics	Twenty Eighth	H.K.Das	S.Chand	2014
7	Advanced Engineering Mathematics	Tenth	Erwin Kreysizg	John Wiley and Sons	2011

Bharatiya Vidya Bhavan'

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

Course (Category) Code	Course Name	Teaching Scheme (hours/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Python programming for Data Science Lab	0	1	2	4	7	0	0	2	2
CS403		Examination Scheme								
		Component	ISE		MSE		ESE		Total	
		Theory								
		Laboratory	100		--		100		200	

Pre-requisite Course Codes, if any.	Linear Algebra, Probability and Statistics, Programming Lab-I,II

Course Objective: To provide students with a comprehensive understanding of the fundamental concepts, tools, and techniques used in data science and data visualization. This course is designed to introduce students to the basic principles of data science and data visualization, including libraries used for Data Science, data exploration, data preprocessing, EDA, data visualization and basic model building.

Learning Outcomes (LO): ***At the End of the course, students will be able to***

CS403.1	Demonstrate the need of libraries used in Data Science.
CS403.2	Make use of different tools and techniques for Data Visualization
CS403.3	Analyze the data performance using the EDA process.
CS403.4	Develop Linear Regression and Logistic Regression Models

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS403.1	3	3	3	3	3				2	2	2	
CS403.2	3	3	3	3	3				2	2	2	
CS403.3	3	3	3	3	3				2	2	2	
CS403.4	3	3	3	3	3				2	2	2	

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2
CS403.1					1	1
CS403.2					1	1
CS403.3					1	1
CS403.4					1	1

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply✓	Analyze✓	Evaluate✓	Create

Lab Experiments on

Exp No.	Topics	Ref.
1	Case Study on Python Programming Fundamentals	1,2

	Your first program, Types, Expressions, Variables, String Operations, Conditions and Branching, Loops, Functions	
2	**Case Study on Python Data Structures:** Lists and Tuples, Sets, and Dictionaries	1,2
3	**Case Study on Python for Data Science: Numpy Library** Basics of Numpy, Creating NumPy Arrays: Mathematical Operations on NumPy Arrays	1,2
4	**Case Study on Python for Data Science: Pandas Library** Basics of Pandas, Data Frames, Indexing and Slicing, Operations on Data Frames, GroupBy and Aggregate Functions, Merging Data Frames, and Pivot Tables	1,2,4
5	**Case Study on Data Visualization** Univariate Analysis using Matplotlib and Seaborn Categorical Ordered and Unordered Univariate Analysis	3,4
6	**Case Study on Data Visualization** Bivariate and Multivariate Analysis using Matplotlib and Seaborn Numerical-Numerical Analysis, Numerical-Categorical Analysis, Categorical-Categorical Analysis	3,4
7	**Case Study on Exploratory Data Analysis** Fixing the rows and columns, Overfitting and Underfitting, Impute/Remove missing values, Feature Engineering Techniques,	3,4,5
8	**Case Study on Exploratory Data Analysis** Feature Reduction Techniques, Handling Outliers, Normalization, and Standardizing values	3,4,5
9	**Case Study on Linear Regression** Simple Linear Regression, and Multiple Linear Regression	3,4,5
10	**Case Study on Logistic Regression** Univariate Logistic Regression, Multivariate Logistic Regression	3,4,5

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Python for Data Science Handbook: Essentials Tools for Working with Data	Second	Jake VanderPlas	O'Reilly	2022
2	Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter	Third	Wes McKinney	O'Reilly	2022
3	Hands-On Exploratory Data Analysis with Python	First	Suresh Kumar Mukhiya, Usman Ahmed	Packt	2020
4	Python Data Science Essentials	Third	Alberto Boschetti, Luca Massaron	Packt	2018

5	Mastering Python for data science,	First	Samir Madhavan	PACKT	2015

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1.	Visualization Analysis and Design	1st	Tamara Munzner	A K Peters/CRC Press	2014
2.	Python Data Visualization Essentials Guide	First	Kalilur Rahman	BPB	2021
3.	Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython.		McKinney, W.	O'Reilly Media, Inc.	2012

Web References:

1. https://www.analyticsvidhya.com/
2. https://www.simplilearn.com/
3. https://www.kaggle.com
4. https://matplotlib.org/
5. https://seaborn.pydata.org/

Bharatiya Vidya Bhavan'

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

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	4	9	3	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
CE/CSE 206		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective:	
Learning Outcomes (LO)): ***At the End of the course students will be able to***	
CE206.1	Comprehend the primitive concepts of Operating System services and System Programming functionality.
CE206.2	Articulate process scheduling algorithms in effective execution of processes.
CE206.3	Acquaint with efficient process synchronization techniques in effective execution of programs.
CE206.4	Analyze virtual memory management algorithms in effective allocation of main memory usage.
CE206.5	Evaluates various algorithms of File Storage & I/O management for performance and quality criterion.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CE206.1	1											1
CE206.2	2	2	2	2								2
CE206.3	2	2	2	2								2
CE206.4	2	2	2	2								2
CE206.5	2	2	2	2								2

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CE206.1							
CE206.2							
CE206.3							

