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

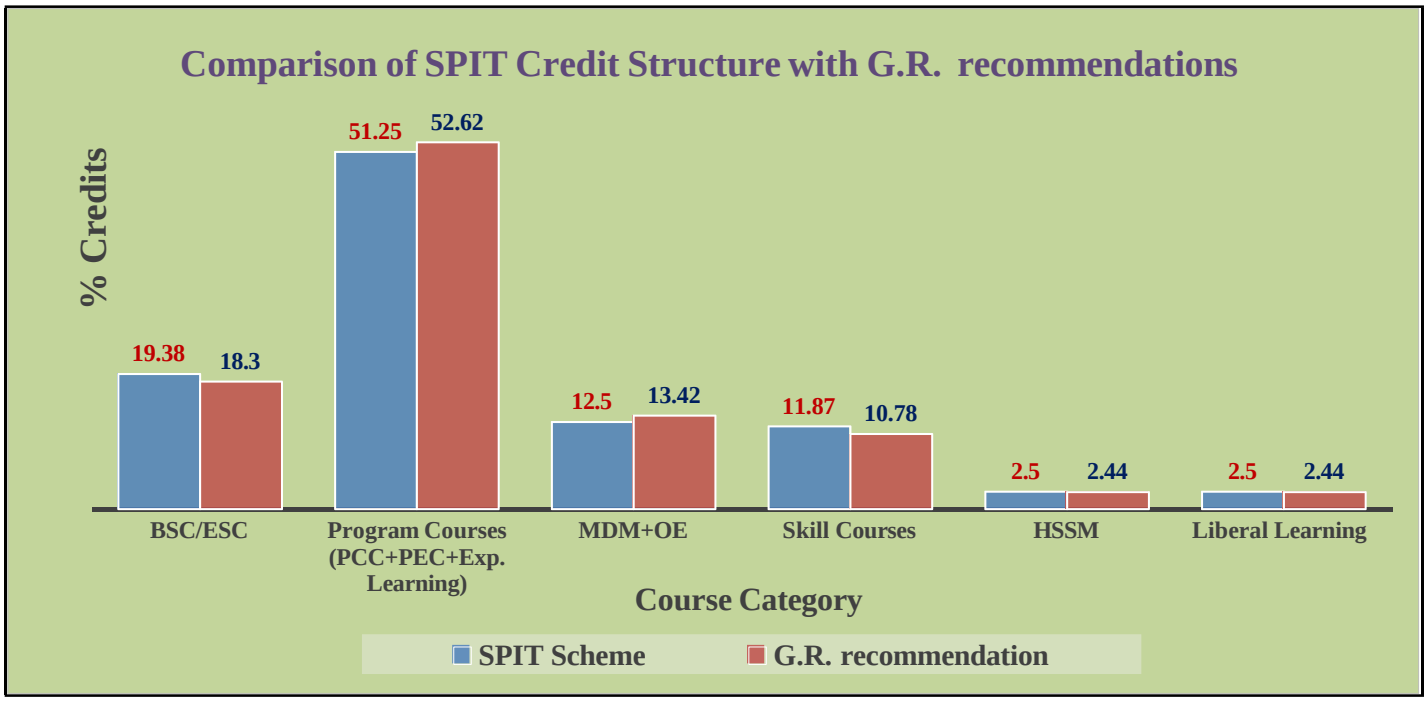

Figure 2: Pie-chart of vertical-wise allocation of credits

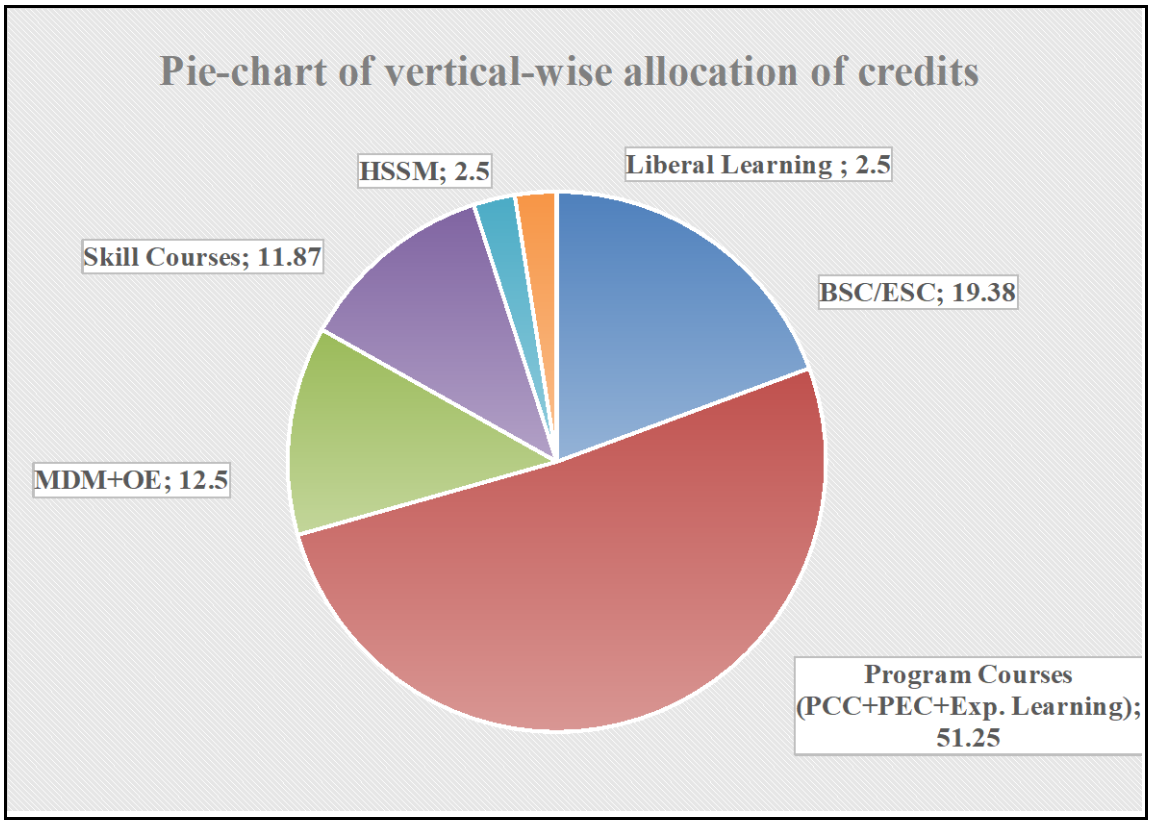

Table 3: Semester-wise allocation of credits to different verticals

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 Enhancemen t 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 Enhancemen t course	SEC	AS106	Tech Shop	1	0	2	2	5	2
			AS107	Soft Skill I						
5	Basic & Engg. Sciences	BSES	EC102	Basic Electrical Engineering	3	0	2	5	10	4
			EC101	Digital Systems	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	EC102	Basic Electrical Engineering	3	0	2	6	11	4
			EC101	Digital Systems	3	0	2	5	10	
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/Wee k)	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	AS202	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	HSM-I	HSMX1	**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*

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	AS201	Python Programming for Data science	0	1	2	4	7	2
4	Humanities	HSSM-II	HSMX2	**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	MDECX1	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	MDECX2	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	MDECX3	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	MDECX4	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	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.*

Indicative List of Humanities courses (HSM-I/II):

Course Code	Course Title	Course Code	Course Title
HSM11	Finance for Engineers-I	HSM12	Finance for Engineers-II
HSM21	Economics-I	HSM22	Economics-II
HSM31	Psychology -I	HSM32	Psychology -II
HSM41	Law for Engineers-I	HSM42	Law for Engineers-II
HSM51	Sanskrit-I	HSM52	Sanskrit-II
HSM61	French-I	HSM62	French-II
HSM71	German-I	HSM72	German-II
HSM81	Japanese-I	HSM82	Japanese-II
HSM91	(NPTEL) HSS/Management-I	HSM92	(NPTEL) HSS/Management-II

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**
    1. If learners earn top grades in any 8 Program core courses. They will be awarded an Honors Certification.
    2. 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.
3. 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.**

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