

**Computer Science and Engineering (Artificial Intelligence & Machine Learning)**

Few specific feedback received reflecting the needs of stakeholders at Local-, Regional-, National-, International level  
(The feedbacks are received through centralised online system using google form with timestamp and reflected in the Feedback Form by the Program Coordinator of Computer Science Engineering (AI & ML) for documentation attested by the HoD). The received feedback (s) are further discussed in the internal pre-BoS meeting and escalated to the BoS for necessary approval.

S. No	Few Feedback at	Few specific feedback received from stakeholders	Integration into the curriculum		Semester	POs/PSOs
			Course Code	Course Name		
1	Local Level	Implementing Artificial Neural Networks	20AI302	Artificial Neural Networks	III	01, 03
		Fundamentals of developing android applications	20AI608	Application Development Lab	VI	05, PSO 1, PSO 2
		Awareness of Ethical Principles	20HSX04	Professional Ethics	VII	08
2	National Level	Internet of Things	20CS004	Internet of things	VI	01, 04, 05
			20AIS02	Competitive Programming Essentials	IV	03,04,05
		<b>Applying AI to Cyber Security</b>	20AI005	Cyber Security	VI	01, 04, 05, PSO2
		<b>Solid Foundations for Developing, Analyzing and Implementing Parallel Algorithms</b>	20AI602	High Performance Computing	VI	02, 03, 05

**Commented [ds1]:** Few feedback received and action taken are furnished in this page as samples and rest of the evidences are attached in the trailing part of the document pertaining to CSE (AI & ML)

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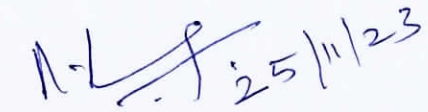
**Commented [ds2]:** In the recent days, the problem solving skills is gaining a significant focus among higher education institutions. In this context the stakeholders had given the feedback for including the competitive programming for effective problem solving

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**Commented [ds3]:** Stakeholders suggested to include the principles of AI for Cyber security. In that context a course on Cyber Security was included in the Semester VI

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**Commented [ds4]:** Members suggested to include High Performance Computing and the concepts of Parallel Computing and algorithms as the applications of the AI is almost in all the domains on earth.

  
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 Computer Science and Engineering (AIML)  
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 Sontyam, Visakhapatnam - 531173

		Architectures and Algorithms of IoT	20ECO01	Architectures and Algorithms of IoT	V	01, 04, 05
		Engineering Technical Report in Academics		Technical Paper Writing	V	PO1 – PO12
		Summer Internship		Summer Internship	IV	5, 8, 9, 10, PSO 1
		Industry 4.0		Summer Internship	VI	5, 8, 9, 10, PSO 1
		Software Development		Full Semester Internship	VIII	5-10, PSO 1, PSO 2
3	International Level	Threat Intelligence Analysis	20AI011	Cyber Threat Analysis	VII	01, 02, 04, 05, 10
		Project Based Learning	20SH002	Design the Thinking	VI	01, 04, 05, PSO 1
		Logical reasoning		Quantitative Aptitude	III-VI	

Head of the Department

Head of the Department  
 Computer Science and Engineering  
 V. S. Raju Institute of Technology  
 Hyderabad - 501173

(A1ML)

*Handwritten signature and date: 25/11/23*

**ICC 20ICC01 Competitive Programming**

**2 0 8 6**

**Version: 01.00**

Duration 240 hours (2 hours theory and 14 hours practical per week) as specified above  
 Industry Collaborator M/s. Demy Software Solutions, Visakhapatnam

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC01.1	Understand the basics of Programming	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.2	Explain various types of Operators, operations, relations, and techniques in programming	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.3	Demonstrate gaming basics	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.4	Execute various Operations on Linked lists	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.5	Explore various applications of the techniques.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC01.6	Solving various problems of Binary Trees, insertion, deletion and updation.	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs  
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

**Deliverables**

WEEK 1 - Introduction- Execution of a program, Decimal - Binary conversion, Ranges of Data Types and constraints, Complexity Analysis of Algorithms, Big-O Notation, Time & Space Analysis and Constraints, Importance of constraints

WEEK 2 - Bit-Manipulation, Bitwise operators, Bit-masking, Modular Arithmetic, Recursion, Thinking Recursively, Recurrence Relations, Sorting Techniques, Two Pointer Technique