CE206.4							
CE206.5							

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 Operating Systems and system software	1,2	**6**
	1.1	**Operating Systems** – Introduction, Structure and Principles of Operations of Operating Systems, Classes of Operating Systems, Batch Processing Systems, Multiprogramming Systems, Time Sharing Systems, Real Time Operating Systems, linker,loader, static and dynamic linking , virtual machine		
2	**Title**	**Process and Threads Management**	1,2	**9**
	2.1	Processes – Process abstraction, System calls for process management, Process execution mechanisms, Process Scheduling, Inter-process communication		
	2.2	Introduction to threads and concurrency – Single threaded process, Multithreaded process, process vs thread, Why threads, scheduling threads, creating threads, threads with shared data, race condition and synchronization .		
3	**Title**	**Process Coordination**	1,2	**12**
	3.1	Process Synchronization - Critical-Section Problem, Peterson's Solution. Locks- basic idea, building a lock, hardware atomic instructions, test- and-set , Spin lock using compare - and – swap, sleeping mutex, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization Examples		
	3.2	**Deadlock** - Characterization, Methods for Handling Deadlocks, Detection, Prevention, Avoidance, Recovery methods Deadlock.		
4	**Title**	**Memory Management**	1,2	**8**
	4.1	**Memory Management Strategies** - Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table.		
	4.2	**Virtual Memory Management** - Demand Paging, Allocation of Frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory, Operating System Examples.		
5	**Title**	**File Management**		**7**
	5.1	**Storage Management** - Disk Structure, Time taken for I/O operation , Disk Scheduling, Disk Management , RAID , introduction to (solid-state storage) SSD		
	5.2	**File-System** - File-System Structure. Allocation Methods, Free Space Management		

	5.3	**UNIX Internal File Representation – Files and directories , file abstraction, directory tree, operations on files and directories, hard links , soft links** Inodes, .		
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.	1,2, 3	
Total (*Not included)				**42**

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

Sr. No	Title of the Experiment
1	Introduction to Linux tools
2	Write a program for creating a static/dynamic link library
3	Write a program to implement various systems call of a process
4	Write a multithreaded program to show race condition
5	Implement different CPU scheduling algorithms
6	Program to implement shared memory and perform read and write operations on it for a given application
7	Program on process synchronization .
8	Write a program for memory management by building a custom memory manager to allocate memory dynamically .
9	Write a program to simulate disk scheduling .
10	Write a program to prevent destructive update of files

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Operating System Concepts	Ninth	Abraham Silberschatz, Peter B Galvin, Greg Gagne	Wiley	2012
2	Operating Systems: Three Easy Pieces		REMZI H. ARPACI-DUSSEAU , ANDREA C. ARPACI-DUSSEAU .	(University of Wisconsin-Madison)	2014
3	UNIX Internals: The New Frontiers	First	Uresh Vahalia	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)	Design and Analysis of Algorithms	3	0	2	4	9	3	0	1	4
CS205		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective: Apply various algorithmic design paradigms, analyze their asymptotic performance, and synthesize efficient algorithms for common engineering design scenarios.	
Learning Outcomes (LO): ***At the End of the course students will be able to***	
CS205.1	Analyze the complexity of algorithms and apply divide-and-conquer strategy to solve problems.
CS205.2	Make use of string matching algorithms to solve problems .
CS205.3	Apply the concept of greedy method, dynamic programming and Maximum Flow.
CS205.4	Apply the idea of backtracking, branch and bound strategy to solve problems.
CS205.5	Make use of NP-completeness and Approximation Algorithms

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

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CS205.1	3	3	2	1	-	-	1	-	-	-	-	-
CS205.2	3	2	2	1	-	-	1	-	-	-	-	-
CS205.3	3	3	2	1	-	-	1	-	-	-	-	-
CS205.4	3	3	2	1	-	-	1	-	-	-	-	-
CS205.5	2	2	3	1	-	-	1	-	-	-	-	-

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS205.1	-	-	-	-	-	-	-
CS205.2	-	-	-	-	-	-	-
CS205.3	-	-	-	-	-	-	-
CS205.4	-	-	-	-	-	-	-
CS205.5	-	-	-	-	-	-	-

BLOOM'S Levels Targeted

Remember	Understand	Apply	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Introduction to Algorithm**		8
	1.1	**Role of Algorithms** – Algorithm as Technology, Introduction to design and analysis of algorithm e.g. Insertion Sort and Selection Sort		
	1.2	**Asymptotic Notations** – All asymptotic (O, Θ, Ω, o, θ and ω) notations, Common Functions, Recurrence Relation and Solutions Methods: Substitution, Recursion-tree and Master Theorem.		
	1.3	**Divide and Conquer** – Concepts, Maximum Subarray Problem, Closest Pair, Strassen's matrix multiplication, Quick-Sort, Merge-Sort, Selection in Linear Time		
2	Title	**Greedy Methods and String Matching**		10
	2.1	**Disjoint Sets DS** – Disjoint set operations, Linked List Representation, Disjoint Set Forests		
	2.2	**Greedy Approach** – Prim's and Kruskal's MST algorithms, Dijkstra's and Bellman Ford's SSSP algorithms, Activity selection, Fractional knapsack problem, Job sequencing with deadlines problem.		
	2.3	**String Matching algorithms** – Naïve string matching Algorithm, Rabin Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm		
3	Title	**Dynamic Programming and Maximum Flow Problem**		10
	3.1	**Dynamic Programming** – Concepts, Longest Common Subsequence, Matrix Chain Multiplication, Optimal Binary Search Trees, 0/1 knapsack problem,		
	3.2	**All Pairs Shortest Paths** – Shortest Paths and Matrix Multiplications, Floyd-Warshall algorithm, Johnson's algorithm for sparse graphs.		
	3.3	**Flow Networks** – Graph-theoretic definition of Flow networks, Ford-Fulkerson and Maximum Bipartite Matching		
4	Title	**Backtracking and Branch-and-bound**		8
	4.1	**Backtracking** – General method, 8-queen problem (N-queen problem), Sum of subsets, Graph coloring, 0/1 Knapsack problem		
	4.2	**Branch-and-bound** – General method, 0/1 knapsack problem, Travelling Salesman problem, 15 puzzle problem		
5	Title	**Approximation and NP-Completeness**		6
	5.1	**NP-Completeness** – Polynomial time, Polynomial-time verification, NP-completeness reducibility and proof.		