WEEK 3 - Binary Search, Applications of Binary Search, Lower Bound & Upper Bound, Finding Frequency, Optimization problems, Hashing, Hashing Techniques, Collision Resolutions, Inbuilt Libraries

WEEK 4 - Maps and Sets, Subarrays and Sub sequences, String matching, Sieve of Eratosthenes, Segmented Sieve, Game Theory, Nims Game, Counting Game

WEEK 5 - Prefix and Suffix concepts, Collecting water, Stacks, Balanced Parentheses, Largest Histogram Area, Queues, Sliding Window Maximum

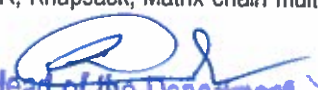
WEEK 6 - Linked Lists, Various Operations on linked lists, LRU Cache, Cloning Linked list with random pointer, Doubly-linked list

WEEK 7 - Binary Trees, BT and FBT, Traversals, Various operations on Binary Trees, Binary Search Trees, Insertion, Updating and Deletion

WEEK 8 - More Problems on Binary Trees, Iterative Traversals, Least Common Ancestor, Heaps, Quick Select, Running Median, Trie, Introduction and Implementation

WEEK 9 - Problems on Tries, Maximum XOR pair, Partitioning of string, 1D Dynamic Programming, Approaching DP problem, Problems on Overlapping subproblems, Problems on Optimal Substructure, Longest Increasing Subsequence

WEEK 10 - 2D Dynamic Programming, Compute NCR, Knapsack, Matrix chain multiplication, Graphs, Introduction and

  
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 Sontyem Visakhapatnam 521170

Implementation, Dijkstra, Topological sort.

### Assessment

<b>Mode of Delivery</b>	Offline / Online
<b>No. of transferable credits for redemption</b>	9 (Nine)
<b>Credits validity</b>	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
<b>Dedicated certificate by the collaborating industries</b>	Yes

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**Chairman  
Board of Studies**

**Head of the Department  
Computer Science and Engineering  
N.S. Raju Institute of Technology  
Santyam, Visakhapatnam - 53117**

**PE 20AI005 Cyber Security**

**3 0 0 3.0**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PO12	
20AI005.1	Understand the components of cyber security	3	1	1	1	L1, L2
20AI005.2	Describe the need of security for operating systems and networks	3	1	1	1	L1, L2
20AI005.3	Explain the countermeasures of security attacks	3	1	1	1	L1, L2
20AI005.4	Understand the importance of privacy in cyber space	3	1	1	1	L1, L2
20AI005.5	Explain the implementation of organizational security	3	1	1	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos  
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Unit I: Introduction to Cyber Security**

**9 hours**

Introduction -Computer Security -Threats -Types of threats – Types of attackers -Harm -Vulnerabilities – Controls -Web User Side – Browser Attack Types – Web Attacks Targeting Users – False or Misleading Content – Malicious Web Content- Protecting against Malicious Web Pages

*Types of Malwares*

**Unit II: Security in Operating Systems and Networks**

**9 hours**

Security in Operating Systems – Operating System Structure – Security features of Operating Systems – Network Security Attacks – Threats to Network Communications – Port Scanning – Wireless Network Security – Wi-Fi Background – Vulnerabilities in Wireless Networks- Difference between WEP and WPA – Comparison between DoS and DDoS

*Protocol Layers, Address and Routing*

**Unit III: Security Countermeasures**

**9 hours**

Firewalls – What is a Firewall? – Design of Firewalls – Types of Firewalls – Personal Firewalls – Comparison of Firewall Types – Intrusion Detection and Prevention Systems – Types of IDSs – Intrusion Prevention System -Intrusion Response – Goals for IDS – IDS Strengths and Limitations – Databases – Security Requirements of Databases

*Network Management*

**Unit IV: Privacy in Cyberspace**

**9 hours**

Privacy Concepts – Privacy Principles and Policies – Privacy on the Web – Email Security – Privacy Impacts of Emerging Technology -Electronic Voting – VoIP and Skype – Privacy in the Cloud

*Authentication and Privacy*

**Unit V: Organizational Security**

**9 hours**

Policies, Procedures, Standards, and Guidelines – Security Awareness and Training – Physical Security – Computer Location and Facility Construction – Facilities Access Controls – Contingency Planning – Environmental Issues – Electromagnetic Eavesdropping