	5.2	**Approximation** – Introduction, Vertex-cover, Travelling-salesman problem and set-covering.		
6	**Self Study**	**Amortized analysis** – Aggregate analysis, accounting and Potential Method, Dynamic Table.		
			Total	**42**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No	Title of the Experiment
1	Experiment based on common mathematical functions.
2	Experiment based on divide and conquers approach.
3	Experiment based on greedy approach
4	Experiment using dynamic programming approach
5	Experiment based on maximum flow
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 based on string matching/amortized analysis.

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	The Design and analysis of algorithms	First	Alfred V. Aho**,** John E. Hopcroft and Jeffrey D. Ullman	Pearson Educatio n India	2006
2	Fundamentals of Algorithmics	First	Gilles Brassard, Paul Bratley	Prentice Hall	1995

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	4	9	3	0	1	4
CS207		Examination Scheme								
		Component		ISE		MSE		ESE		Total
		Theory		50		50		100		200
		Laboratory		50		--		50		100

Pre-requisite Course Codes, if any.	
Course Objective: The objective of the Computer Communication Networks course is to equip students with comprehensive knowledge and practical skills in the field of network engineering. The course aims to prepare individuals for various specialized roles within the networking industry, enabling them to proficiently design, implement, and manage computer communication networks. Throughout the course, students will develop expertise in areas such as network analysis, administration, architecture, and specialized technical roles. By the end of the program, graduates should be capable of seamlessly navigating between the technical and business aspects of network management, and be well-prepared for roles such as network engineer, network manager, network analyst, network administrator, network specialist, network technician, and network architect. The curriculum will emphasize hands-on experience, problem-solving, and staying abreast of the latest advancements in networking technologies, ensuring that students are well-positioned to contribute effectively in the dynamic and evolving field of computer communication networks.	
Learning Outcomes (LO):At the End of the course students will be able to	
LO1	Identify key principles and concepts of computer networking and the Internet.
LO2	Evaluate the effectiveness of different protocols in diverse network applications.
LO3	Apply knowledge of protocols to configure transport layer settings for optimal data transmission.
LO4	Apply the knowledge of subnetting, routing mechanisms and Software Defined Networking.
LO5	Analyze the performance and security of different access network technologies.

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

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
LO1	2	2			2							1
LO2	2	2			2							1
LO3	2	2			2							1
LO4	2	2			2							1
LO5	2	2			2							1

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
LO1	2						
LO2	2						
LO3	2						
LO4	2						
LO5	2						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	Computer Communication and The Internet	1,2	06
	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	
2	Title	Application Layer	1,2	06

		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	10
		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. additive-increase, multiplicative-decrease (AIMD)	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	10
	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	
	5.4	WiFi: 802.11 Wireless LANs:The 802.11 Wireless LAN Architecture,The 802.11 MAC Protocol,The IEEE 802.11 Frame, Advanced Features in 802.11, Personal Area Networks: Bluetooth	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	Network Setup: Network configuration, commands and troubleshooting
2	Network Socket Programming
3	Network Socket Programming using Python Scapy
4	Server Configuration-I
5	Server Configuration-II
6	Network Protocol Analysis

7	Network Simulation using Cisco Packet Tracer
8	Software Defined Networking using Mininet
9	Switch and WLAN Configuration
10	Installation and configuration of network traffic analyzer NTOP
11	Network Server Automation using Ansible
12	Network mapping techniques using open source tools

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Computer Networking: Top Down Approach	8th	James Kurose and Kieth Ross	Pearson	2020
2	Data Communication and Networking	5th	Behrouz Forouzan	McGraw Hill	2020

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

SEMESTER V

SEM V										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Experiential Learning	ELC	PR1	Mini Project I	0	0	4	4	8	2
2	Program Core Courses (17 Credits)	PCC	CS301	Distributed Computing	2	0	2	6	10	3
3		PCC	CS302	Software Engineering	2	0	2	6	10	3
4		PCC	CS303	Artificial Intelligence and Soft Computing	3	0	2	6	11	4
5		PCC	CS304	Theory of Computation	3	0	0	5	8	3
6		PCC	CS305	Cryptography and Network Security	3	0	2	5	10	4
7	Multidisciplinary Minor	MDM	MDEC2X	MDM-II	To be defined by others					4
		Total			**13**	**0**	**12**	**32**	**57**	**23**

- Research internship of minimum 1 month for the "Honors by Research" for 3 credits HR31 (Not for DSY)
- For Enrollment to Honors by research, Minimum CGPA must be 8.25

Bharatiya Vidya Bhavan'
Sardar Patel Institute of Technology
(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

SEMESTER VI

SEM VI										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Program Core Courses (7credits)	PCC	CS306	Human Machine Interaction	3	0	2	4	9	4
2		PCC	CS307	Machine Learning	2	0	2	5	9	3
3	Multidisciplinary Minor	MDM	MDEC3X	MDM-III	To be defined by others					3
4	Experiential Learning	ELC	PR3-I	Main Project Stage I	0	0	4	4	8	2
5	Program Elective Courses	PEC	CS3X1	PE-I	2	0	1	4	7	3
6	Program Elective Courses	PEC	CS3X2	PE-II	2	0	1	4	7	3
7	Skill Enhancement Course	SEC	CS308	DevOps Lab	0	1	2	2	5	2
				Total	**9**	**1**	**12**	**23**	**45**	**20**

- Research internship of minimum 2 month for the "Honors by Research" for 6 credits HR32 (Not for DSY)
- For Enrollment to Honors by research, Minimum CGPA must be 8.25