*Issues and Challenges in Organizational Security*

**Textbooks**

1. Charles P. Pfleeger, Shari Lawrence, and Pfleeger Jonathan Margulies, "Security in Computing", Fifth Edition, Pearson Edition, 2015
2. George K. Kostopoulos, "Cyber Space and Cyber Security", CRC Press, 2013

**Reference Books**

1. Nina Godbole, Sunit Belapure, "Cyber Security, Understanding cybercrimes, computer forensics and legal perspectives", Wiley Publications, Reprint 2016
2. Scott Barman, "Writing Information Security Policies", New Riders Publications, 2002
3. William Stallings, "Cryptography and Network security", Pearson Education, 7th Edition, 2016

**Web Resources**

1. <https://online.stanford.edu/professional-education/cybersecurity>
2. <https://www.cybrary.it/course/introduction-to-it-and-cybersecurity/>
3. <https://www.springboard.com/resources/learning-paths/cybersecurity-foundations/>

#### Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
Total (%)	100	100

#### L1: Remembering

1. What is Cyber Crime? List the types of cybercriminals
2. What are the weak areas of the ITA 2000?
3. What is a Rootkit?
4. Define Mobile viruses and Mishing
5. Define the different categories of cybercrimes?
6. How to prevent SQL Injection Attacks?
7. What is the need for Computer Forensics?

#### L2: Understanding

1. Explain the following terms related to cybercrimes: i) Spamming ii) Salami technique iii) Hacking iv) Password sniffing
2. Discuss the global perspective on cybercrimes.
3. Define Social Engineering? Describe the classification of Social Engineering with examples.
4. Explain the following terms according to IT Act 2000: i) Records as evidence ii) Proof of electronic agreements iii) Status of electronic
5. Discuss the legal perspectives of cybercrime.
6. What are the positive aspects of the ITA 2000? Explain
7. What are the physical security countermeasures for laptops?

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Board of Studies CSE (AIML)

**PC 20AI603 High Performance Computing**

**3 1 0 3.0**

At the end of the course, students will be able to

Code	Course Outcomes	Mapping with POs				DoK
		PO2	PO3	PO5	PO12	
20AI503.1	Describe GPU architecture	3	1	1	1	L1, L2
20AI503.2	Write programs using CUDA, identify issues and debug them	3	1	1	1	L1, L2, L3
20AI503.3	Implement efficient algorithms in GPU for common application kernels	3	1	1	1	L1, L2, L3
20AI503.4	Write simple programs using OpenCL	3	1	1	1	L1, L2, L3
20AI503.5	Identify efficient parallel programming patterns to solve problems	3	1	1	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs  
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Unit I: GPU Architecture**

**9+3 hours**

Evolution of GPU architectures – Understanding Parallelism with GPU – Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

*RISC pipeline*

**Unit II: Multi Processor Architecture**

**9+3 hours**

Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions

*Divergence*

**Unit III: Issues in Programming**

**9+3 hours**

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

*Error handling*

**Unit IV: OPENCL Basics**

**9+3 hours**

OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.

*More OpenCL examples*

**Unit V: Efficient MPI programming**

**9+3 hours**

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.

*Issues in clusters*

**Text Books**

1. Shane Cook, "CUDA Programming: –A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing)", First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, "Heterogeneous computing with OpenCL", Third Edition, Morgan Kauffman, 2015.

**Reference Books**

1. Nicholas Wilt, "CUDA Handbook: A Comprehensive Guide to GPU Programming", First edition, Addison – Wesley, 2013
2. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General Purpose GPU Programming", Addison – Wesley, 2010
3. David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors – A Hands-on Approach", Third Edition, Morgan Kaufmann, 2016

4. [http://www.nvidia.com/object/cuda\\_home\\_new.html](http://www.nvidia.com/object/cuda_home_new.html)
5. <http://www.openCL.org>

#### Web Resources

1. <http://www.nptelvideos.in/2012/11/high-performance-computing.html>

#### Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

#### Sample Short and Long Answer Questions of Various Cognitive Levels

##### L1: Remember

1. List any four advantages of GPUs
2. List the differences between CPU and GPU
3. What are the core features of GPUs?
4. Define pipelining
5. What is meant by instruction cycle?