SEMESTER VII

SEM VII									
Course Category	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
Multidisciplinary Minor	MDM	MDEC4X	MDM-IV	To be defined others					4
Program Elective Courses	PEC	CS4X3	PE-III	2	0	1	4	7	3
Program Elective Courses	PEC	CS4X4	PE-IV	2	0	1	4	7	3
Open Elective	OE	OE1	OE-I	2	0	1	4	7	3
Experiential Learning	ELC	PR3-II	Main Project Stage II	0	0	8	4	12	4
			Total	**6**	**0**	**11**	**16**	**33**	**17**

- Research internship of minimum 1 month for the "Honors by Research" for 3 credits HR41 (Not for DSY)
- For Enrollment to Honors by research, Minimum CGPA must be 8.25

SEMESTER VIII

SEM VIII										
Sr. No	**Course Category**	**Abbreviation**	**Course Code**	**Course Name**	**L**	**T**	**P**	**O**	**E**	**C**
1	Open Elective	OE	OE2	OE-II**	2	0	1	4	7	3
2	Experiential Learning	ELC	INTR INTI PR4	Research/ Industry Internship/Major Project Stage III***	0	0	24	12	36	11
				Total	**2**	**0**	**25**	**16**	**43**	**14**

*** To be completed from MOOCs*

****Students neither taking research or industry internship nor willing to extend their project work can earn additional 11 credits from Swayam Platform or NPTEL or registering courses from any peer institution of higher learning., besides open elective program elective courses offered by the institute.*

PROGRAM ELECTIVE COURSES

4 Electives are sufficient to specialize in a particular domain.

Track	PE-I CS3X1	PE-II CS3X2	PE-III CS4X3	PE-IV CS4X4
Emerging Networking Technologies	CS311: Digital Forensic	CS312: Cloud Computing	CS413: Block chain Technology	CS414: IT Infrastructure Monitoring and Management
Emerging AI	CS321: Natural Language Processing	CS322: Deep Learning	CS423: Generative AI	CS424: Explainable AI
Data Analytics	CS331: Business analytics with Python	CS332: Big data Analytics	CS433: Data Warehouse and Mining	CS434: AI for Healthcare Analytics
Digital Visualization	CS341: Fundamentals of Signal & Image Processing	CS332: Augmented Reality &Virtual Reality [AR-VR]	CS433: Computer Vision	CS434: Visual Intelligence

Indicative list of Multidisciplinary Minors

MDM Sequels for EXTC

- Computer Engineering
- AIML
- Data Science
- Interface and Experience Design
- IT Infrastructure

Course Category of Multidisciplinary Minor	MDM-I (Semester IV)	MDM-II (Semester V)	MDM-III (Semester VI)	MDM-IV (Semester VII)
Computer Engineering	**MDCE11:** Database Management Systems	**MDCE12:** Data Structures and Algorithms	**MDCE13:** Cloud Computing	**MDCE14:** Internet and Web Technology
Artificial Intelligence and Machine Learning	**MDCE21:** Fundamentals of NNFL	**MDCE22:** Artificial Intelligence Machine Learning	**MDCE23:** Natural Language Processing	**MDCE24:** Image Processing and Pattern Recognition
Data Science	**MDCS31:** Fundamentals of Data Science	**MDCS32:** Data Analytics and Visualization	**MDCS33:** Decision Making and Business Intelligence	**MDCS34:** Social Media Analytics
Interface and Experience Design	**MDCS41:** UI/UX Fundamentals	**MDCS42:** Design Thinking and Innovations	**MDCS43:** Human Computer Interaction	**MDCS44:** Total Experience Design
IT Infrastructure	**MDCE51:** IT Infrastructure and DevOps Lab	**MDCE52:** Virtualization and Computing	**MDCE53:** SDN and NFV	**MDCE54:** Network Management

MDM Sequels for CE/CSE

- Industrial IoT
- Digital Signal Processing
- Electronics Communication
- VLSI
- Mathematics and Statistics
- Finance
- Economics

Course Category of Multidisciplinary Minor	MDM-I (Semester IV)	MDM-II (Semester V)	MDM-III (Semester VI)	MDM-IV (Semester VII)
Industrial IoT	**MDEC11:** Fundamental of Internet of Things	**MDEC12:** Embedded "C" and Micro Python for IoT	**MDEC13:** IOT Communication and Network Layer Protocols	**MDEC14:** IoT Applications and Security
Digital Signal Processing	**MDEC21:** Digital Signal Processing	**MDEC22**: Digital Image Processing	**MDEC23:** Multimedia Signal Processing	**MDEC24:** Digital Signal Processor System Design
Electronics Communication	**MDEC31:** Linear Electronics Circuit	**MDEC32:** Principles of Communication & Systems	**MDEC33:** Data Compression and Encryption	**MDEC34:** Wireless Communication and Networks
VLSI	**MDEC41:** Hardware Description Language programming	**MDEC42:** Digital CMOS VLSI Design	**MDEC43:** VLSI Physical Design	**MDEC44:** ASIC Verification

Bharatiya Vidya Bhavan'
Sardar Patel Institute of Technology
(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

SYLLABUS
MDM Sequels for EXTC

Course Category of Multidisciplinary Minor	**MDM-I (Semester IV)**
Computer Engineering	**MDCE11:** Database Management Systems
Artificial Intelligence and Machine Learning	**MDCE21:** Fundamentals of NNFL
Data Science	**MDCS31:** Fundamentals of Data Science
Interface and Experience Design	**MDCS41:** UI/UX Fundamentals
IT Infrastructure	**MDCE51:** IT Infrastructure and DevOps Lab

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
MDM-I	Database Management Systems	2	0	2	4	08	3	0	0	3
MDCE11		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective:	
Learning Outcomes (LO): ***At the End of the course students will be able to***	
MDCE11:.1	Demonstrate understanding of given system to construct a database model
MDCE11:.2	Apply various Relational and SQL commands on the populated database
MDCE11.3	Examine the functional dependencies to make a normalized database system and transaction processing techniques on a database
MDCE11.4	Illustrate query processing and optimization method on a database

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Database Concepts and ER Modeling**	1,2	05
	1.1	Introduction to basic concept of Database, File system V/s Database system, Users of Database system, Database Administrator, Data Independence		
	1.2	The Entity-Relationship (ER) Model, Extended Entity-Relationship (EER) Model , Database integrity		
2	Title	**Relational Algebra And SQL**	1,2	07
	2.1	Relational model, Relational query languages, Relational algebra, Tuple and domain calculus		
	2.2	Structured Query Language: Data Definition Commands, Data Manipulation commands, Data Control commands, Join expressions, views, Triggers		
3	Title	**Normalization And Transaction Processing**	1,2	05
	3.1	Design guidelines for relational schema, Functional dependencies		
	3.2	Normal Forms- 1NF, 2 NF, 3NF, BCNF		
4	Title	**Transaction Processing**	1,2	06
		Transactions, ACID properties, Concurrency Control, Recovery		
		Serializability, Recoverability, Lock-based, Timestamp-based, Validation-based protocols.		

5	**Title**	**Indexing And Query Optimization:**	1,2	**05**
	4.1	Row-wise and column database, database buffering. Indexing, B+-tree indices		
	4.2	Query Processing, Query Optimization		
6	**Self Study**	NO SQL-Data type, Database creation, Basic command for creation, updating and querying the database, Mongo dB, Applications of Hyper Graph DB, cloud database		
			Total	**28**

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

SN	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 data using a Subquery.
8	To Create a different view of the database.
9	To examine the integrity of the database using Triggers.
10	To study distributed databases/Normalization

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Database System Concepts	7th	Korth, Slberchatz, Sudarshan	McGraw – Hill	2019
2	Fundamentals of Database Systems	6th	Elmasri and Navathe	PEARSON Education	2011

©**Reference Books**

Sr. No	Title	Edition	Authors	Publisher	Year
1	Database Management Systems	3rd	Raghu Ramkrishnan and Johannes Gehrke	TMH	2003
2	Database Management Systems	1st	G. K. Gupta	McGraw – Hill.	2018

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
MDM-1	Fundamentals of NNFL	2	0	2	4	8	2	0	1	3
MDCE21		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Basic understanding of mathematics, probability, and programming.	
Course Objective: This course focuses on the fundamental of Neural networks and Fuzzy Logic along with its application. Students will be able to design 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***	
AI3X1.1	Identify the various characteristics of Neural Network techniques in building intelligent machines
AI3X1.2	Apply the supervised and unsupervised Neural Network Learning algorithm to solve real world engineering problems.
AI3X1.3	Design Fuzzy Logic Controller System

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

	PO1	PO2	PO3	PO4	PO5	PO12	PSO1
AI3X1.1	2	2	--	2	--	--	--
AI3X1.2	2	2	--	2	3	2	1
AI3X1.3	2	2	2	2	3	2	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**	**Neural Networks**	T1, T2 T3, R1	**12**
	1.1	**Basics of Neural Networks:** Introduction to Neural Networks, Biological Neural Networks, Models of ANN with its terminologies, Activation functions and its types		
	1.2	McCulloch-Pitts Model, Linear separability, Hebb Network		
	1.3	**Supervised Learning algorithms:** Perceptron (Single-Layer perceptron: Learning Rule and Applications), Multi-Layer Perceptrons (MLPs), Backpropagation Algorithm: Training MLPs Activation Functions Vanishing Gradient Problem and Solutions		
	1.4	**Un-Supervised Learning algorithms:** Hebbian Learning, Winner takes all, Self-Organizing Maps KSOFMN, Learning Vector Quantization.		
2	**Title**	**Fuzzy Logic, Classical Set and Fuzzy Relations**	T2, T3,T4, R1, R3	**10**
	2.1	Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Functions, Classical and Fuzzy set operations, and properties of classical and Fuzzy sets. Fuzzy Logic Operators: AND, OR, NOT		
	2.2	Classical and Fuzzy Relations**:** Cartesian product of relation, Fuzzy Max-Min and Max-Product Composition, Fuzzy extension principle		
3	**Title**	**Fuzzy control system design**	T2, T3 T4	**6**
	3.1	Fuzzy Inference System and its types, Fuzzification ,Defuzzification, Designing Fuzzy logic control systems.		
	3.2	Mamdani and Sugeno Fuzzy Inference Systems		
4	**Self Study**	Associative Memory Network, Architecture of Neuro-Fuzzy Networks(ANFIS and CANFIS), Performance Metrics for Neural Networks and Fuzzy Logic Systems, Model Evaluation Techniques: Cross-Validation, ROC Analysis, Optimization Techniques: Genetic Algorithms, Particle Swarm Optimization	-	**5**
			Total	**28**

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.
2	To design ANN to implement logic gates.
3	To implement Hebb Network for a given problem statement.
4	To design and implement ANN (perceptron) for a given problem statement using Joone Editor
5	Write a program using Single Layer perceptron
6	To implement the Supervised Learning algorithm.
7	To implement the Unsupervised Learning algorithm
8	To implement Fuzzy Sets for a given problem statement
9	To implement Fuzzy Relations for a given problem statement
10	To design and implement Fuzzy Logic controller 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.Vijayalakshmi Pai	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