##### L2: Understand

1. Explain multiprocessor architecture with diagram
2. Describe the working of multiprocessor environment
3. Explain parallel processing in terms of instruction execution in multiprocessor environment
4. Explain clustering in multiprogramming environment

##### L3: Apply

1. Write any four instructions in OPENCL
2. Write a simple program in CUDA
3. Illustrate matrix multiplication in parallel programming

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## Computer Science and Engineering (Artificial Intelligence and Machine Learning)

Credit requirement for the award of the degree under academic Regulation 2020 – 2021 for the candidates admitted from the academic year 2021 onwards

	Four Years	Three Years
B. Tech. (Regular Degree)	160	121
B. Tech. (Honors Degree)	180	141
B. Tech. (With minor specialization other than Chosen Branch of Engg. & Tech.)	180	141

Semester I								
No.	Course Code	Course	POs	Contact Hours				
				L	T	P	C	
01	20HSX01	Communicative English	10	3	0	0	3.0	HS
02	20BSX11	Linear Algebra and Differential Equations	1, 12 <sup>1</sup>	3	1	0	3.0	BS
03	20BSX33	Applied Physics	1	3	1	0	3.0	BS
04	20ESX02	Programming for Problem Solving using 'C'	1	1	0	4	3.0	ES
05	20CS101	Fundamentals of Computer Science	1	3	0	0	3.0	ES
06	20HSX02	Communicative English Laboratory	1, 10	-	-	3	1.5	BS
07	20BSX34	Applied Physics Laboratory	1, 4	-	-	3	1.5	HS
08	20ESX07	Programming for Problem Solving using 'C' Lab	1, 4	-	-	3	1.5	ES
Sub-total				13	02	13	19.5	

Semester II								
No.	Course Code	Course	POs	L	T	P	C	
01	20BSX12	Partial Differential Equations and Vector Calculus	1	3	1	0	3.0	BS
02	20BSX23	Applied Chemistry	1	3	1	0	3.0	BS
03	20ESX05	Basic Electrical and Electronics Engineering	1	3	1	0	3.0	ES
04	20CS201	Data Structures using 'C'	1	3	1	0	3.0	ES
05	20EC203	Digital Logic Design	1	3	1	0	3.0	ES
06	20BSX24	Applied Chemistry Laboratory	1, 4	0	0	3	1.5	BS
07	20CS202	Data Structures using 'C' Laboratory	1, 4	0	0	3	1.5	ES
08	20ESX08	Basic Electrical & Electronics Engineering Lab	1, 4	0	0	3	1.5	ES
09	20MCX01	Environmental Science	1, 6	2	0	0	-	MC
Sub-total				17	05	09	19.5	

Semester III								
No.	Course Code	Course	POs	L	T	P	C	
01	20BSX16	Mathematical Foundations for Computer Science	1	3	1	0	3.0	BS
02	20CS302	Design and Analysis of Algorithms	1, 2, 3	3	1	0	3.0	PC
03	20CS303	Database Management Systems	1, PSO1	3	1	0	3.0	PC
04	20DS304	Programming with Python	1, 2, 5	3	1	0	3.0	PC
05	20CS305	Computer Organization	1	3	0	0	3.0	PC
06	20CS306	Design and Analysis of Algorithms Lab	4	-	-	3	1.5	PC
07	20CS307	Database Management Systems Laboratory	1, 4, PSO1	-	-	3	1.5	PC
08	20DS307	Programming with Python Lab	1, 4, 5	-	-	3	1.5	PC
09	20AIS01	Short-term Skill Oriented Elective <sup>2</sup>	4, 5	0	0	4	2.0	SC
10	20MCX02	Constitution of India <sup>3</sup>		0	0	0	-	MC
Sub-total				15	4	13	21.5	

\* Suggested hours for tutorial

<sup>1</sup> By default, all courses are mapped to PO 12 as they are weakly contributing

<sup>2</sup> The students shall opt any of the short-term skill-oriented course electives

<sup>3</sup> It is mandate for all students to pursue an online certification course for minimum duration of 30 hours