Bharatiya Vidya Bhavan'

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
MDM-I	Fundamentals of Data Science	2	0	2	5	10	2	0	1	3
		Examination Scheme								
MDCS31		Component	ISE		MSE		ESE		Total	
		Theory	50		50		100		200	
		Laboratory	50		—--		50		100	

Pre-requisite Course Codes, if any.	–
Course Objective: To provide students with a comprehensive understanding of the fundamental concepts, tools, and techniques used in data science and data visualization. This course is designed to introduce students to the basic principles of data science and data visualization, including libraries used for Data Science, data exploration, data preprocessing, EDA, data visualization and basic model building.	
Learning Outcomes (LO): ***At the End of the course students will be able to***	
MDCS31.1	Demonstrate the need of libraries used in Data Science.
MDCS31.2	Make use of different tools and techniques for Data Visualization
MDCS31.3	Analyze the data performance using the EDA process.
MDCS31.4	Develop Linear Regression and Logistic Regression Models for a given case study.

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

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MDCS31.1	-	2	-	2	3	-	-	-	-	-	-	-
MDCS31.2												
MDCS31.3	2	2	2	2	3	-	-	-	-	-	-	-
MDCS31.4	-	2	2	-	3	-	-	-	1	1	-	-

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
MDCS31.1							
MDCS31.2							
MDCS31.3							
MDCS31.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Python for Data Science**		**06**
	1.1	Introduction to Data Science and its roles in Modern Society, Descriptive Statistics		
	1.2	Working with Numpy Basics of Numpy, Creating NumPy Arrays, Mathematical Operations on NumPy Arrays	1,2, 3	
	1.3	Working with Pandas Basics of Pandas, Data Frames, Indexing and Slicing, Operations on Data Frames, GroupBy and Aggregate Functions, Merging Data Frames, Pivot Tables	1,2, 3	
2	**Title**	**Data Visualization**		**06**
	2.1	Data Visualization using Matplotlib Bar Graphs, Scatter Plots, Line Graphs, Histogram, Box Plots, Sub Plots	1,3, 7	
	2.2	Data Visualization using Seaborn Distribution Plots, Pie Charts, Bar Charts, Scatter Plots, Box Plots, Pair Plots, Heat Maps, Line Charts	1,3, 8	
4	**Title**	**Data Preprocessing and Exploratory Data Analysis**		**06**
	4.1	Data Sourcing Public Data and Private Data, Web Scraping	5,6	
	4.2	Data Cleaning Fixing the rows and columns, Overfitting and Underfitting, Impute/Remove missing values, Feature Engineering Techniques, Feature Reduction Techniques, Handling Outliers, Standardizing values	5,6	
	4.3	Univariate Analysis Categorical Ordered and Unordered Univariate Analysis	5,6	
	4.4	Bivariate and Multivariate Analysis Numerical-Numerical Analysis, Numerical-Categorical Analysis, Categorical-Categorical Analysis	5,6	
5	**Title**	**Regression**		**10**
	5.1	Linear Regression Simple Linear Regression, Multiple Linear Regression	5,6	
	5.2	Logistic Regression Univariate Logistic Regression, Multivariate Logistic Regression Model Building and Evaluation	5,6	
6	**Self Study**	Plotly, Different Visualization visualization techniques other than Python and Tableau.	1,2, 5	
			Total	**28**

Laboratory Component:

Sr. No	Title of the Experiment
1	Working with Python Basics
2	Working with Python Data Structures
3	Working with Python Numpy Library
4	Working with Python Pandas Library
5	Working with Python Matplotlib Library
6	Working with Python Seaborn Library
7	Exploratory Data Analysis on the given Case Study
8	Develop a Linear Regression Model on the given Case Study
9	Develop a Logistic Regression Model on the given Case Study
10	Mini Project based on a case study.

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Python for Data Science Handbook: Essentials Tools for Working with Data	Second	Jake VanderPlas	O'Reilly	2022
2	Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter	Third	Wes McKinney	O'Reilly	2022
3	Python Data Visualization Essentials Guide	First	Kalilur Rahman	BPB	2021
4	Data Visualization Through TABLEAU	First	George Peck	McGraw Hill	2020
5	Hands-On Exploratory Data Analysis with Python	First	Suresh Kumar Mukhiya, Usman Ahmed	Packt	2020
6	Python Data Science Essentials	Third	Alberto Boschetti, Luca Massaron	Packt	2018

Web References:

7) https://matplotlib.org/
8) https://seaborn.pydata.org/

Bharatiya Vidya Bhavan'

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
MDM I	UI/UX Fundamentals	2	0	2	4	8	2	0	1	3
MDCS41		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	AI305
Course Objective: The aim of the UI/UX course is to provide students with the knowledge of user-centered design, user -centered methods in design, graphic design on screens, simulation and prototyping techniques, usability testing methods, interface technologies and user centered design in corporate perspective. The course is organized around a practical project with iterative design of a graphical user interface to organize information about users into useful summaries with affinity diagrams, to convey user research findings with personas and scenarios and to learn the skill of sketching as a process for user experience design. The students will be given exposure to wireframing and Prototyping software in the various UI/UX Design tools.	
Learning Outcomes (LO):*At the End of the course students will be able to*	
MDCS41.1	Understand iterative user-centered design of graphical user interfaces
MDCS41.2	Apply the user Interfaces to different devices and requirements
MDCS41.3	Design prototype for the given design problems.

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

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MDCS41.1	2	-	--	2	--	--	--	--	--	--	--	--
MDCS41.2	-	-	2	-	2	--	--	--	--	--	--	--
MDCS41.3	-	-	-	-	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 UI and UX**	T1-T4	06
	1.1	What is User Interface Design (UI) -The Relationship Between UI and UX , Roles in UI/UX, Menus, Tabs, Bottom tab bar, Buttons (including "Call to action" or CTA) ,Accordion ,Carousel		

		,Breadcrumbs, Modals Forms ,etc		
	1.2	A Brief Historical Overview of Interface Design, Interface Conventions, Designer vs. developer, Skills to be a top designer.		
2	**Title**	**User Interface Design Elements**	T2,T4	**06**
	2.1	Approaches to Screen Based UI, Template vs Content, Formal Elements of Interface Design, Active Elements of Interface Design, Composing the Elements of Interface Design, UI Design Process, Visual Communication design component in Interface Design, Spacing and the grid.		
3	**Title**	**Colors, Typography & Fonts**	T1-T4	**05**
	3.1	Display Text (Such as Headings) versus Body Text , Legibility , Type Trends, Typeface Selection & Pairing, Where to Get Web Fonts, Ideal Line Height, Column Width (Line Length), Hyphenation & Justification		
	3.2	Color Harmonies, Creating Contrast with Color, Guidelines for Proper Color Usage		
4	**Title**	**Design Guidelines and Process**	T1-T4	**06**
	4.1	UX Basics- Foundation of UX design, Good and poor design, Understanding Your Users, Designing the Experience , Elements of user Experience, Visual Design Principles, Functional Layout, Interaction design, Introduction to the Interface, Navigation Design, User Testing, Developing and Releasing Your Design		
5	**Title**	**Design Tools**	T2,T4	**03**
	5.1	Adobe Photoshop, Illustrator, Figma, AdobeXD, Pencil Project tool.		
	Self Study	Mobile Ecosystem: Platforms, Application frameworks: Types of Mobile Applications: Widgets, Applications.		**02**
			Total	**28**

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

Sr. No	Title of the Experiment
1	Case Study to understand and know about UI elements for Zomato, Swiggy app.
2	To create logo for restaurant based on given scenario using Adobe XD.
3	To create basic app for creating your own profile using Adobe XD.
4	To create different icons for giving ratings using Pencil tool. Use your own creativity.
5	To customize typography for logo for fitness app in UI design using Pencil tool. Use your own creativity.
6	To evaluate Good and Bad Design of UI elements for IRCTC website
7	To customize typography for logo for selling variations of plants, pots and fertilizers in UI

	design using Illustrator tool.
8	To create GUI for creating feedback form for taking feedback from students and teachers by using only icons which are familiar to users and choose colors based on the scenario and describe the reason for such selection for the same.
9	To create simple Web UI for newly developed Pencil company (like apsara, doms etc.) using different kinds of Menus in an application using Figma tool.
10	To create simple flower selling application in Mobile app layout, laptop screen layout and Desktop layout and compare using Figma tool.

Refernces:

1. A Project Guide to UX Design: For user experience designers in the field or in the making (2nd. ed.). Russ Unger and Carolyn Chandler. New Riders Publishing, USA, 2012.
2. The Elements of User Experience: User-Centered Design for the Web and Beyond, Second Edition Jesse James Garrett, Pearson Education. 2011.
3. The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques, Third Edition Wilbert O. Galitz , Wiley Publishing, 2007.
4. The UX Book Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson and Pardha S. Pyla, Elsevier, 2012.

Bharatiya Vidya Bhavan'

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai) Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	IT Infrastructure and DevOps Lab (ITIDL)	1	0	4	5	10	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
MDCE51		Theory	0		0		0			0
		Laboratory	100		100		100			100

Pre-requisite Course Codes, if any.	Fundamentals of Computer and Coding, PSIPL, PSOOP
Course Objective: Evaluate basics of IT Infrastructure and server-side storage, work with hypervisor and virtualization, understand and utilize various DevOps technologies.	
Learning Outcomes (LO): At the End of the course students will be able to	
LO1	Evaluate various IT Infrastructures (Hardware and Software)
LO2	Experiment with Hypervisors
LO3	Create a Version Control Environment and perform Continuous Integration
LO4	Create Continuous Deployment Environment

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

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO9	PO10	PO11	PO12
LO1			1		3				2		1	
LO2			1		3				2		1	
LO3			1		3				2		1	
LO4			1		3				2		1	

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

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
LO1							
LO2							
LO3							
LO4							
LO5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze ✓	Evaluate ✓	Create ✓

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	Introduction to IT Infrastructure (Hardware/Software)	2,3	3
	1.1	Introduction to Computing Hardware: Multicore systems, RAMs, HDD, SSD, NVME Drives, MultiGigabit Networks, System Fundamentals: BIOS/UEFI, Multiboot environment, PXE, thin clients		
	1.2	Linux Basics: Installation, Partitioning of Hard Disk, Dual Booting, Boot Loader (GRUB), kernel booting, system V initialization, file system, bash environment, user mode, kernel mode, user administration, system commands and utilities, system administration, network configuration, software installation and maintenance, standard storage and backup systems		
2	Title	Server-side Infrastructure and Storage	2,3	2
	2.1	Server infrastructure, Rack, Tower server, hot-swappable systems, RAID configuration, Fault Tolerance and Load Balancing, Server Administration (Web, FTP, NFS, DNS, DHCP, DATABASE, TELNET/SSH)		
	2.2	Network Attached Storages (NAS) and SAN, distributed file systems-NFS, Caching,		
3	Title	Virtualization and Hypervisors	1,2,	3