Semester IV								
No.	Course Code	Course	POs	Contact Hours				
				L	T	P	C	
01	20HSX03	Managerial Economics & Financial Analysis	11	3	0	0	3.0	HS
02	20BSX15	Probability and Statistics	2, 5	3	1	0	3.0	BS
03	20CS502	Computer Networks	1, 2	3	0	0	3.0	PC
04	20CS404	Operating Systems	1	3	1	0	3.0	PC
05	20AI405	Artificial Intelligence	1, 2	3	1	0	3.0	PC
06	20AI406	Python Programming for Statistics Laboratory	4, 5	0	0	3	1.5	PC
07	20AI407	Artificial Intelligence Laboratory	4, 5	0	0	3	1.5	PC
08	20CS408	Operating Systems Lab	4	0	0	3	1.5	PC
09	20AIS02	Short-term Skill Oriented Elective	4, 5	0	0	4	2.0	SC
Sub-total				15	3	13	21.5	
Semester V								
01	20CS405	Theory of Computation	1, 2	3	1	0	3.0	PC
02	20AI502	Machine Learning	1, 2	3	1	0	3.0	PC
03	20AI503	Artificial Neural Networks	1, 2	3	1	0	3.0	PC
04	-	Professional Elective I		3	0	0	3.0	OE
05	-	Open Elective I		3	0	0	3.0	PE
06	20AI506	Web Development Laboratory	4, 5	0	0	3	1.5	PC
07	20AI507	Machine Learning Laboratory	4, 5, PSO1, PSO2	0	0	3	1.5	PC
08	20AIS03	Technical Paper Writing <sup>4</sup>	1, 10	0	0	4	2.0	SC
09	20MCX03	Intellectual Property Rights and Patents		0	0	0	-	MC
10	-	Summer Internship #1 <sup>5</sup> / CSP		0	0	0	1.5	TG
Sub-total				17	3	10	21.5	
Semester VI								
01	20CS603	Modern Software Engineering	1, 2, 3	3	0	0	3.0	PC
02	20AI602	Deep Learning Principles and Practices	2, 3, 5	3	1	0	3.0	PC
03	20AI603	High Performance Computing	2, 3, 5	3	1	0	3.0	PC
04	-	Professional Elective II		3	1	0	3.0	PE
05	-	Open Elective II		3	0	0	3.0	OE
06	20CS608	Modern Software Engineering Laboratory	4, 5	0	0	3	1.5	PC
07	20AI607	Deep Learning Laboratory	4, 5	0	0	3	1.5	PC
08	20AI608	Natural Language Processing with Python Lab	4, 5	0	0	3	1.5	PC
09	20AIS04	Short-term Skill Oriented Elective		0	0	4	2.0	SC
10	20MCX04	Indian Traditional Knowledge	-	0	0	0	-	MC
Sub-total				15	3	13	21.5	
Semester VII								
01	-	Professional Elective III		3	0	0	3.0	PE
02	-	Professional Elective IV		3	0	0	3.0	PE
03	-	Professional Elective V		3	0	0	3.0	PE
04	-	Open Elective III		2	0	2	3.0	OE
05	-	Open Elective IV		2	0	2	3.0	OE
06	20HSX04	Professional Ethics	8	3	0	0	3.0	HS
07	20AIS05	Datasets & Packages for ML Engineer	4, 5	0	0	4	2.0	SC

<sup>4</sup> The students are expected to identify one research area in the recent trends, collect recent research articles, prepare a technical research review paper and publish in renowned annual conferences/ journals, preferably indexed in Scopus or UGC care

<sup>5</sup> It is mandate for all the students to undergo 4-6 weeks of industrial training and appear for assessment during Semester V with report. With regard to Community Service Project (CSP), based on the availability the students can opt CSP as an alternate option for summer internship #1 for a duration of 08 weeks

08	-	Summer Internship #2 <sup>6</sup>	All POs, PSOs	0	0	0	3.0	TG
Sub-total				16	0	8	23	
<b>Semester VIII</b>								
01		Full Semester Internship <sup>7</sup>	5 – 10, PSOs				06	
02		Capstone Project <sup>3</sup>	5 – 10, PSOs				06	
Sub-total							12.0	
<b>Total Credits</b>							<b>160</b>	