	3.1	Concept of Virtualization, Types of Virtualization, VirtualBox, VMWare, KVM, QUEMU, ZEN	3,4	
	3.2	Container Technologies: Docker and podman Minikube and Kubernetes		
4	Title	DevOps Basics: Git, Jenkins, and SonarQube	1,4	3
	4.1	Concept of DevOps, CI/CD Pipeline Introduction to Git: Distributed version control system. Importance in tracking changes, collaboration, and branch management.		
	4.2	Jenkins for Continuous Integration Introduction to Jenkins: Overview of Continuous Integration/Continuous Deployment (CI/CD), Key features and plugins		
	4.3	SonarQube for Code Quality Analysis: Introduction to SonarQube, Importance of code quality and security Key metrics and issues tracked by SonarQube		
5	Title	Advanced DevOps: Continuous Deployment and Infrastructure as Code	1,4	3
	5.1	Ansible for Configuration Management: Introduction to Ansible Agentless configuration management tool. Overview of key features and architecture, Ansible Basics, Understanding Playbooks and Roles YAML syntax		
	5.2	Writing basic playbooks, Inventory Management Static and dynamic inventories, Advanced Ansible usage, Ansible Modules and Plugins		
	5.3	Terraform for Infrastructure as Code: Introduction to Terraform Terraform Basics, Understanding Terraform Configuration Files HCL syntax, Writing basic .tf files, Advanced Terraform Usage, Modules and State Management, Creating and using modules Managing state files and remote state,		
	5.4	Terraform in Action, Provisioning Infrastructure, Using providers (AWS, Azure, GCP), Applying and destroying infrastructure		
6	Self Study	Chef Configuration tool, Puppet Configuration tool, Grafana Monitoring tool, Prometheus Monitoring tool, NagiOS Configuration tool, OpenVAS, TravisCI tool, CircleCI Tool		6
Total				14*

*Excluding Self Study

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Installation and configuration of Linux in dual boot environment: Partitioning of Hard Disk, Creating and selecting partitions for Linux (Root, swap, special partitions),
2	Linux OS system administration- login/logout, user creation, desktop management, file and directory related commands, system information commands, process management, memory management, filesystems commands, package installation/deletion, network commands, backup and restore, shell scripting
3	Installation and configuration of Hypervisors (VirtualBox/VMWare/KVM): Loading the Virtual Machines (VMMs), Network configuration and management
4	Installation and Configuration of Docker (Container) and Docker-compose: Docker usage, docker images, docker containers, docker networking, docker monitoring, managing the containers
5	Kubernetes using Minikube
6	Installation and configuration of Git: Basic Git Commands, Basic Operations, Working with Remote Repositories-Connecting to Remote Repos Setting up SSH keys Adding remote repositories: git remote add origin <url> Fetching and Pulling from Remotes Understanding git fetch vs. git pull ,Collaboration and Workflow, Branching Strategies, Feature branches GitFlow, Handling Merge Conflicts, Rebasing vs. Merging
7	Installing and Configuration of Jenkins: Installation Steps, Using Docker Configuring Jenkins, Initial Setup, Jenkins Dashboard, Creating a Jenkins user, Setting Up Jobs and Pipelines,Freestyle projects, Pipeline projects, Jenkinsfile basics, Declarative vs. Scripted Pipelines Creating a Simple Pipeline, Stages, steps, and post actions, Integrating Jenkins with Git Setting Up Git Repositories in Jenkins, Polling SCM Webhooks, Building and Testing Code Automated builds, Running test suites, Advanced Jenkins Usage Using Plugins Commonly used plugins (Git plugin, Pipeline plugin, etc.) Distributed Builds, Master-slave configurations
8	Installation and configuration of SonarQube for Code Quality Analysis: Installing SonarQube, Installation Steps, Configuring SonarQube Initial Setup, SonarQube DashboardCreating a SonarQube user and projects Connecting to Databases, Configuring database settings (PostgreSQL, MySQL, etc.) Running SonarQube Analysis, Setting Up SonarQube Scanners SonarQube Scanner CLI, Integrating with Maven, Gradle, and other build tools Analyzing a Project Configuring sonar-project.properties Running the scanner and interpreting the results Integrating SonarQube with Jenkins Installing SonarQube Plugin in Jenkins

	Setting Up a Jenkins Job for SonarQube Analysis Configuring analysis parameters Running SonarQube analysis as part of Jenkins pipeline Advanced SonarQube Usage Custom Quality Profiles and Gates Creating and managing quality profiles Setting up quality gates
9	Installation and configuration of Ansible for Configuration Management: Agentless configuration management tool. Overview of key features and architecture, Ansible Basics, Understanding Playbooks and Roles, YAML syntax Writing basic playbooks, Inventory Management, Static and dynamic inventories, Advanced Ansible usage, Ansible Modules and Plugins
10	Terraform for Infrastructure as Code: Installation Steps, Terraform Configuration Files, HCL syntax Writing basic .tf files, Advanced Terraform Usage, Modules and State Management Creating and using modules, Managing state files and remote state Applying and destroying infrastructure

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Learning DevOps - Second Edition: A comprehensive guide to accelerating DevOps culture adoption with Terraform, Azure DevOps, Kubernetes, and Jenkins	Second	M. Krief	Packt	2022
2	Practical Linux System Administration: A Guide to Installation, Configuration, and Management	First	Kenneth Hess	O'Reilly	2023
3	Linux For Beginners	Twenty Fourth	Papercut Limited	Papercut Limited	2024
4.	Building Cloud and Virtualization Infrastructure: A Hands-on Approach to Virtualization and Implementation of a Private Cloud Using Real-time Use-cases	First	Mrs.Lavanya S Dr. Venkatachalam K Dr. Saravanakumar N M Dr. Balamurugan S	BPB Publications	2021

Reference Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	The DevOps Handbook	First	Gene Kim, Jez Humble, Patrick Debois, John Willis, Nicole Forsgren	IT Revolution Press	2021