## List of Electives

<b>Professional Elective #1</b>								
1	20AI001	Fundamentals of Natural Language Processing		3	0	0	3.0	PE
2	20AI002	Cryptography		3	0	0	3.0	PE
3	20AI003	Cloud Computing Essentials		3	0	0	3.0	PE
<b>Professional Elective #2</b>								
5	20AI004	Computer Vision and Applications		3	1	0	3.0	PE
6	20AI005	Cyber Security		3	0	0	3.0	PE
7	20AI006	Social Network Analysis		3	1	0	3.0	PE
<b>Professional Elective #3</b>								
9	20AI007	Bio-informatics		3	0	0	3.0	PE
10	20AI008	Fundamentals of Blockchain		3	0	0	3.0	PE
11	20AI009	Big Data Analytics		3	1	0	3.0	PE
<b>Professional Elective #4</b>								
13	20AI010	Soft Computing		3	0	0	3.0	PE
14	20AI011	Cyber Threat Analysis		3	0	0	3.0	PE
15	20AI012	Distributed Computing		3	0	0	3.0	PE
<b>Professional Elective #5</b>								
The curriculum provides academic flexibility to choose any of the domain specific courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration (4-credits) and the assessment shall be as per the academic regulation 2020.								PE
<b>Open Elective #1</b>								
25	20CEO01	Urban Environmental Service		3	0	0	3.0	OE
26	20CSO01	Data Structures and Algorithms		3	0	0	3.0	OE
27	20AIO01	Machine Learning for Engineers		3	0	0	3.0	OE
28	20DSO01	Introduction to Database Management Systems		3	0	0	3.0	OE
29	20ECO01	Architecture and Algorithms of IoT		3	0	0	3.0	OE
30	20EEO01	Introduction to Renewable Energy Sources		3	0	0	3.0	OE
31	20MEO01	Nano Technology		3	0	0	3.0	OE
32	20SHO01	Women and Society		3	0	0	3.0	OE
<b>Open Elective #2</b>								
33	20CEO02	Ecology, Environment and resource management		3	0	0	3.0	OE
34	20CSO02	Designing the Internet of Things		3	0	0	3.0	OE
35	20AIO02	Fundamentals of Deep Learning		3	0	0	3.0	OE
36	20DSO02	Introduction to Data Science		3	0	0	3.0	OE
37	20ECO02	IoT for Smart Grids		3	0	0	3.0	OE
38	20EEO02	Electrical Safety and Management		3	0	0	3.0	OE
39	20MEO02	Fundamentals of Automobile Engineering		3	0	0	3.0	OE
<b>Open Elective #3</b>								
40	20CEO03	Disaster, Risk mitigation and Management		3	0	0	3.0	OE
41	20CS404	Operating Systems		3	0	0	3.0	OE
42	20AIO03	Fundamentals of AI		3	0	0	3.0	OE
43	20DSO03	Introduction to Big Data		3	0	0	3.0	OE

<sup>6</sup> It is mandate for all the students to undergo 6-8 weeks of industrial training and appear for assessment during Semester VII with report and those opted FSI during Semester VII shall appear through online for reviews

<sup>7</sup> Students opting for FSI in VII semester have to take up courses of VII semester in VIII semester

44	20ECO03	Privacy and Security in IoT		3	0	0	3.0	OE
45	20EEO03	Low-cost Automation		3	0	0	3.0	OE
46	20MEO03	Industrial Automation		3	0	0	3.0	OE
47	20SHO02	Design Innovations		3	0	0	3.0	OE
<b>Open Elective #4</b>								
The curriculum provides academic flexibility to choose any of the inter-disciplinary courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration and the assessment shall be as per the academic regulation 2020.								OE
<b>B. Tech. (Honors)</b>								
<b>Category I</b>								
1	20DSH01	Text Analytics		4	0	0	4.0	HO
2	20AIH02	Advanced Data Structures and Algorithms		4	0	0	4.0	HO
3	20AIH03	Game Theory		4	0	0	4.0	HO
<b>Category II</b>								
4	20DSH04	Recommender Systems		4	0	0	4.0	HO
5	20AIH05	Video Analytics		4	0	0	4.0	HO
6	20AIH06	Game Programming		4	0	0	4.0	HO
<b>Category III</b>								
7	20DSH07	Data Analysis with MATLAB		4	0	0	4.0	HO
8	20AIH08	Natural Language Processing		4	0	0	4.0	HO
9	20AIH09	3D Graphics and Animations		4	0	0	4.0	HO
<b>Category IV</b>								
10	20DSH10	Data Preparation and Cleaning		4	0	0	4.0	HO
11	20AIH11	Digital Forensics		4	0	0	4.0	HO
12	20AIH12	Augmented Reality and Virtual Reality		4	0	0	4.0	HO
<b>B. Tech. (Minor with Specialization)</b>								
<b>Category I</b>								
1	20CEM01	Air Pollution		3	0	0	3.0	MI
2	20CSM01	E Commerce		3	0	0	3.0	MI
3	20MEM01	Biomaterials		3	0	0	3.0	MI
4	20EEM01	Basic Control systems		3	0	0	3.0	MI
5	20ECM01	Fundamentals of Electronics		3	0	0	3.0	MI
6	20AIM01	Fundamentals of Neural Networks		3	0	0	3.0	MI
7	20DSM01	Introduction to R Programming		3	0	0	3.0	MI
8	20SHM01	Psychology		3	0	0	3.0	MI
9	20SHM02	Statistical Methods		3	0	0	3.0	MI
10	20MBM01	General Management		3	0	0	3.0	MI
11	20MBM02	Human Resource Planning		3	0	0	3.0	MI
<b>Category II</b>								
12	20CEM02	Climate Change Mitigation and Adaptation		3	0	0	3.0	MI
13	20CSM02	Knowledge Discovery and Databases		3	0	0	3.0	MI
14	20MEM02	Micro Electromechanical Systems		3	0	0	3.0	MI
15	20EEM02	Basics of Electrical Machines and Drives		3	0	0	3.0	MI
16	20ECM02	Digital Electronics		3	0	0	3.0	MI
17	20AIM02	Machine Learning with Python		3	0	0	3.0	MI
18	20DSM02	Data Management and Analysis		3	0	0	3.0	MI
19	20SHM03	English for Media		3	0	0	3.0	MI
20	20SHM04	Statistical Inference		3	0	0	3.0	MI
21	20MBM03	Organization Behaviour		3	0	0	3.0	MI
22	20MBM04	Compensation Management & Employee Welfare Laws		3	0	0	3.0	MI
<b>Category III</b>								
23	20CEM03	Sustainability and Pollution Prevention Practices		3	0	0	3.0	MI
24	20CSM03	Database Security		3	0	0	3.0	MI
25	20MEM03	Surface Engineering		3	0	0	3.0	MI
26	20EEM03	Electrical Engineering Material Science		3	0	0	3.0	MI
27	20ECM03	Analog Electronic Circuits		3	0	0	3.0	MI
28	20AIM03	Interpretable Machine Learning		3	0	0	3.0	MI

29	20DSM03	Data Governance		3	0	0	3.0	MI
30	20SHM06	Journalism		3	0	0	3.0	MI
31	20SHM07	Statistical Quality Control		3	0	0	3.0	MI
32	20MBM05	Entrepreneurship & Business Venture Planning		3	0	0	3.0	MI
33	20MBM06	Performance Management & Talent Management		3	0	0	3.0	MI

Short Term Skill Oriented Electives								
34	20AIS01	JAVA Programming		0	0	4	2.0	SC
35	20AIS02	R Programming		0	0	4	2.0	SC
36	20AIS04	Deep Learning Frameworks		0	0	4	2.0	SC
Long Term Skill Oriented Courses (Industry Oriented) <sup>a</sup>								
37	20ICC01	Competitive Programming	-	2	0	8	6.0	ICC
38	20ICC02	Web Technologies – Transferring to Practice	-	2	0	8	6.0	ICC
39	20ICC03	Java and Spring boot	-	2	0	8	6.0	ICC
40	20ICC04	Robotics Process Automation (RPA)	-	2	0	8	6.0	ICC
41	20ICC05	Information Security and Forensics	-	2	0	8	6.0	ICC
42	20ICC06	Battery System – Design Engineering	-	2	0	8	6.0	ICC
43	20ICC07	Blockchain Technology	-	2	0	8	6.0	ICC
44	20ICC08	Network Administration	-	2	0	8	6.0	ICC
45	20ICC09	Product Engineering	-	2	0	14	9.0	ICC
46	20ICC10	Machine Learning Engineer	-	2	0	8	6.0	ICC
47	20ICC11	Data Scientist	-	2	0	8	6.0	ICC
48	20ICC12	Industrial IoT	-	2	0	8	6.0	ICC

#### List of Honors offered by Computer Science and Engineering (AI & ML) Program

1. Data Analytics
2. Surveillance Systems
3. Game Programming

#### List of Minor Specializations offered by Computer Science and Engineering (AI & ML) Program

1. Machine Learning and Deep Learning

#### List of Minor's offered by the Freshman engineering and Management studies such as

1. Liberal Arts
2. Statistics
3. General Management
4. Human Resource Management

These will be implemented for the 2021 admitted students

<sup>a</sup> The credits earned through Long Term Skill Oriented Course can be trade-off with any other 3-Credit course other than Professional Core